WASHINGTON NATURAL HERITAGE PROGRAM

Wetland Ecosystem Conservation Priorities for Washington State. An Update of Natural Heritage Classification, Inventory, and Prioritization of Wetlands of High Conservation Value.

Prepared for

U.S. Environmental Protection Agency
Region 10

Prepared by

F. Joseph Rocchio, Rex C. Crawford, and Rebecca Niggemann

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WASHINGTON STATE DEPARTMENT OF
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ON THE COVER:
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1 Introduction

Land managers, planners, and the public need tools to better understand the resource value of individual wetlands in order to make informed decisions to minimize loss or to protect wetland integrity and ecosystem services (Hruby 2004a,b). An important wetland value is their contribution to biodiversity. Wetlands provide habitat for numerous plant and animal species and are floristically diverse ecosystems. Wetlands only represent approximately 2% of Washington's landscape but are utilized by over 66% of the state's terrestrial vertebrates (Sheldon et al. 2005). Similarily, a significant portion of the flora is associated with wetlands and riparian areas. For example, approximately 30% of the native flora of western Washington has a FACW (Facultative-Wetland) or OBL (Obligate Wetland) wetland indicator status (614 of 2022 native species)–an undoubtedly conservative estimate of the percentage of plant species supported by wetlands. Of the plant species considered Endangered, Threatened, or Sensitive by the Washington Natural Heritage Program (WNHP), 45% (147 of 328) are limited to or commonly found within wetlands or riparian areas. Certain wetland types support a higher proportion of rare plants than other types. For example, compared to other wetland types, peatlands and seasonal wetlands support the highest proportion of rare plant species that often occur in wetlands (Table 1). Variable climatic conditions, geologic diversity, landscape contexts, and phytogeography result in wide diversity of wetland plant associations on the landscape. The total number of plant associations currently documented as occurring, or with a high likelihood of occurring, in Washington is 1,175 (based on the U.S. National Vegetation Classification). Of those, approximately 53% (~ 618 plant associations) are associated with Washington's wetlands and riparian areas. These plant associations represent unique ecological conditions and can be viewed as coarse filters for the full suite of biodiversity (from large ungulates to soil microbes) found in wetlands. In summary, although they only represent approximately 2% of the landscape, wetlands and riparian areas support and contribute to a significant percentage of Washington's biodiversity.

Information about wetland biodiversity values is critical for conservation planning, wetland restoration and management, and application of various regulatory programs. The Washington Wetland Rating System (Rating System) is often used by local municipalities for developing standards for protecting and managing wetlands. The Rating System provides a systematic process for categorizing wetlands based on their sensitivity to disturbance, their significance, their rarity, their replaceability through restoration/mitigation, and the functions they provide (Hruby 2004a,b). The Rating System places wetlands into four categories from Category I (irreplaceable wetlands, which are relatively undisturbed, rare or provide unique or a high level of functions) to Category IV (wetlands that are heavily disturbed or provide the lowest level of functions). These rating categories are intended to be used to develop criteria for protecting and managing wetlands and prevent loss of their associated values (Hruby 2004a,b). Determining buffer widths, mitigation ratios, biodiversity values, and permitted uses are examples of the types of decisions with which the Rating System can assist (Hruby 2004a,b). Knowing the location of Category I wetlands is integral to protecting the most irreplaceable and significant wetland resources in Washington State.

One criterion for designating Category I Wetlands is whether they are considered to be Wetlands of High Conservation Value (formerly called Natural Heritage Wetlands). Wetlands of High Conservation Value (WHCV) are those places that the Washington Natural Heritage Program (WNHP) has identified as conservation priorities. These wetlands either support a rare and/or

Table 1. Distribution of Rare Plants (i.e. considered Endangered, Threatened, or Sensitive by the Washington Natural Heritage Program) by Wetland Type. Note: Some species occur in more than one wetland type)

	Total Number of Associated Rare Plants	% of Wetland Rare Plants (147)	% of Upland + Wetland Rare Plants (328)
All Peatlands	43	29%	13%
Bogs & Poor Fens	22	15%	7%
Intermediate Fens	9	6%	3%
Rich Fens	12	8%	4%
Marsh	16	11%	5%
Wet Meadow / Seasonal Wetlands	42	29%	13%
Wet Prairie	6	4%	2%
Vernal Pool	18	12%	5%
Swamps	16	11%	5%
Riparian	34	23%	10%
Alkaline/interior saline	7	5%	2%
Interdunal	1	1%	0%
Wet Cliffs/Spray Zones	12	8%	4%
Seep/Springs	16	11%	5%
Salt Marsh/Tidal	1	1%	0%

high-quality wetland plant association **or** a state listed Endangered, Threatened, or Sensitive plant species. WNHP's database contains the locations of known WHCV and is an integral resource for identifying Category 1 wetlands. However, prior to implementing this project, much of the information about WHCV in this database was outdated (> 20 years old) and limited to western Washington lowlands (Kunze 1984, 1986, 1987, 1988, 1989, 1990, 1991). Although Kunze's surveys represent a significant effort, many ecological changes have occurred in the intervening 20-30 years, including increased development and spread of non-native species (Puget Sound Partnership 2009). WNHP has records of WHCV in other parts of the State, although these sites were not a product of a statewide, focused effort to identify the most significant wetlands for conservation. Thus, many areas of Washington had not been systematically surveyed for wetlands with significant conservation value, including montane and subalpine elevations and the entirety of eastern Washington. Such data gaps restrict the State's ability to ensure that these important wetlands are accounted for when planning for wetland protection, restoration, and management.

This report summarizes work completed in fulfillment of three EPA Region 10 Wetland Program Development Grants (CD-00J263010, CD-00J49101, and CD-00J64201-0). The goal of this work was to improve wetland data managed by the Washington Natural Heritage Program (WNHP) as it relates to the Washington Department of Ecology's Wetland Rating System and also to inform wetland conservation actions. The outcome of this project is an updated list of statewide wetland conservation priorities.

1.1 Project Overview

This project is intended to provide important information about the locations of Washington's wetlands with high conservation value. This report describes the methods and results from a multi-phased project and is intended to improve statewide wetland data managed by the Washington Natural Heritage Program (WNHP). A previous report titled "Wetland Conservation Priorities for Western Washington. A Focus on Rare & High-quality Wetland & Riparian Plant Associations" was submitted to EPA that summarized the work conducted under Region 10 Wetland Program Development Grants Phase 1 (CD-00J26301) and Phase 2 (CD-00J49101). This report expands on that report by including work conducted for Phase 3 (CD-00J64201-0) and summarizes objectives, methods, and results from all three grants.

The specific objectives of this project were to:

1. Revise and update the wetland classification used by WNHP to identify wetland conservation targets.
2. Update information about existing, and conduct inventory for new, Wetlands of High Conservation Value (WHCV).
3. Develop a Level 1 Ecological Integrity Assessment to help determine possible locations of WHCV.
4. Develop coefficients of conservatism for Washington's flora that can be applied toward the wetland Ecological Integrity Assessment method.
5. Identify a list of potential reference standard wetlands.

The outcomes of this project are intended to inform land use planning, conservation actions, and wetland permitting decisions. Specifically, this information will provide the best available science needed to effectively identify the location of Wetlands of High Conservation Value, meet some of the scientific needs identified under the Growth Management Act (Hruby 2004a,b), and provide critical information for other land use planning that may affect Washington's wetland resource [e.g., Puget Sound Action Agenda (Puget Sound Partnership 2009)]. The results of this project will inform priorities established in the biennial *State of Washington Natural Heritage Plan* (the current edition: WADNR 2011). *Natural Heritage Plan* priorities are a key component of evaluating sites for Washington Wildlife and Recreation Program (WWRP) funding. <u>As such, this project will help guide where the State of Washington spends millions of dollars to voluntarily protect irreplaceable habitat.</u>

1.2 Project Scope

This project is focused on wetlands and riparian areas within Washington State. Wetlands of High Conservation Value may be designated either because they support a rare and/or high-quality wetland plant association or a State listed sensitive, threatened, or endangered plant species (regardless of whether the rare plant is considered an upland or wetland species). The focus of this report is primarily on plant association-based WHCV. This is because (1) field work was focused on plant association targets (although new rare plant records were noted when observed) and (2) it is difficult to determine (*a priori* or without a field visit) which rare plant occurrences in the WNHP information system occur in wetlands.

The majority of field work in western Washington was conducted in lowland areas since most known locations of Wetlands of High Conservation Value occur in low elevation environments. In addition, these tend to be the most threatened by human activities. However, high elevation wetland types and their biodiversity significance are less known and some effort was made to visit high elevation sites. In eastern Washington, a higher percentage of field work was conducted at higher elevations due to the fact that 1) wetlands are more numerous at higher elevations; (2) numerous rare wetland types occur within montane/subalpine areas; and (3) few wetlands of significant quality remain in the Columbia Basin ecoregion due to significant impacts from past stressors such as livestock grazing, water management, and invasive species.

1.3 Products and Outputs

The following products were submitted as part of this three-phased project:

Table 2. Products from this Project

Product	Comments
Ecological Classification of Native Wetland & Riparian Vegetation of Washington	Described in Section 2.5 and included as Appendix B in this report. A stand-alone report describing development of the classification is expected to be available on WNHP's website in 2016/2017 (Rocchio and Crawford *In Progress*).
Updated Conservation Status Ranks.	Conservation Status Ranks were assigned to many wetland plant associations. All Conservation Status Ranks are listed in Appendix B of this report.
Updated Element Occurrence Ranks	Level 2 (field-based) EIA ranks were assigned to 383 element occurrences. All updates were entered into WNHP's information system and also in the included Wetland of High Conservation Value GIS file (see below.)
GIS shapefile depicting the locations of Wetlands of High Conservation Value	Submitted with this report and will also be made available on WNHP's website.
GIS shapefile with the Level 1 EIA Ranks for most National Wetland Inventory Wetlands across Washington State	Submitted with the Phase 2 report and will also be made available on WNHP's website.

Product	Comments
Floristic Quality Assessment report and list of ‘coefficients of conservatism’ for the Washington flora	Submitted to EPA as part of Phase 1 and 2 reports. These products are available on WNHP’s website.
EcoObs database	Microsoft Access database designed to house EIA data. Included as Appendix E of this report.
List of Potential Reference Standard Wetlands	Includes as Appendix F of this report.

2 Methods

2.1 Natural Heritage Methodology

WNHP uses Natural Heritage methodology to identify Wetlands of High Conservation Value (WHCV). Natural Heritage methodology provides documentation of what elements (i.e. a species or ecosystem type) exist in a region (classification), how those elements are doing (assessing their condition or viability/integrity), and where precisely they are found (documenting and mapping locations). This information is synthesized into a Conservation Status Rank which reflects an element's risk of extinction based on rarity, threats, and trends. Information pertaining to the viability (species) or ecological integrity (plant associations) of an individual population or occurrence (an area of land or water in which an element is found) is synthesized into what is called an Element Occurrence Rank. Together the Conservation Status Rank and Element Occurrence Rank help prioritize which element occurrences meet the criteria for WHCV status. Only wetlands supporting rare plant species or rare or high-quality wetland plant associations are considered to be a 'Wetland of High Conservation Value' and included in WNHP's Information System.

As noted above, if a rare plant tracked by WNHP is located in a wetland, that wetland is considered a WHCV. However, because WNHP does not conduct wetland delineations when rare plant occurrences are documented, we are not able to identify *a priori* where rare plant-based WHCV occur. Instead, project proponents using the Washington Wetland Rating System will need to overlay WNHP's GIS dataset (available from WNHP and soon to be accessible via an online web viewer) to determine whether any rare plant occurrences fall within the bounds of any wetland identified in their project area. If a rare plant currently documented in WNHP's information system does occur in such a wetland, that wetland is considered to be a Wetland of High Conservation Value, per the guidelines of the Washington Wetland Rating System (Hruby 2014a, b).

Plant association-based element occurrences are prioritized for inclusion in WNHP's information system based on a combination of the association's Global and State Conservation Status Ranks (see Section 2.3 and Appendix A) and the occurrence's Element Occurrence Rank (relative quality or ecological integrity; see Appendix A). A decision matrix is used to determine whether a site-specific occurrence of a wetland plant association qualifies as an element occurrence and thus a "Wetland of High Conservation Value". Basically, all occurrences of rare wetland types, regardless of their ecological integrity, are considered element occurrences or Wetlands of High Conservation Value, while for more common wetland types, only those with good to excellent ecological integrity are considered element occurrences.

See Appendix A for more details about Natural Heritage Methdology, especially as it pertains to identifying Wetlands of High Conservation Value.

2.2 Element Occurrence vs. Wetland of High Conservation Value

2.2.1 Element Occurrences

WNHP refers to a specific location of a rare species population or a stand of a rare/high-quality plant association as an element occurrence. The element occurrence is considered the most fundamental unit of conservation interest and is at the heart of Natural Heritage Methodology (Appendix A; NatureServe 2002). Because one of the primary objectives of WNHP is to prioritize conservation actions, only those element occurrences thought to be the most important for conservation are generally entered into WNHP's database.

An element occurrence is represented spatially (either on maps or in a GIS) by a point (if specific spatial boundaries are unknown) or polygon. An element occurrence is sometimes represented by more than one polygon. Even though two or more polygons may be spatially distinct, if they are thought to be ecologically or genetically connected they are considered part of the same element occurrence.

Known locations of any plant species considered to be Endangered, Threatened, or Sensitive are entered in WNHP's information system as an element occurrence. The locations of rare plants are obtained from a variety of sources including herbarium records, private consultants, government agency scientists, citizen scientists, and field inventory by WNHP staff.

Ecosystem element occurrences are prioritized for inclusion in WNHP's information system based on a combination of the ecosystem element's conservation status rank (see Appendx B) and the occurrence's element occurrence rank (Appendix A). A decision matrix (or tracking guidelines) is used to determine whether a site-specific occurrence of a wetland plant association qualifies as an element occurrence (Table 3). Basically, all occurrences of rare wetland types, regardless of their condition, are considered element occurrences or Wetlands of High Conservation Value, while for more common wetland types, only those in good to excellent condition are considered element occurrences.

Table 3. Decision Matrix to Determine Ecosystem Element Occurrences (e.g. Tracking Guidelines)

Conservation Status Ranks		Ecological Integrity Assessment Rank			
Global Rank	**State Rank**	**A Excellent integrity**	**B Good Integrity**	**C Fair integrity**	**D Poor integrity**
G1/G2/GU	**S1/S2**				
G3/GU	**S1/S2/S3**				
G4/G5/GU	**S1/S2**				
G4/G5/GU	**S3/S4/S5**				
Red Shading = Element Occurrence					

2.2.2 Wetland of High Conservation Value

A Wetland of High Conservation Value (WHCV) is a term used in the Washington Wetland Rating System (Hruby 2014a,b) that refers to any wetland that supports an element occurrence (as described above) recognized by WNHP. WHCV were called Natural Heritage Wetlands in previous version of the Wetland Rating System. The latest versions of the Washington Wetland Rating System (Hruby 2014a,b) specifically defines WHCV as wetlands that "have been identified by the Washington Natural Heritage Program at the Department of Natural Resources (DNR) as either high-quality undisturbed wetlands or wetlands that support rare or sensitive plant populations or rare plant communities." Essentially, if an element occurrence currently documented in WNHP's database is located within the bounds of a wetland being assessed by the Wetland Rating System, that wetland would be considered a Wetland of High Conservation Value. In summary, a WHCV could be designated based on the presence of a rare plant, rare (or high-quality common) plant community, or both.

In the past, WNHP assigned rare plant species (i.e., Endangered, Threatened, or Sensitive plant species) a 'W' if the plant was thought to be a wetland species. Element occurrences of these rare 'wetland' plants were considered a Wetland of High Conservation Value. However, the subjective assignment of wetland status to rare plants provoked the thought that even if a rare plant has a low probability of occurring in a wetland, when it does, perhaps that wetland should be considered a Wetland of High Conservation Value. Additionally, WNHP does not conduct wetland delineations when rare plant occurrences are documented. Thus, until wetland determinations have been made on the ground it is not possible to know *a priori* which rare plant occurrences are found in wetlands. Consequently, in consultation with Washington Department of Ecology, the process for using rare plants for designating Wetlands of High Conservation Value was reevaluated for this project.

The new approach, agreed to by WNHP/DNR, Washington Department of Ecology, and U.S. Environmental Protection Agency, is to consider any occurrence of a rare plant that occurs within a wetland (regardless of its overall probability of occurring in a wetland) as being worthy of the Wetland of High Conservation Value designation. This approach alleviated the need to make a subjective determination of whether a rare plant is a "wetland" species. However, since WNHP does not conduct wetland delineations when rare plant occurrences are documented, the approach also limits the ability to identify which rare plant element occurrences in WNHP's database are Wetlands of High Conservation Value until wetland determinations have been made on the ground. Instead, project proponents using the Washington Wetland Rating System will need to overlay WNHP's GIS dataset (or contact WNHP) to determine whether any rare plant occurrences falls within the bounds of any wetland identified in their project area. If a rare plant currently documented in WNHP's information system does occur in such a wetland, that wetland is considered to be a Wetland of High Conservation Value, per the guidelines of the Washington Wetland Rating System (Hruby 2014a,b). In cases where a new occurrence (i.e. not currently documented in WNHP's information system) of a state listed Endangered, Threatened or Sensitive species is identified by a qualified consultant or surveyor the protocols described in section 2.2.3 will be followed. Specific guidelines on this new approach are also included in the recent update of the Wetland Rating System (Hruby 2014a,b).

It is important to note that a single WHCV could have more than one element occurrence. The number of element occurrences does not change the WHCV status within the context of the Wetland Rating System. However, a high number of element occrrences would suggest that a particular wetland is significant in terms of the concentration of rare elements it supports.

2.2.3 Proposing New Wetlands of High Conservation Value to Washington Natural Heritage Program

Because WNHP has not been able to survey every wetland on the landscape, it is very likely there are as yet undocumented Wetlands of High Conservation Value to be found. Thus, the list of Wetlands of High Conservation Value is not static and changes as WNHP collects or receives new information. In situations where a new occurrence of a rare plant or a rare or high-quality ecosystem is encountered that does not currently exist in WNHP's information system, that information can be submitted to WNHP for possible inclusion in WNHP's database. In the past, if such an element was encountered but not already present in WNHP's database, it could not be considered a Wetland of High Conservation Value. Recognizing that this procedure could result in miscategorization of many wetlands of conservation significance, WNHP and Washington Department of Ecology outlined a process that provides an opportunity for WNHP to review data as it is submitted by consultants, agency personnel, etc. The following guidelines will be used for such data:

1. WNHP will have 30 days to review submitted data and determine if its reliability (e.g., the technical expertise of the individual who made the observation) and level of detail is sufficient for determining if the observation should be incorporated into WNHP's database.

2. If deemed reliable and containing sufficient information, WNHP will approve the data for inclusion into their database.

3. If WNHP does not have the capacity or time to respond within 30 days the wetland cannot be considered a WHCV within the context of the Wetland Rating System.

This process addresses WNHP's desire to gather more information concerning the location of rare/high-quality ecological communities and WDOE's need for a systematic quality control process before any such data be considered a Wetland of High Conservation Value.

Thus, if a rare plant species, rare plant association, or high-quality common plant association is encountered but is not currently documented in the WNHP's database, relevant information can be submitted to WNHP for consideration. Information required for documenting a new rare plant location can be found here at WNHP's website. Necessary information about wetland plant communities includes the classification of the plant community and its current quality or integrity. Appendix B of this document contains the updated list of plant associations found in Washington's wetlands and riparian areas. WNHP is currently drafting a field guide and key to these types, which we expect to be available by the end of 2016. To document current ecological integrity, WNHP recommends using the appropriate Ecological Integrity Assessment (EIA). Additionally, WNHP will be offering training courses to assist users in the application of the classification and EIA in late 2016. Upon completion of these products and training, WNHP would request that users submit the classification of the plant community and its associated EIA score (which indicates its quality) in order to provide WNHP staff the necessary information to make a conclusion about the designation of the site as a Wetland of High Conservation Value. Until those products are available, plot data with a relatively comprehensive species list and associated cover values and any information pertaining to the condition of the plant community relative to minimally disturbed conditions are needed for WNHP staff to determine if the site meets WHCV criteria.

2.3 Prioritizing Conservation of Wetland & Riparian Vegetation Types: The Conservation Status Rank

Information about the rarity or potential risk of elimination or extirpation of specific wetland and riparian vegetetation types (or elements) can help prioritize and guide conservation and/or management actions toward those ecosystems that are of most concern. Since the early 1980s, the NatureServe/Natural Heritage Network has conducted conservation assessments of species and ecosystems to help prioritize conservation actions (Master et al. 2012). The outcome of those assessments is a **conservation status rank** which indicates the rarity and risk of extinction (species) or elimination (ecosystems) of the elements of biodiversity. The conservation status rank is an integral part of Natural Heritage Methodology (Master et al. 2012, Faber-Langendoen et al. 2012a). This method is summarized in Master et al. (2012) and Faber-Langendoen et al. (2012a). Additionally, NatureServe developed a Conservation Status Rank calculator that automates much of the ranking process: http://www.natureserve.org/conservation-tools/conservation-rank-calculator.

The conservation status of a species or ecosystem is designated by a number from 1 to 5, preceded by a letter reflecting the appropriate geographic scale of the assessment (G = Global and S = State or Subnational). The Global rank characterizes the relative rarity or endangerment of the element across its entire global range whereas the Subnational rank characterizes the relative rarity or endangerment within a subnational unit (in our case, the State of Washington.)

The conservation status ranks have the following meaning:

- **G1 or S1 = Critically Imperiled.** At very high risk of extirpation Globally (G) or in Washington (S) due to a very restricted range, very few occurrences, very steep declines, severe threats, or other factors.
- **G2 or S2 = Imperiled**. At high risk of extirpation Globally (G) or in Washington (S) due to restricted range, few occurrences, steep declines, severe threats, or other factors.
- **G3 or S3 = Vulnerable.** At moderate risk of extirpation Globally (G) or in Washington (S) due to a fairly restricted range, relatively few occurrences, recent and widespread declines, threats, or other factors.
- **G4 or S4 = Apparently Secure.** At a fairly low risk of extirpation Globally (G) or in Washington (S) due to an extensive range and/or many occurrences but with possible cause for some concern as a result of local recent declines, threats, or other factors.
- **G5 or S5 = Secure.** At very low or no risk of extirpation Globally (G) or in Washington (S) due to a very extensive range, abundant occurrences, with little to no concern from declines or threats.
- **GU or SU = Unrankable.** Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
- **GH or SH = Possibly Extirpated.** Known from only historical records (either Globally or in Washington) but still with some hope of rediscovery. There is evidence that the species or ecosystem may no longer be present in the jurisdiction, but not enough to state this with certainty. Examples of such evidence include (1) that a species has not been documented in approximately 20-40 years despite some searching and/or some evidence of significant habitat loss or degradation; (2) that a species or ecosystem has been searched for unsuccessfully, but not thoroughly enough to presume that it is no longer present in the jurisdiction.
- **GNR or SNR = Unranked.** Sufficient time and effort have not yet been devoted to ranking this taxon.
- **GNA or SNA = Not Applicable.** A conservation status rank is not applicable because the species or ecosystem is not a suitable target for conservation activities.

- **GX or SX = Presumed Extinct.** Species or ecosystem is believed to be extirpated Globally (G) or in Washington (S). Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.
- **G? or S? = Inexact Numeric Rank.** Denotes inexact numeric rank; this should not be used with any of the Variant National or Subnational Conservation Status Ranks, or NX, SX, NH, or SH.
- **G#G# or S#S# = Range Rank.** Numeric range rank (e.g., S2S3 or S1S3) is used to indicate any range of uncertainty about the status of the species or ecosystem. Ranges cannot skip more than two ranks (e.g., SU is used rather than S1S4).

A G1 rank indicates critical imperilment on a global basis; the species (or ecosystem) is at great risk of extinction. S1 indicates critical imperilment within a particular state or province, regardless of its status elsewhere. Conversely, a G5 or S5 indicates that an element is secure, widespread, and abundant throughout its global or state range.

Uncertainty in the Conservation Status Rank is expressed as a Range Rank. For example, S2S3 indicates a range of uncertainty such that there is a roughly equal chance of it being a S2 or S3 and that other ranks are less likely. Range ranks can span three ranks, e.g., S2S4, meaning that the appropriate rank is somewhere between S2 and S4. A rank of SU indicates that a rank is unable to be assigned due to a lack of information or due to conflicting information about status or trends. When the taxonomic distinctiveness of an element is questionable, it is given a modifier of "Q" in combination with a standard numerical S rank. For example S3Q, indicates that the element is considered vulnerable within Washington but that there is uncertainty about the taxonomic status of the element.

Global ranks are assigned through a collaborative process involving both NatureServe and individual Natural Heritage Program scientists. Subnational ranks are assigned by state or provincial scientists with the proviso that the subnational rank cannot be rarer than indicated by the global rank. WNHP scientists have responsibility for assigning Washington's State ranks. A number of factors, such as the total range, the number of occurrences, severity of threats, and resilience contribute to the assignment of global and state ranks. Natural Heritage scientists apply their field experience along with herbarium records, plot data, and published research to assign a G/S rank.

For this project, conservation significance of Washington's wetland and riparian vegetation types was assessed via the assignment of Conservation Status Ranks (i.e. Global/State Ranks) to each wetland association type (as listed in Appendix B). WNHP used the Conservation Status Rank calcuator to assign state ranks to those associations that were lacking them and reviewed ranks for associations whose taxonomic status was changed. Any new or changed ranks resulting from this process are not considered final until they have undergone additional review by Washington Department of Natural Resources staff and management. Thus, State Conservation Status ranks that were changed are tagged with a "Proposed" modifier until that review is concluded.

2.4 Wetland & Riparian Definitions

Wetlands and riparian areas can be defined in different ways. Under the Clean Water Act the U.S. Army Corps of Engineers (Corps) and U.S. Environmental Protection Agency have defined a wetland as “those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.” (Environmental Laboratory 1987). The Corps uses this definition for the implementation of a dredge and fill permit system required by Section 404 of the Clean Water Act. From the Corps perspective, in order for an area to be classified as a wetland subject to federal regulations, it must have all three of the following criteria: (1) hydrophytic vegetation (wetland plants); (2) wetland hydrology; and (3) hydric soils. The U.S. Fish and Wildlife Service (USFWS; Cowardin et al. 1979) define wetlands as “lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water." The USFWS definition only requires one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes (wetland plants); (2) the substrate is predominantly undrained hydric soil; and/or (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

Riparian areas often lack the characteristics embedded in the wetland definitions discussed above. However, because they are associated with surface and/or subsurface water and generally have distinct vegetation from surrounding uplands, the USFWS developed a definition for these areas (USFWS 2009): “Riparian areas are plant communities contiguous to and affected by surface and subsurface hydrologic features of perennial or intermittent lotic and lentic water bodies (rivers, streams, lakes, or drainage ways). Riparian areas have one or both of the following characteristics: 1) distinctly different vegetative species than adjacent areas, and 2) species similar to adjacent areas but exhibiting more vigorous or robust growth forms. Riparian areas are usually transitional between wetland and upland.”

WNHP uses the USFWS definitions for both wetlands and riparian areas.

2.5 Ecological Classification of Native Wetland & Riparian Vegetation of Washington -- A New Classification Framework for Washington’s Wetland Vegetation

The purpose of the *Ecological Classification of Native Wetland & Riparian Vegetation of Washington* is to provide a hierarchical classification that enables WNHP to track biodiversity within spatially explicit ecological templates. The primary objective is to ensure WNHP’s efforts in prioritizing conservation targets are based on a comprehensive assessment of the variety of ecological templates and associated biological diversity which characterize Washington’s wetland resource. Accounting for both biotic and abiotic variation also improves the likelihood of conservation success in the face of climate change as it has been noted that without adequate protection of both biotic and abiotic variability, the ability of ecosystems to adapt to potential climate change effects are diminished (Whitlock 1992).

The *Ecological Classification of Native Wetland & Riparian Vegetation of Washington* is essentially a modification of the U.S. National Vegetation Classification (FGDC 2008; Faber-Langendoen et al. 2014) that incorporates elements of other wetland classifications that are commonly used such as Cowardin (Cowardin 1979) and HGM (Brinson 1993). In the next few sections, a brief discussion of wetland classification and the U.S. National Vegetation Classification (USNVC) are provided. Thereafter, the process of modifying the USNVC is discussed.

2.5.1 Brief History of Wetland Classification in Washington

The goal of classifying wetlands is to reduce variability associated with ecological characteristics. Standardized, regional classification schemes are useful for constraining natural variability of ecosystems, thereby allowing users of the classification to effectively communicate, assess, and plan for conservation, management, and restoration of a given ecosystem type. Because the reasons for classification vary, there is no universally correct unit or approach to the classification of ecosystems (Whittaker 1962). Wetland classification (within Washington and elsewhere) has been approached from many different perspectives including water chemistry, geomorphology, water source, nutrient status, landscape position, soil type, vegetation physiognomy, and vegetation composition (USEPA 2002).

The "Classification of Wetlands and Deepwater Habitats of the United States" system, commonly called the Cowardin classification, was developed for resource managers to map wetlands and to provide uniformity of concepts and terms (Cowardin et al. 1979). The structure of the classification allows it to be used at any of its four hierarchical levels. National Wetland Inventory maps use Cowardin as the basis for their map legend. As such, Cowardin is one of the most commonly used wetland classification schemes, at least for coarse analyses and development of mapping products.

The Cowardin classification hierarchy includes four major levels (Systems, Subsystems, Class, and Dominance Type) along with a set of modifiers for these types. Systems are the highest level and include Marine, Estuarine, Riverine, Lacustrine, and Palustrine. Marine and Estuarine Systems each have two Subsystems, Subtidal and Intertidal; the Riverine System has four Subsystems, Tidal, Lower Perennial, Upper Perennial, and Intermittent; the Lacustrine has two, Littoral and Limnetic; and the Palustrine has no Subsystems (Cowardin et al. 1979). Classes are a subdivision of the Subsystems and are based on substrate, flooding regime, or vegetative life form. Classes are not strictly hierarchical in that the same Class may occur under more than one System or Subsystem. The lowest level of the classification is Dominance Type, which is named for the dominant plant cover class (e.g., forested, scrub-shrub, emergent, aquatic) or animal forms. Dominance types are developed by individual users of the classification (Cowardin et al. 1979). Modifiers associated with water regime, water chemistry, soil type, and human disturbance can be applied to the Classes or Subclasses.

The hydrogeomorphic classification, or HGM, emphasizes the hydrologic and geomorphic controls of wetlands (Brinson 1993). HGM assumes that these abiotic characteristics are of primary importance for grouping wetlands according to the similarity of the ecological functions they perform. HGM classes are distinguished based on a wetland's position in the landscape (i.e., geomorphic setting), the source of water, and the wetland's hydrodynamics (i.e. direction and fluctuation of water) (Brinson 1993). HGM uses a hierarchical classification with seven major hydrogeomorphic wetland classes: Riverine, Depression, Slope, Flats (Organic Soil and Mineral Soil), and Fringe (Estuarine and Lacustrine). Within a specific geographic region, these classes can be further divided into regional subclasses. The Washington Department of Ecology has defined subclasses for some of the HGM classes which occur in the state. The classes and subclasses are grouped into domains (western vs. eastern Washington) and regions such as lowland, montane, Columbia Basin, etc. (Hruby et al. 1999; Sheldon et al. 2005).

Early research on wetland vegetation patterns in Washington primarily focused on describing or characterizing vegetation in peat-forming wetlands (Rigg 1922a, 1922b, 1925, 1940; Rigg and

Richardson 1934, Osvald 1933, and Hansen 1941, 1943, 1944). Fitzgerald (1966) and Lebednik and del Moral (1976) studied vegetation and selected physical environmental parameters in a peat system in King County. Wiedemann (1984) classified coastal dune communities in Oregon and Washington, including deflation plain wetland communities. U.S. Forest Service ecologists, in developing forest classifications, included some forested and non-forested wetland associations (Henderson et al. 1989; Henderson et al. 1992; Topik et al. 1988). Christy and Putera (1993) described riparian and wetland vegetation along the lower Columbia River. Diaz and Mellon (1996) and McCain (2004) classified riparian plant communities of northwest Oregon and southwest Washington (West Cascades). Murray (2000), Christy and Putera (1993), and Christy (2004) describe wetland plant associations of northwest Oregon. Chappell (1999) classified riparian plant associations of the western Olympic peninsula while Peter (2000) did the same for the southeastern Olympic peninsula.

Some British Columbia classification efforts are relevant to the classification of Washington wetlands. Hebda and Biggs (1981) described wetland communities in a large peat system on the Fraser River Delta. Orloci (1965) and Kojima and Krajina (1975) classified tree and shrub dominated wetland communities in the coastal western hemlock zone in British Columbia. Banner and Pojar, in a series of articles with others (1983, 1986, 1987a, 1987b), described wetland types which occur along the northern British Columbia coast. Most recently, MacKenzie and Moran (2004) described wetland vegetation as well as wetland ecological types for the entire province of British Columbia.

The most significant body of work for western Washington wetlands is the classification by Kunze (1994). This work, based on ten years of data collection, describes a preliminary classification of native, low elevation wetlands in western Washington. Wetlands were characterized within a hierarchy consisting of (from coarse- to fine- scale): Regions, Wetland Kind (i.e., Natural Community type), Hydrological Regime, Physiognomy, and Plant Community type (see Appendix A of Kunze 1994). The Plant Community types were based on plot data collected by Linda Kunze synthesized with many of the classification works cited above.

2.5.2 U.S. National Vegetation Classification

The various vegetation classifications conducted in the state over the years have provided much insight into the composition of wetland and riparian plant communities, but these projects were often completed in isolation from each other, thereby making comparison of types difficult. The development of the U.S. National Vegetation Classification (USNVC) in 1997 (FGDC 1997) followed by a revised version in 2008 (FGDC 2008) provided a framework for synthesis and comparision of plant communities across large spatial scales.

The U.S. National Vegetation Classification (USNVC), supported by the Federal Geographic Data Committee (FGDC 2008), NatureServe (Faber-Langendoen et al. 2009b), and the Ecological Society of America (Jennings et al. 2009), has a hierarchical structure which provides a common language for the effective management and conservation of plant communities across the United States. The classification standard was developed over many years by the FGDC Vegetation Subcommittee (FGDC 2008), with members from a diversity of federal agencies, the Vegetation Panel of the Ecological Society of America, and NatureServe (http://usnvc.org/overview/). The intent of the USNVC is to allow federal agencies to produce uniform statistics about vegetation resources across the nation, facilitate interagency cooperation on vegetation management issues that transcend jurisdictional boundaries, and encourage non-Federal partners to utilize and contribute to a common system when working with their Federal partners.

The USNVC consists of eight levels. The three upper levels are based primarily on physiognomic features; the three middle levels incorporate biogeographic and meso-climatic factors along with diagnostic species and life forms; and the two lower levels are based on floristics (FGDC 2008; Faber-Langendoen et al. 2014). The FGDC 2008 standard fully discusses the rationale and criteria of each hierarchy level (http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/NVCS V2_FINAL_2008-02.pdf).

The Association is the finest unit of the USNVC and has been used by WNHP as a primary unit to identify wetland conservation priorities (e.g., Wetlands of High Conservation Value). The Association is defined on the basis of a characteristic range of plant species composition, diagnostic plant species occurrence, habitat conditions and physiognomy (Jennings et al. 2009). Associations reflect topo-edaphic climate, substrates, hydrology, and disturbance regimes.

WNHP has played a key role in the identification and development of USNVC Associations for Washington State. WNHP ecologists accomplished this through synthesis of the various vegetation classification efforts conducted within or applicable to Washington (as discussed in the previous section), as well as firsthand collection and analysis of vegetation plot data over the past 30 years. All of the existing information is synthesized with intent to produce a syononymized list of USNVC Associations occurring in Washington. This process continues as new information become available. WNHP maintains a statewide database of plant associations and works with NatureServe to integrate these concepts into the USNVC.

2.5.3 Modifying the USNVC

For the *Ecological Classification of Native Wetland & Riparian Vegetation of Washington*, WNHP made one modification to the USNVC as it applies to Washington--the insertion of a new classification level between the Group and Association levels. The Subgroup is used *in lieu* of Alliances which is the official USNVC level between Groups and Associations. To date, Alliances have not been fully developed for the revised version of the USNVC (Figure 1). Those Alliances that have been proposed were deemed insufficient for WNHP's purposes, not meeting the program's need for an ecological unit that more explicitly encompasses primary ecological drivers. Thus, Subgroups were incorporated into the USNVC for use in classifying Washington's wetlands (note: Subgroups were developed by WNHP and are not an official part of the USNVC). The Subgroup unit aggregates Plant Associations based on similar primary ecological drivers such as landscape position, water source, water chemistry, and elevation. Subgroup concepts were developed by WNHP ecologists based on (1) scientific literature, (2) distribution information, and (3) their own field experience. Initial concepts were vetted during field work and adjusted according to observations of Plant Assocition relationships to these concepts. The USNVC is a nested hierarchy. Subgroups are also strictly nested within a single USNVC Group. However, Plant Associations can occur in more than a single Subgroup. This relationship is one reason why WNHP felt the need to develop the Subgroup concept. The Subgroup will allow WNHP to track the various ecological settings on the landscaped while Plant Associations provide the ability to track the biotic diversity within those settings.

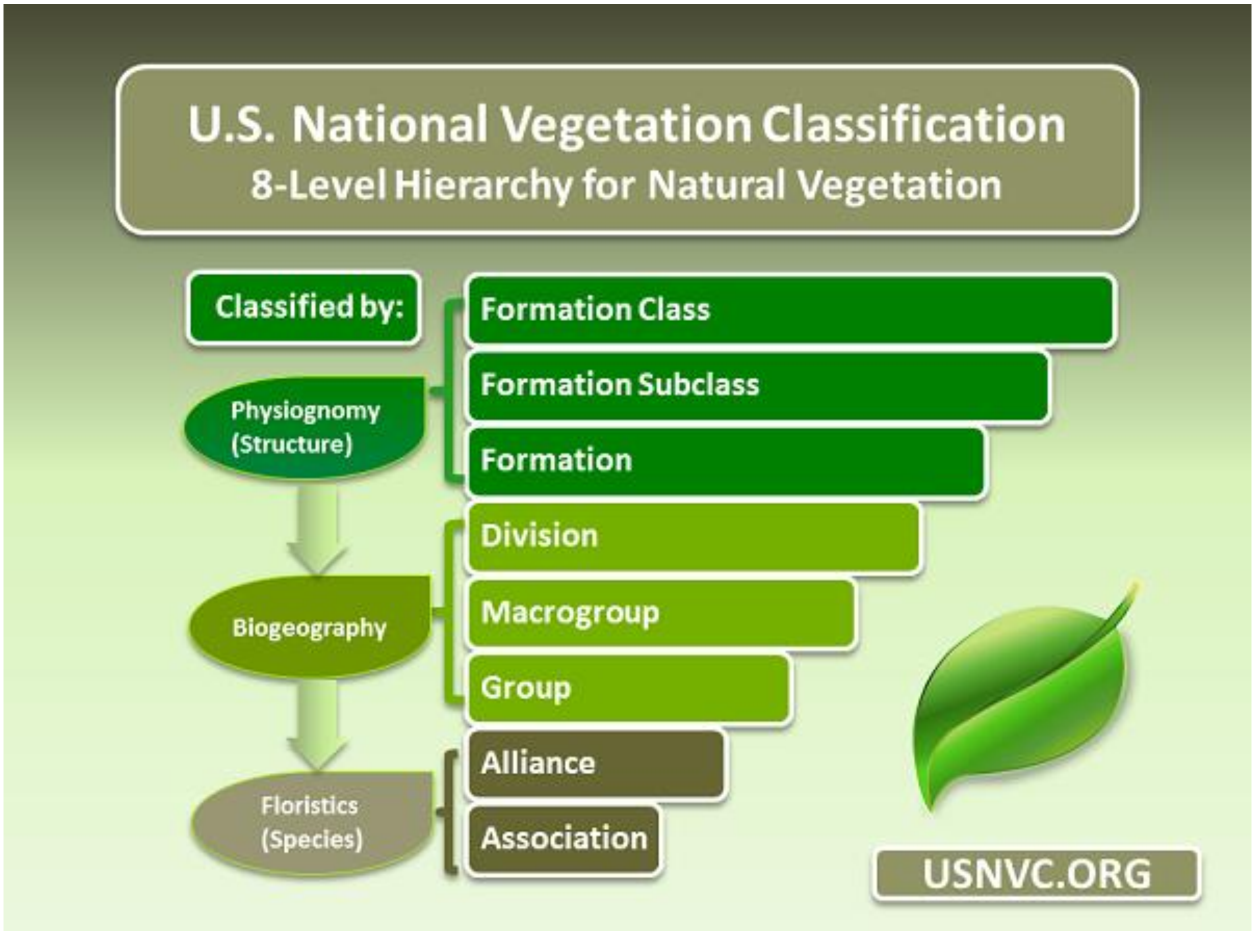

Figure 1. U.S. National Vegetation Classification Hierarchy

2.6 Updating Existing and Searching for New Wetlands of High Conservation Value

The objective of field-based data collection was to update classification and ecological integrity characteristics of known plant association-based Wetlands of High Conservation Value and to survey for additional wetlands that might meet criteria for Wetlands of High Conservation Value. This section outlines the methods used to complete these tasks.

2.6.1 Applying Tracking Guideline Filter to Existing WHCV

As noted in Section 2.2.1, a combination of an element occurrence's Global/State conservation status rank and its element occurrence rank (EORANK) determine whether it should be included in WNHP's information system. The decision matrix show in Table 3 was not always used in the past, as Natural Heritage methodology has evolved over the years. To clean up the database and remove element occurrences that do no meet the standard outlined in Table 3, each element occurrence was subjected to the decision matrix and tagged as either pass or fail (i.e. pass = the element occurrence was within the shading in Table 3). Those that were tagged as 'fail' were individually reviewed to determine whether any other circumstances or characteristics merited retention of the element occurrence in the database. For example, if the occurrence was the only record for an element in the database or data suggested that classification and/or ecological integrity assessments were in need of further field review, the occurrence was retained. If not, the element occurrence was deleted and no longer considered a WHCV. Examples of element occurrences that were deleted are *Spiraea douglasii* Shrubland (G5S5) occurrences that had EORANKs of C or D. These are fair to poor quality examples of a very common plant association. They don't merit special conservation attention and thus were deleted. In addition, there were many Natural Community (Kunze 1994; see Section 2.5.1) element occurrences which occur in the same locations as plant association element occurrences. If this scenario reflected conceptual duplication, then the Natural Community occurrence was deleted and the plant association occurrence was retained (assuming it met the decision matrix criteria). For example, Low Elevation Sphagnum Bog element occurrences almost always had bog plant association element occurrences in the same location.

2.6.2 Prioritizing Field Surveys of Existing Plant Association-Based Wetlands of High Conservation Value

Prior to implementing this project, there were 1,362 wetland ecosystem-based WHCV documented in WNHP's information system. Of those, 1,229 were located in western Washington and 133 in eastern Washington.

All of the WHCV in eastern Washignton were targeted for field work. However, because the number of WHCV located in western Washington far exceeded what could be sampled with available funding, it was necessary to prioritize field work. The selection of targeted sample sites was implemented using the following process:

- Salt/brackish marsh WHCV were not targeted for field work.
- A Level 1 EIA of all existing WHCV was conducted (described in Section 2.5)
- Based on the Level 1 EIA analysis, the WHCV were split into two possible sample site groups: (1) those with the lowest quality (e.g., C or D rank) Level 1 EIA Rank and (2) those with the highest quality (e.g., A rank) Level 1 EIA rank. The goal was to sample from each group. Low quality sites were targeted due to the assumption that they may be most likely to have degraded even further and thus may no longer meet WHCV criteria. High-quality sites were selected to determine the degree to which the "best" remaining wetlands have remained intact since they were last assessed.
- An approximately equal number of sites per wetland association (approximately five per association) were selected from the low and high-quality WHCV groups--these were subjectively chosen with an intended bias of capturing a diversity of plant association types across each ecoregion.

This process helped plan and target field visits but once field work was initiated the process became much more oppotrunistic due complications arising from inability to access sites (either due to being denied permission or because site conditions made access very difficult), some sites had multiple WHCV, and because potential new WHCV were often unexpectably stumbled upon. Thus, time management was driven more by making limited field time as efficient and productive as possible than it was about sticking to a preconceived sample design. Since our objective was not to make sample estimates of WHCV *per se*, we felt this shift was justified so that as many new and existing WHCV as possible could be documented and updated.

2.6.3 Prioritizing Field Surveys for Undocumented Wetlands of High Conservation Value.
Another objective of this project was to identify undocumented Wetlands of High Conservation Value. The process used to identify potential WHCV sites was as follows:

Western Washington:

- Kunze's field work conducted in the 1980s/1990s had been prioritized based on a meticulous review of aerial photographs. Wetlands observed on aerial photography were circled on a map and color coded according to survey priority. Wetlands surrounded by more intact buffers and embedded in more intact landscapes were given higher priority. For this project, these maps were digitized in ArcGIS and then intersected with known locations of WHCV. Data were not available to know whether sites that did not overlap with WHCV had been visited but then dropped from consideration, or if they were never visited at all. Thus, those sites not overlapping with WHCV were assumed to have not been visited. Of the latter sites, only those categorized by Kunze as high priority were selected as possible sample sites (129 sites).

- The Kunze high priority sites were intersected with National Wetland Inventory Level 1 EIA "A" ranked sites. The assumption was that when Kunze originally identified the high priority sites it was because they were embedded in a relatively intact landscape. If they overlapped with a NWI wetland of Level 1 A rank (which indicates that the landscape around those sites remains relatively intact), then they remained high priorities for field surveys as part of this project.

- For Phase 2, additional sites were selected based on data gaps and information needs for montane fens and rare wetlands associated with geothermal springs. Data sources for the former were mostly derived from Dewey (2011) and data for the latter were extracted from a database of geothermal springs developed by Washington Department of Natural Resources' Geology Division.

Eastern Washington:

- USFS and WNHP vegetation plot data were used to identify locations of specific wetland types of interest. Some of these were targeted for inventory based on species information and other notes associated with the plot data that suggested the site was of high-quality or supported a rare plant association type.

- Aerial photography was reviewed to identify potential peatlands (i.e., fens). Peatlands can be identified by several remote sensing signatures such as greenish-brown vegetation, late season wetness, and occasional surface features such as patterned ground or predictable vegetation structure.

- WNHP rare plant data were reviewed for species characteristic of calcareous fens. Some examples of those species include *Carex gynocrates*, *C. falva*, *Salix candida*, *Muhlebergia glomerata*.

2.6.4 Office Preparations
Numerous tasks preceded field work, including:

- Gathering and photocopying existing data about known Wetlands of High Conservation Value from WNHP's general manual file.
- Printing hard copy field maps for each targeted field site.
- Contacting landowners to request permission to access private lands.
- Scheduling field visits with public agency biologists and/or managers.
- Researching current and past land use.
- Conducting literature search for existing ecological data.

2.6.5 Mobile Data Collection and Field Forms
Field data were collected electronically using an Ashtech MobileMapper 10. Field forms previously developed for the EIA, Washington Wetland Rating System, and Stressor Checklist were converted to digital versions using ArcPad Studio. These forms are employed via ArcPad on the MobileMapper 10 units, resulting in a georeferenced data point attributed with the data associated with each form. A PocketExcel spreadsheet was developed for collecting vegetation plot data on the MobileMapper 10 units. The field forms upon which the EIA, Stressor Checklist, and vegetation plot digital forms are based are found in Appendix D. Wetland Rating Forms can be found in Hruby (2014a,b).

2.6.6 General Site Data Collected
At each site the following types of data were collected (see field forms in Appendix D and Hruby 2014a,b):

- General site characteristics
- Vegetation composition and abundance
- Ecological condition data (using Ecological Integrity Assessment; see below)
- Potential performance of wetland functions (Hruby 2014a,b)
- List of stressors, following NatureServe methodology (Master et al. 2012)

Methods for collecting these data are described below.

2.6.7 Vegetation Data
Vegetation releve plots were established in areas with homogenous vegetation patterns that did not cross significant ecological gradients. Multiple vegetation plots were often collected from a single site. Plot size was 100 m^2 for herbaceous, dwarf shrub, and shrub types and 400 m^2 for forested types. Data collected for each plot included site name, plot ID, soil pH/conductivity/temperature, and plant association names (when known). For undescribed association types, a preliminary name was assigned. Crown cover (in classes) was recorded for all species observed in the plot. Cover of bryophytes was recorded when cover was greater than 1%. Bryophytes growing on logs were excluded from cover estimates. Cover classes were as followed (see Appendix C for plot form example):

> 1: trace 2: 0–1% 3: 1–2% 4: 2–5% 5: 5–10% 6: 10–25% 7: 25–50% 8: 50–75% 9: 75–95% 10: >95%.

Strata and height classes were also assigned to trees and tall shrubs:

> U=understory; C=co-dominant; D=dominant; O=old growth; 1=<0.5m, 2=0.5 -1m, 3=1-2m, 4=2-5m, 5=>5m;

The primary regional source for species identification is Hitchcock and Cronquist (1973). Wilson et al. (2008) was used to identify sedges (Carices). For this report, species names identified in Hitchcock were synonymized to the USDA PLANTS name. (March 2011; Rocchio and Crawford 2013).

2.6.8 Ecological Integrity Assessment Data

The intent of rapid assessment methods, such as a Level 2 EIA, is to evaluate the ecological condition of a selected ecosystem using a specific set of observable field indicators or metrics relative to reference standards (e.g., minimal human disturbance). Level 2 EIAs rely primarily on relatively rapid (~2- 4 hour) field-based site visits in order to conduct direct, ground-based surveys of ecosystem occurrences (Faber-Langendoen et al. 2008). The Level 2 EIA scorecard is then used to convey the relative integrity of a particular occurrence in a manner that informs decision-making, whether for restoration, mitigation, conservation planning, or other ecosystem management goals (Stein et al. 2009). The Washington Natural Heritage Program has developedEIAs specific to Washington's wetland and riparian ecosystems (WNHP 2010). These Washington-specific EIAs were used to rapidly assess the ecological integrity of wetlands visited during this project. The metrics and rating criteria used in the Level 2 EIA assessments can be found in the individual EIA documents located here: http://www1.dnr.wa.gov/nhp/refdesk/communities/eia_list.html

Level 2 EIAs were used in this project to assess on-the-ground ecological integrity of known and potential Wetlands of High Conservation Value that were visited. The bounded area to which the Level 2 EIA was applied equaled the spatial boundary of the targeted Wetland of High Conservation Value. Because the EIA is applied to a WHCV, the EIA rank does not necessarily apply to the entire wetland, rather only the specific plant association being targeted. Protocols for applying the EIA are described in Faber-Langendoen et al. (2012b) and Rocchio and Crawford (2011). These data were entered in the EcoObs (NatureServe's database for storing EIA related data) and WNHP's information system.

Due to time constraints, some WHCV were updated using a set of field-based observations rather than EIA data. Some sites have multiple WHCV (sometimes over five). If each of those WHCV were assessed using the EIA, time spent at a given site could range up to multiple days. In order to visit as many sites as possible during the course of the project, EIAs were only applied to to those WHCV identified during the the sample site selection process described above. General observations were made about the other WHCV that occurred at the same site. Observations included obvious signs of degradation such as presence of invasive species, alterations to hydrology, indications of excess sediment or nutrients, etc. Often, species lists were also collected from these sites. These data were entered in WNHP's information system.

2.6.9 Wetland Function Assessment (Wetland Rating System)

The Washington Wetland Rating System was used to assess the potential performance of a set of ecological functions. Specifically, the Wetland Rating System is comprised of Water Quality, Hydrologic, and Habitat Function Scores which are integrated into an overall score. The Rating System is applied to a single HGM wetland type. Protocols for applying the Rating System follow Hruby (2014a,b).

Correlation analyses between the Rating Sytem and Level 2 EIA were conducted as part of Phase 1 and 2 and are summarize there (Rocchio et al. 2013, 2014). Briefly, there was no discernible correlation between Level 2 (r=-0.15) EIA scores with the Wetland Rating System score (Figure 2). The lack of correlation may reflect the lack of samples points from wetlands that are in very poor ecological condition. On the other hand, the Wetland Rating System gives more points to wetlands that occur in landscape where anthropogenic activities increase the likelihood that a wetland has the opportunity to perform (i.e., “improve”) water quality and hydrologic functions. For example, a wetland which occurs within an urbanized landscape has a higher potential to improve water quality than a wetland which occurs in a landscape with a relatively natural land cover. In contrast, the metrics measured for a Level 2 EIA generally score higher in a landscape with higher natural land cover.

2.6.10 Stressor Data

Documenting stressors or direct threats independently from assessing ecological conditions can provide possible correlations between ecological integrity and specific stressors. Those correlations can assist in management recommendations, restoration actions, and conservation decisions. Stressors are defined as “the proximate (human) activities or processes that have caused, are causing, or may cause the destruction, degradation, and/or impairment of biodiversity and natural processes” (Salafsky et al. 2008).

Stressors were documented at each site using NatureServe’s stressor checklist methodology (Master et al. 2012; Appendix D). Within this methodology, a predefined list of stressors is used at each site to document the presence, scope, and severity of stressors in four categories: (1) Landscape; (2) Vegetation; (3) Soil; and (4) Hydrology.

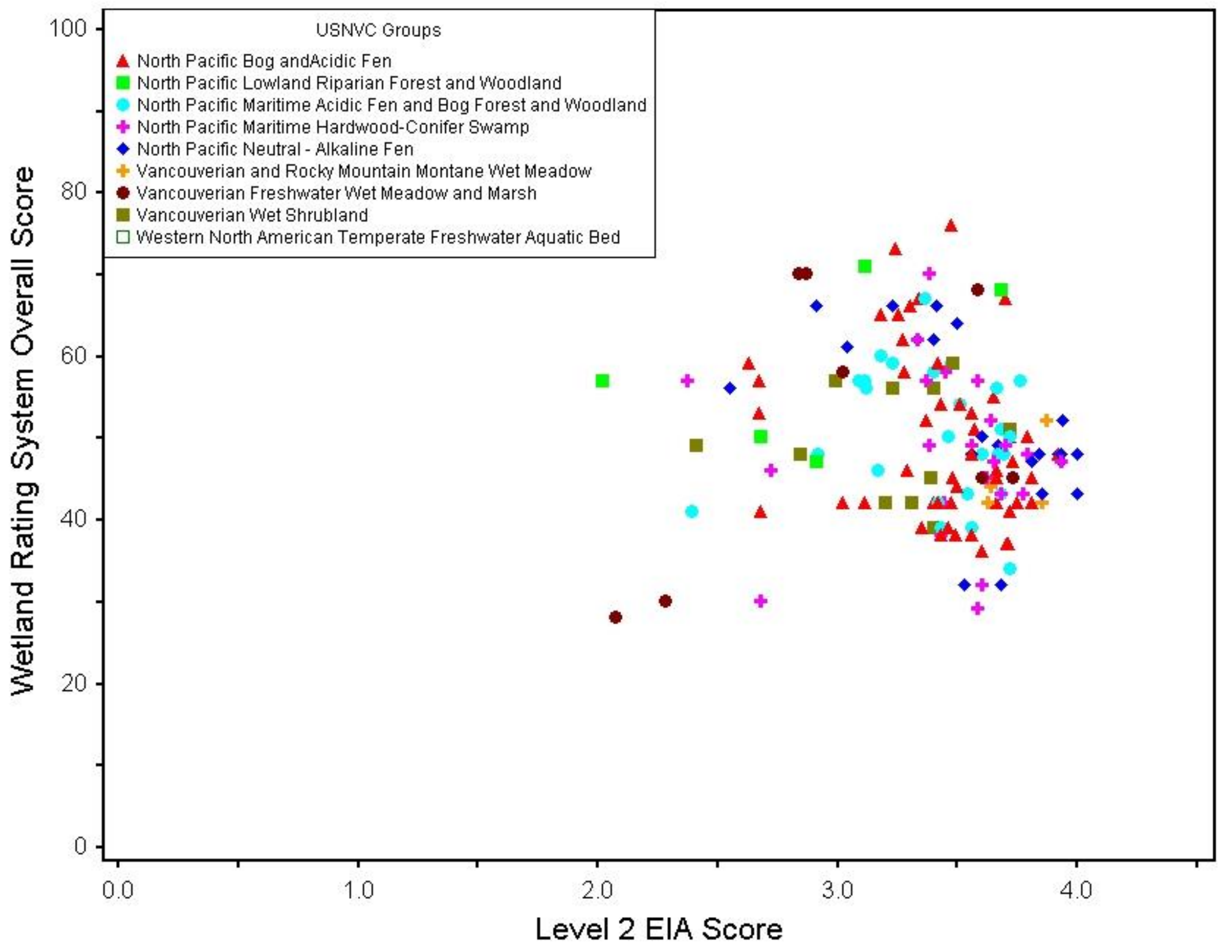

Figure 2. Correlation between Level 2 EIA and Wetland Rating System Score (higher scores = higher ecological integrity and increased potential of performing wetland functions)

Stressors may be characterized in terms of scope and severity. **Scope** is defined as the proportion of the wetland system that can reasonably be expected to be affected by the stressor within 10 years, given continuation of current circumstances and trends. **Severity** is the level of damage to the ecosystem from the threat that can reasonably be expected with continuation of current circumstances and trends. For ecosystems, severity is typically assessed by known or inferred degree of degradation or decline in integrity to one or more key ecological attributes and is assessed within a ten-year time frame.

For each category, stressors were listed if they were observed or inferred to occur, but not if they were merely projected to occur. The scope and severity of each stressor was then assigned to one of four categories. These ratings were then combined to determine an overall impact of that category using decision matrices (Table 4; Master et al. 2012). Similarly, an overall impact rating can be assessed by aggregating the overall impact rating of the four categories and using the decision matrix to determine an overall impact rating for the site.

For this project, the Stressor Impact Ratings were converted to a numeric score in order to allow for correlation analysis with EIA and Wetland Rating System data (Table 4; Nichols and Faber-Langendoen 2012a). For example, a stressor with 'large' scope and 'serious' severity would get a score of 5. Numeric scores are then summed for all stressors documented in the four categories (i.e., Landscape, Vegetation, Soil, and Hydrology) to calculate an overall site stressor score.

Table 4. Stressor Impact Ratings and Scores

Threat Impact Calculator		Scope			
		Pervasive	Large	Restricted	Small
Severity	Extreme	Very High=7	High=5	Medium=3	Low=1
	Serious	High=5	High=5	Medium=3	Low=1
	Moderate	Medium=3	Medium=3	Low=1	Low=1
	Slight	Low=1	Low=1	Low=1	Low=1

2.6.11 Data Storage and Development of the EcoObs Database

Data collected on the Ashtech MobileMapper 10 units were downloaded and stored in a variety of databases which are described below.

Vegetation plot data is currently stored in a Microsoft Excel workbook that will be imported into a Microsoft Access database used to store all of WNHP's plot data. Eventually the data will be stored in EcoObs (NatureServe's database for storing EIA related data; see below).

EIA data is currently stored in a Microsoft Excel workbook. NatureServe has initiated the development of a nationally-standardized Ecological Integrity Assessment (EIA) database called EcoObs that allows integration of wetland condition data across the United States. For this project, we partnered with NatureServe to modify the EcoObs database for specific use by WNHP. EcoObs will allow WNHP to store EIA data, calculate EIA metric scores, and produce a site summary of EIA data in a scorecard format. EcoOBs will directly support the information currently stored in the WNHP's database (Biotics) and improve management of data pertinent to identifying wetland conservation priorities. The database can be used by others for similar purposes. The information housed in the database will be made available online.

Most of the collected data have been integrated into WNHP's Information System, specifically into the information system and as attributes of a GIS file depicting the locations of Wetlands of High Conservation Value. The latter is available on WNHP's website (http://www1.dnr.wa.gov/nhp/refdesk/gis/index.html). In addition, hard copies of site data summaries are stored in WNHP's manual files.

2.7 Level 1 Ecological Integrity Assessment Model Development

Level 1 EIAs are based primarily on metrics derived from remotely sensed imagery. The goal is to develop metrics that assess the landscape context and the on-site conditions of an ecosystem. Satellite imagery and aerial photos are the most common sources of information for these assessments. Typically, stressors associated with degradation of ecological integrity are most observable with these sources of information, resulting in a heavy focus on stressor-based metrics in Level 1 EIAs.

The Level 1 EIA developed and used for this project is an overall index that aggregates four metrics characterizing ecological integrity of the buffer and surrounding landscape of a particular wetland. No metrics were used to assess size or condition of the wetland. Thus, it is a direct assessment of the buffer and landscape context which are used as surrogate measures (or predictors) of on-site condition of a given wetland.

Table 5. Level 1 EIA Metrics Used for This Project

LEVEL 1 EIA METRIC	CALCULATION	RANGE OF SCORE
LANDSCAPE CONTEXT		
Connectivity (up to 500 meters beyond wetland)		
M1 - *Connectivity: % Natural Land Cover (NLC) within 500 meters of wetland*	= (0.5(%NLC 50m buffer))+(0.3(%NLC 50-250m))+(0.2(%NLC 250-500m buffer))	**0.0 – 1.0**
Surrounding Land Use Index		
M2 - *Surrounding Land Use: Average Land Use Score (LU) for 50-500 meters within wetland*	= (0.65(Avg. LU 50-250m))+(0.35(Avg. LU 250-500M)	**0.0 – 1.0**
Buffer (within 50 meter of wetland)		
M3 - *Buffer Length (% of buffer with natural land cover)*	= % NLC abutting wetland polygon	**0.0 – 1.0**
M4 - *Buffer Condition (land use score within 50 meters of wetland)*	= Avg. LU 50m	**0.0 – 1.0**
SIZE		
No metric used		n/a
CONDITION		
No metric used		n/a
Overall Level 1 EIA Score	= (M1*0.25)+(M2*0.25)+((0.5*((M3+M4)/2)))	**0.0 – 1.0**

Table 6. Conversion of Level 1 Raw Values to EIA Ranks

EIA Raw Value	EIA Score	EIA Letter Rank	Ecological Conditions
1.0 to 0.9	5	A	Excellent integrity; relatively intact; almost all natural land cover with minimal stressors
0.89 to 0.60	4	B	Good integrity; mostly natural land cover; some low-impact land uses
0.59 to 0.20	3	C	Fair integrity; about equal natural/non-natural land cover; moderate intensity land uses
<0.20	1	D	Poor integrity; almost all non-natural land cover; high intensity land uses

NatureServe has developed an automated approach to assessing buffer and landscape context metrics using GIS (Lyons 2009). This method was modified for use in this project (Appendix C). The modification is a different method of automating the analysis. This method was applied to all known Wetlands of High Conservation Value and a subset of polygons contained within the National Wetland Inventory (NWI) maps (only vegetated Lacustrine and Palustrine polygons were targeted). Below is a summary of how the Level 1 EIA was employed to arrive at an EIA score/rank for a given wetland polygon.

NatureServe's Ecological Systems map (NatureServe 2012) served as the base layer from which metric calculations were derived. Each land cover unit found in the Ecological Systems map was categorized as either 'natural' or 'non-natural' land cover type (see Appendix C). In addition, all 'natural' land cover types were assigned a coefficient or weight of "1.0", while non-natural land cover weights were assigned a coefficient relative to their perceived impact on ecological integrity, with low scores being assigned to those with the greatest impact (see Appendix C). The land cover designations and land use weights were then used to calculate four metric scores which are shown in Appendix C. Each metric score ranged from 0.0 – 1.0. The metric scores were then plugged into a weight-based algorithm to calculate an overall Level 1 score for a given polygon. This overall score was converted into letter and numeric Level 1 EIA ranks (i.e. A = 5; B=4; C=3; D=1). The conversion from raw metric score to Level 1 EIA score/rank is shown in Table 6. The Level 1 EIA ranks were then appended to the Wetland of High Conservation Value and National Wetland Inventory map GIS layers. The end result is that every Wetland of High Conservation Value and every vegetated Lacustrine and Palustrine NWI polygon in Washington was assigned a Level 1 EIA score/rank.

The Level 1 EIA results have multiple purposes:

- Level 1 EIA ranks of National Wetland Inventory polygons were used to assist in prioritizing field work for this project.
- Level 1 EIA ranks of National Wetland Inventory polygons were used to identify potential Wetlands of High Conservation Value (e.g., those with predicted excellent ecological integrity).
- Level 1 EIA ranks of National Wetland Inventory polygons can also be used as a cursory assessment of ecological integrity of each polygon. Such data can be used for a variety of purposes such as landscape planning, incorporated into ambient monitoring protocols, etc.

2.8 Developing the Floristic Quality Assessment Method

A brief description of the FQA for Washington is described below. For more details see Rocchio and Crawford (2013) and/or the FQA page on WNHP's website: http://www1.dnr.wa.gov/nhp/refdesk/communities/fqa.html

The Floristic Quality Assessment (FQA) (Swink and Wilhelm 1994), originally called the Natural Area Rating Index (Wilhelm 1977; Swink and Wilhelm 1979), was developed to assist in the identification of natural areas worthy of conservation actions (Swink and Wilhelm 1979, 1994; Taft et. al. 1997). In recent years, FQA has also been used extensively for monitoring and assessment of wetland condition, with a variety of objectives (USACE 2003, 2005, 2006; Lopez and Fennessy 2002; Mack et al. 2004; Rocchio 2007). FQA uses vegetation composition as a means of assessing ecological condition. FQA focuses particularly on the concept of plant ‘conservatism’ as an indicator of the ecological quality of a given site. Conservatism-based indicators offer a unique approach to ecological monitoring and assessment which moves beyond traditional measures of species richness and abundance. Plant species conservatism has been defined in a variety of ways (see Rocchio and Crawford 2013) but can be summarized as reflecting the degree to which a plant species is restricted to intact native ecosystems. In other words, conservative plants are those species that cannot adapt to human-induced alterations and thus are typically the first plants to disappear from a habitat impacted by human activities (Wilhelm and Masters 1996). In summary, a high-quality natural ecological system is comprised of both conservative and non-conservative plants, whereas highly stressed, low-quality natural areas or sites of recent anthropogenic origin have few, if any, surviving conservative plants. Thus, the proportion of conservative plants in a plant community provides a powerful and relatively easy indirect assessment of the integrity of both biotic and abiotic processes and, as such, is indicative of the ecological integrity of a site (Wilhelm and Ladd 1988).

The primary component in developing a FQA is the assignment of coefficients of conservatism values to all native species in a flora. Although the coefficients are subjectively assigned, they are *applied* consistently and objectively since value judgments have already been determined. The coefficients range from 0-10 and represent the collective opinion of local botanical and ecological experts regarding a species relative conservatism. Non-native plants were not part of the pre-settlement flora, so no coefficients are assigned to them. However, if non-native species are used in the calculation of FQA indices, they are given default coefficients of 0. Because plants often exhibit varying degrees of conservatism due to physiological and ecological variations within the range of each species, coefficient values are assigned on a regional basis.

As part of this project, the Washington Natural Heritage Program (WNHP) organized the assignment of coefficients of conservatism for the Washington flora. Sixty-six regional botanical and ecological experts were invited to participate on the Western Washington Floristic Quality Assessment Panel and 65 were invited to participate on the Eastern Washington Floristic Quality Assessment Panel. Of those, a total of 37 participants submitted their opinions on coefficients of conservatism for the Washington flora (Table 7 and Table 8). There was some overlap in participation between western and eastern Washington panels.

Each of the panel members were provided with a database of the eastern or western Washington flora and guidelines to help them assign coefficients. They were given approximately two months to individually assign coefficients to species with which they were familiar. Once panel members completed their C value assignments, descriptive statistics of assigned coefficients for each species were calculated by WNHP (Rocchio and Crawford 2013). If the range of coefficients assigned was ≤ 3, the average was accepted as the final coefficient for that species. If the range was ≥ 4 then the species was considered to have wide disagreement among the panel members and was flagged for further review by a subset of the Assessment Panel called the “Review Panel”.

In addition to a final report documenting this process and the results in more detail (Rocchio and Crawford 2013), WNHP has also developed Microsoft Excel-based calculators that include the final FQA database for western and eastern Washington (http://www1.dnr.wa.gov/nhp/refdesk/communities/fqa.html). The calculators automatically compute index values for a given dataset. Many different metrics are calculated, including conservatism-based indices and more commonly used metrics such as % non-natives, % annuals, etc.

FQA index values are commonly used for baseline monitoring or to document ecological condition or conservation value relative to regional reference values for a given ecological type. In baseline monitoring applications, FQA index values can be compared over time at a particular site to monitor trends in ecological condition. In such cases, increasing index values suggest improvement and decreasing values suggest degradation of ecological conditions.

Table 7. Western Washington Floristic Quality Assessment Panel Members

Name	Organization/Affiliation	Name	Organization/Affiliation
Clay Antieau*	Seattle Public Utilities, City of Seattle	Jan Henderson	U.S. Forest Service (retired)
Joe Arnett	Washington Department of Natural Resources, Natural Heritage Program	Vikki Jackson	Northwest Ecological Services, LLC
Elizabeth Binney*	Pacific Ecological Consultants, LLC	Linda Kunze	L.M. Kunze Consulting
Mignonne Bivin*	North Cascades National Park Complex	Cathy Maxwell	Consulting botanist
Chris Chappell	Consulting ecologist	Jenifer Parsons	Washington Department of Ecology
Marty Chaney	U.S. Department of Agriculture, Natural Resources Conservation Service	Laura Potash	U.S. Forest Service
Rex Crawford*	Washington Department of Natural Resources, Natural Heritage Program	Joe Rocchio**	Washington Department of Natural Resources, Natural Heritage Program
Peter Dunwiddie*	Consulting ecologist / University of Washington	Regina Rochefort	North Cascades National Park Complex
Steve Erickson*	Frosty Hollow Ecological Restoration	Debra Salstrom	SEE Botanical Consulting
Sarah Gage	Washington State Recreation and Conservation Office, Washington Biodiversity Council	Reid Schuller	Western Stewardship Science Institute
David Giblin	University of Washington Herbarium at the Burke Museum	Jeff Walker	URS Corporation, Seattle
Rod Gilbert*	U.S. Department of Defense, Joint Base Lewis-McChord	David Wilderman	Washington Department of Natural Resources, Natural Areas Program
Thor Hansen	Consulting ecologist		

*Review Panel member
** moderated the process of C value assignments

Table 8. Eastern Washington Floristic Quality Assessment Panel Members

Name	Organization/Affiliation	Name	Organization/Affiliation
Kathy Ahlenslager	Colville National Forest	Jennifer Miller	Idaho Department of Fish and Game
Joe Arnett	Washington Department of Natural Resources, Natural Heritage Program	Jenifer Parsons	Washington Department of Ecology
Katy Beck	Consulting botanist	Joe Rocchio**	Washington Department of Natural Resources, Natural Heritage Program
Edd Bracken	Washington Department of Fish and Wildlife	Debra Salstrom	SEE Botanical Consulting
Amy Cabral	Colville National Forest	Reid Schuller	Western Stewardship Science Institute
Pam Camp	U.S. Bureau of Land Management (retired)	Dana Visalli	Consulting botanist
Florence Caplow	Consulting botanist	David Wilderman	Washington Department of Natural Resources, Natural Areas Program
Rex Crawford**	Washington Department of Natural Resources, Natural Heritage Program	George Wooten	Botanist, Pacific Biodiversity Institute
Mark Darrach	Corydalis Consulting	Carolyn Wright	Consulting botanist
Peter Dunwiddie	Consulting ecologist / University of Washington	Ben Zamora	Washington State University
Terry Lillybridge	Okanogan-Wenatchee National Forest (retired)		

**moderated the process of C value assignments

2.9 Identifying Reference Standard Wetlands

A *reference network* is a group of wetlands that reflect the range of variability associated with specific wetland types in a given geographic region. *Reference standard wetlands* are a subset of those wetlands that reflect the range of conditions that are used as a benchmark for comparison to other wetlands for a specific objective, such as evaluating wetland ecosystem services or ecological integrity. Thus, the group of wetlands representing the reference standard condition varies according to the stated objective. This section describes the use of WHCV data managed by WNHP to develop a network of *reference standard* sites that possess ecological and vegetation conditions that best represent the historical or natural range of variation of western Washington wetlands and riparian areas.

The concept of minimally disturbed condition (MDC), or the ecological condition of sites in the absence of significant human disturbance, is one approach for defining reference standard wetlands (Stoddard et al. 2006). The inclusion of the qualifier of “significant” human disturbance, recognizes that most sites have likely been exposed to at least some minimum level of human stressor (e.g. atmospheric contaminants, initial climate change effects, etc.). MDC sites represent one end of a continuum ranging from sites with minimal or no exposure to human-induced disturbance (i.e. reference standard sites) to those in a highly degraded condition due to such impacts (Bailey et al. 2004; Stoddard et al. 2006). The natural variation of the MDC provides a baseline from which biotic or abiotic variables can be assessed to determine whether ecological integrity has been compromised at a site. In other words, it becomes easier to separate the signal (response to human disturbance) from noise (natural variability) when sampling wetlands across a human disturbance gradient. It follows that, if ecological response to stressors can be identified then better informed restoration, management, and protection projects can be implemented.

The Level 2 EIA method used by WNHP to assess current ecological integrity of WHCV is based on the MDC concept. Thus, many of the plant association-based WHCV documented by WNHP can serve as reference standard wetlands for objectives based on comparison with wetlands with minimal or no human disturbance. Such objectives might include identifying restoration potential and benchmarks, mitigation performance standards (Faber-Langendoen et al. 2006; 2008), conservation priorities, or assessing ecological response to human-induced disturbance.

In order to identify which WHCV would be designated as reference standard wetlands, sites were selected with the highest EIA/EO rank for each wetland type (per WNHP's wetland classification). For many wetlands, these are WHCV with an EIA rank of excellent integrity (e.g., "A" rank). However, because of varying degrees of loss and degradation on the landscape, not all wetlands are represented by examples close to historical conditions (e.g., wet prairies). For those wetland types, the highest ranked examples would qualify as reference standard sites for that wetland type. For example, the highest quality example of wet prairie remaining in western Washington has an EIA Rank of "C" (fair integrity). Thus, although the site is significantly degraded relative to historical conditions, it is still the best remaining example of wet prairie and would be identified as a reference standard wetland. Presence within a Natural Area Preserve or other similarly protected area was also considered as a filter of candidate WHCV, since such sites are likely to persist in the long-term.

For this project, the number of element occurrences (EOs) for each association were summarized. These EOs will provide the baseline from which the final selection of reference standard sites will be selected during the Phase 4 project (EPA Region 10 Wetland Program Development Grant: CD-00J78501).

3. Results/Discussion

3.1 Ecological Classification of Native Wetland & Riparian Vegetation of Washington: A Summary of Types

The results of the classification are summarized in Table 9. The full classification hierarchy accompanies this report as Appendix B. The USNVC has eight formation classes (see http://usnvc.org/explore-classification/), two of which are cultural vegetation types. Of the six native vegetation formation classes, four encompass the range of wetland and riparian vegetation in Washington. Within those four formation classes, there are five formation subclasses, six formations, six divisions, eight macrogroups, and 34 groups, eight of which are upland groups. There are 124 subgroups and 618 associations (Table 9). The highest numbers of subgroups were found in the Vancouverian Wet Shrubland Group (9), Vancouverian & Rocky Mountain Subalpine & Alpine Snowbed, Wet Meadow & Dwarf-Shrubland Group (8), and Western Montane-Subalpine Riparian & Seep Shrubland Group (8). The Western Montane-Subalpine Riparian & Seep Shrubland Group (52) and Vancouverian Wet Meadow & Marsh Group (51) had the highest total number of associations. These totals suggest a higher range of ecological variability (e.g., Subgroups) and higher vegetation diversity (Associations) than in groups with lower numbers (Table 9). Outside of the upland and ruderal groups, the groups with low number of subgroups and associations generally have received much less classification, research, and inventory than other wetland types. However, what we do know about these wetlands suggests that they are likely not very diverse due to influence from a single primary ecological driver within a very narrow range of landscape positions. Conversely, groups with a large number of associations all have multiple ecological drivers (water source, water chemistry, soil type, and hydrodynamics) that occur in a variety of landscape positions resulting in high diversity of vegetation types.

The diversity of ecological templates and biotic diversity associated with Washington wetlands is not well characterized by established and commonly used classification schemes. The *Ecological Classification of Native Wetland & Riparian Vegetation of Washington* provides a standardized language for describing Washington's wetland ecological diversity. This classification provides a flexible framework for categorizing wetlands and riparian vegetation types from a variety of conceptual and spatial scales.

3.2 Conservation Status Ranks Assignments

The global and state ranks of the 618 plant associations are listed in Appendix A. Global ranks had been previously assigned to 361 (58%) of the 618 wetland plant associations occurring in Washington. This tally includes those with GU ranks. No global ranks were assigned for this project as that process involves Natural Heritage scientists from each of the states and/or provinces in which the element occurs and is outside the scope of this project. State ranks had been previously assigned to 344 (56%) of the 618 wetland plant associations occurring in Washington. For this project, WNHP assigned state ranks to 82 (30%) of the 274 associations that were missing state ranks (no rank had ever been attempted). That leaves 193 associations (31%) of the 618 total without a State Conservation Status Rank (i.e. current status is SNR). The distribution of Global and State Conservation Status Ranks for the 618 wetland plant associations in Washington are shown in Figure 3 and Figure 4.

Table 9. Summary of Types in the Ecological Classification of Native Wetland & Riparian Vegetation of Washington

Class to Group Types	Number of Subgroups	Number of Associations
1 Forest & Woodland Class		
1.B Temperate & Boreal Forest & Woodland Subclass		
1.B.2 Cool Temperate Forest & Woodland Formation (xeroriparian types)		
1.B.2.Nb Rocky Mountain Cool Temperate Forest Division		
Central Rocky Mountain Mesic Lower Montane Forest Macrogroup		
Central Rocky Mountain Inland Western Red-cedar - Western Hemlock Forest Group	**1**	**6**
Central Rocky Mountain Mesic Grand Fir - Douglas-fir Forest Group	**1**	**2**
East Cascades Mesic Grand Fir - Douglas-fir Forest Group	**1**	**1**
Rocky Mountain Subalpine-High Montane Conifer Forest Macrogroup		
Rocky Mountain Subalpine Dry-Mesic Spruce - Fir Forest & Woodland Group	**1**	**1**
Rocky Mountain Subalpine Moist Spruce - Fir Forest & Woodland Group	**1**	**2**
1.B.2.Nc Western North American Cool Temperate Woodland & Scrub Division		
Intermountain Singleleaf Pinyon - Utah Juniper - Western Juniper Woodland Macrogroup		
Columbia Plateau Western Juniper Woodland & Savanna Group	**1**	**1**
1.B.2.Nd Vancouverian Cool Temperate Forest Division		
Vancouverian Lowland & Montane Rainforest Macrogroup		
North Pacific Maritime Silver Fir - Western Hemlock Forest Group	**1**	**2**
Vancouverian Subalpine Forest Macrogroup		
North Pacific Mountain Hemlock - Silver Fir Forest & Tree Island Group	**1**	**2**
1.B.3 Temperate Flooded & Swamp Forest Formation		
1.B.3.Nc Rocky Mountain & Great Basin Montane Flooded & Swamp Forest Division		
Rocky Mountain & Great Basin Montane Riparian Forest Macrogroup		
Northern Rocky Mountain Lowland & Foothill Riparian Forest Group	**5**	**32**
Rocky Mountain & Great Basin Montane Riparian Forest Group	**5**	**34**
Rocky Mountain & Great Basin Swamp Forest Group	**5**	**15**
1.B.3.Nd Inland Lowland West Flooded & Swamp Forest Division		

Class to Group Types	Number of Subgroups	Number of Associations
Interior West Ruderal Flooded & Swamp Forest Macrogroup		
Inland West Ruderal Riparian Forest & Scrub Group	**1**	**4**
1.B.3.Ng Vancouverian Flooded & Swamp Forest Division		
Vancouverian Flooded & Swamp Forest Macrogroup		
North Pacific Lowland Riparian Forest & Woodland Group	**4**	**36**
North Pacific Maritime Hardwood-Conifer Swamp Group	**6**	**22**
North Pacific Montane Riparian Woodland Group	**4**	**18**
Vancouverian Ruderal Flooded & Swamp Forest Macrogroup		
North Pacific Ruderal Riparian and Swamp Forest Group	**1**	**3**
2 Shrubland & Herb Vegetation Class		
2.C Shrub & Herb Wetland Subclass		
2.C.2 Temperate to Polar Bog & Fen Formation		
2.C.2.Na North American Bog & Fen Division		
North American Boreal & Sub-Boreal Acidic Bog & Fen Macrogroup		
Rocky Mountain Acidic Fen Group	**2**	**5**
North American Boreal & Sub-Boreal Alkaline Fen Macrogroup		
Rocky Mountain Neutral - Alkaline Fen Group	**5**	**31**
North Pacific Bog & Fen Macrogroup		
North Pacific Acidic Open Bog and Fen Group	**5**	**31**
North Pacific Alkaline Open Fen Group	**2**	**19**
North Pacific Maritime Wooded Bog & Poor Fen Group	**5**	**12**
2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland Formation		
2.C.4.Nb Western North American Freshwater Shrubland, Wet Meadow & Marsh Division		
Arid West Inland Freshwater Emergent Marsh Macrogroup		
Arid West Inland Freshwater Emergent Marsh Group	**4**	**24**
Vancouverian Lowland Wet Shrubland, Wet Meadow & Marsh Macrogroup		
Temperate Pacific Freshwater Wet Mudflat Group	**2**	**4**

Class to Group Types	**Number of Subgroups**	**Number of Associations**
Vancouverian Freshwater Wet Meadow & Marsh Group	**7**	**51**
Vancouverian Wet Shrubland Group	**9**	**38**
Western North American Montane-Subalpine Wet Shrubland & Wet Meadow Macrogroup		
Rocky Mountain & Great Basin Lowland & Foothill Riparian Shrubland Group	**4**	**30**
Vancouverian & Rocky Mountain Montane Wet Meadow Group	**7**	**38**
Vancouverian & Rocky Mountain Subalpine & Alpine Snowbed, Wet Meadow & Dwarf-Shrubland Group	**8**	**14**
Western Montane-Subalpine Riparian & Seep Shrubland Group	**8**	**52**
Western North American Ruderal Wet Shrubland, Meadow & Marsh Macrogroup		
Western North American Ruderal Wet Shrubland, Meadow & Marsh Group	**2**	**18**
Western North American Vernal Pool Macrogroup		
North Pacific Vernal Pool Group	**2**	**9**
2.C.5 Salt Marsh Formation		
2.C.5.Nc Temperate & Boreal Pacific Coastal Salt Marsh Division		
North American Pacific Coastal Salt Marsh Macrogroup		
Temperate Pacific Tidal Salt & Brackish Marsh Group	**4**	**20**
2.C.5.Nd North American Western Inland Brackish Marsh Division		
Warm & Cool Desert Alkali-Saline Wetland Macrogroup		
North American Desert Alkaline-Saline Herbaceous Wetland & Playa Group	**2**	**13**
North American Desert Alkaline-Saline Shrub Wetland Group	**1**	**2**
5 Aquatic Vegetation Class		
5.A Saltwater Aquatic Vegetation Subclass		
5.A.2 Benthic Macroalgae Saltwater Vegetation Formation		
5.A.2.Wb Temperate Intertidal Shore Division		
Temperate Pacific Seaweed Intertidal Vegetation Macrogroup		
North American Pacific Intertidal Algal Flat Group	**1**	**0**
5.A.3 Benthic Vascular Saltwater Vegetation Formation		

Class to Group Types	Number of Subgroups	Number of Associations
5.A.3.We Temperate Seagrass Aquatic Vegetation		
Temperate Pacific Seagrass Intertidal Vascular Vegetation Macrogroup		
Temperate Pacific Seagrass Group	**1**	**1**
5.B Freshwater Aquatic Vegetation Subclass		
5.B.2 Temperate & Boreal Freshwater Aquatic Vegetation Formation		
5.B.2.Na North American Freshwater Aquatic Vegetation Division		
Western North American Freshwater Aquatic Vegetation Macrogroup		
Western North American Temperate Freshwater Aquatic Bed Group	**6**	**23**
6 Open Rock Vegetation Class		
6.B Temperate & Boreal Open Rock Vegetation Subclass		
6.B.1 Temperate & Boreal Cliff, Scree & Other Rock Vegetation Formation		
6.B.1.Nb Western North American Temperate Cliff, Scree & Rock Vegetation Division		
Western North American Temperate Cliff, Scree & Rock Vegetation Macrogroup		
North Vancouverian Montane Massive Bedrock, Cliff & Talus Group	**2**	**0**
Rocky Mountain Cliff, Scree & Rock Vegetation Group	**2**	**1**

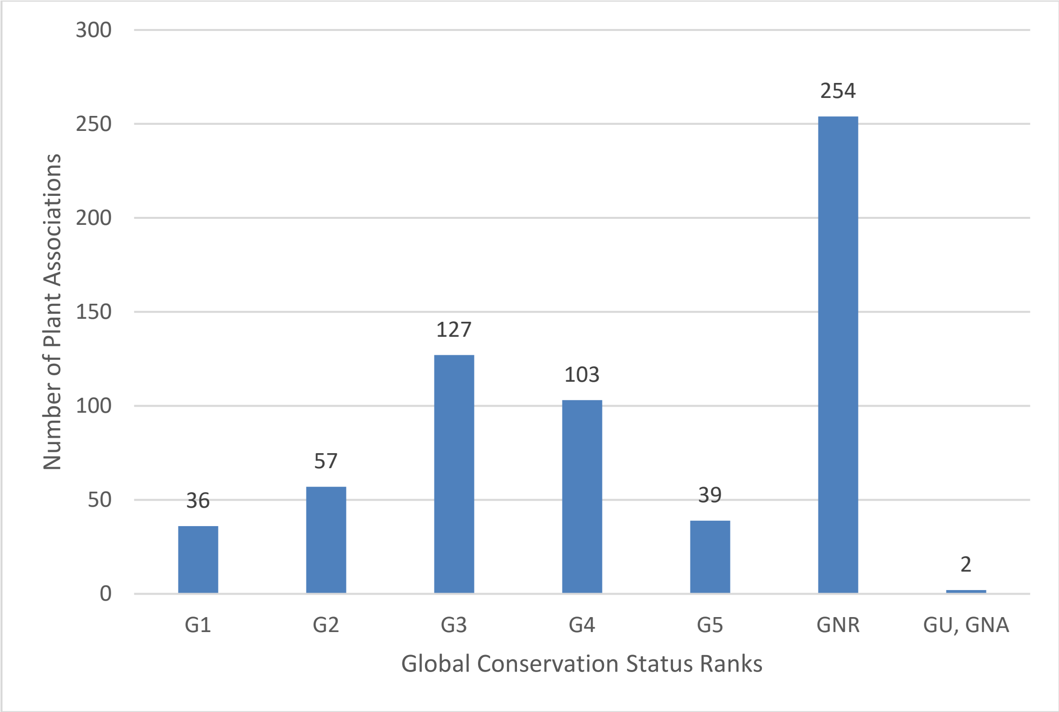

Figure 3. Global Conservation Status Ranks of Washington Wetland Plant Associations

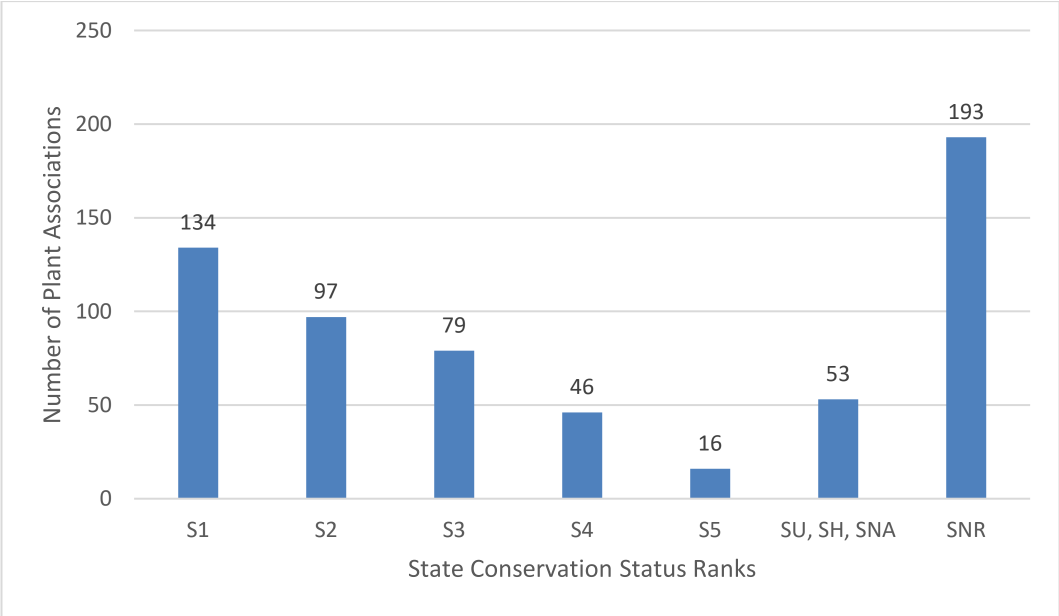

Figure 4. State Conservation Status Ranks of Washington Wetland Plant Associations

3.3 Field Surveys of Existing and New Wetlands of High Conservation Value

Prior to the implementation of this project, there were 1,362 ecosystem-based WHCV in WNHP's information system. Of those 1,362, there were 199 (15%) revisited during this project (Figure 5; Table 10). In addition, 254 new WHCV were documented. Most WHCV occur in western Washington (Figure 5). The majority of new WHCV documented in this project were in eastern Washington, primarily in the montane areas (Figure 5). WHCV are not as abundant in the Columbia Basin as in other regions of the State (Figure 5) due to the long-term human-induced stressors which have occurred there, the sensitivity of the wetland types in that area, and the widespread dominance of the non-native invasive reed canary grass (*Phalaris arundinaceae*) in wetlands throughout the Columbia Basin. However, the Columbia Basin does contain vernal pools, alkaline fens, and rare riparian associations which are of conservation significance.

Travel time coupled with time spent at an individual site (anywhere from a few hours to a full day) often resulted in only one or two sites being surveyed per day. Because WHCV are defined based on plant associations, many sites (i.e. a single wetland or wetland comlex) had multiple WHCV present (i.e. individual wetlands are often comprised of multiple plant associations). Other factors such as access-denial by private landowners and environmental limitations of the site (e.g., water levels were too high in areas where boats were not feasible to use; impenetrable woody vegetation; treacherous areas of deep muck) also limited the number of WHCV that WNHP personnel were able to visit.

Datasets associated with vegetation composition, ecological integrity, wetland functions, and stressors were collected at most sites (Table 11). The sample site selection process often directed field work to a site where more than one WHCV occurred. In order to expedite field time and ensure that we were able to visit as many sites as possible, not all WHCV at a given site were assessed using the EIA methods. EIAs were used to update information on those WHCV selected for field sampling while general observations were made about the other WHCV that occurred at the same site. In addition, the wetland rating system was applied to most, but not all, WHCV sampled. Often, more than one vegetation plot was sampled within a given WHCV. Consequently, the number of datasets for various data collection efforts varies (Table 11).

General site information and data related to the assessment of ecological integrity are stored in WNHP's information system. A spatial representation of those data as well as selected tabular information will be delivered via an online web viewer that is currently in development and projected to be accessible by the public by December 2016. Detailed data is also stored in the EcoObs database developed by NatureServe for this project (Appendix E). Vegetation plot data was collected to help with classification of Washington wetland vegetation types and provide an overview of floristics within each wetland type. Those data are not summarized here, but are available from WNHP upon request.

3.4 WHCV Deleted from WNHP's Biotics Database

After field work was completed and existing WHCV data were updated, each element occurrence was filtered through the decision matrix (Table 3). That analysis (see Section 2.6.1) identified 395 Natural Community WHCV and 109 Plant Association WHCV to be deleted from the database (Figure 6; Table 10). Although these records have been removed from WNHP's information system, the records (both spatial and tabular data) have been retained as archive datasets in the form of GIS shapefiles and paper copies of each record. Upon completing the deletions, the total number of WHCV retained in WNHP's database is 1,112 (Table 10). See section 2.6.1 for details on the process used to identify which WHCV would be deleted.

Table 10. Summary of Updated, Newly Discovered, and Deleted WHCV.

Project Phase	Updated (existing) WHCV	New WHCV	Total WHCV Assessed	Total WHCV
Pre-Project Total				**1,362**
Phase 1 (2011)	*103*	*15*	*118*	+15
Phase 2 (2012)	*68*	*66*	*134*	+66
Phase 3 (2013-2015)	*28*	*173*	*188*	+173
Subtotal	***199***	***254***	***453***	***1,616***
Deleted WHCV (Natural Communities)				*-395*
Deleted WHCV (Plant Associations)				*-109*
Post-Project Total				**1,112**

Table 11. Number of Datasets Collected from Plant Association-Based Wetlands of High Conservation Value

Project Phase	Level 2 EIA	Stressor Checklist	Wetland Rating System	Vegetation Plots
Phase 1 (2011)	86	86	85	170
Phase 2 (2012)	108	108	95	204
Phase3 (2013-2015)	189	189	92	244
Total	**383**	**383**	**272**	**618**

3.5 Level 1 EIA Results

The Level 1 EIA assigned a rank of relative ecological integrity (from excellent to poor) to most NWI polygons in Washington (see Section 2.7). Figure 7 shows the predicted locations of wetlands with excellent (= A rank) ecological integrity. In western Washington, many of the predicted high-quality wetlands occur along river and/or stream corridors, especially on the western portion of the Olympic peninsula and in upper elevations of the Olympic Mountains and Cascades. There are also numerous wetlands in the Puget Sound Basin, especially on the Kitsap Peninsula and near the foothills of the Cascades that are predicted to be of excellent integrity. Other areas of high potential include the flat lowlands of Lewis and Cowlitz counties (possibly wet prairies), and near the Columbia River in the Willamette Valley ecoregion. In eastern Washington, the majority of wetlands with predicted excellent ecological integrity occur along montane riparian zones (Figure 7). Within the Columbia Basin, there are a high-density of wetlands with predicted excellent ecological integrity within channeled scabland tracts (Figure 7).

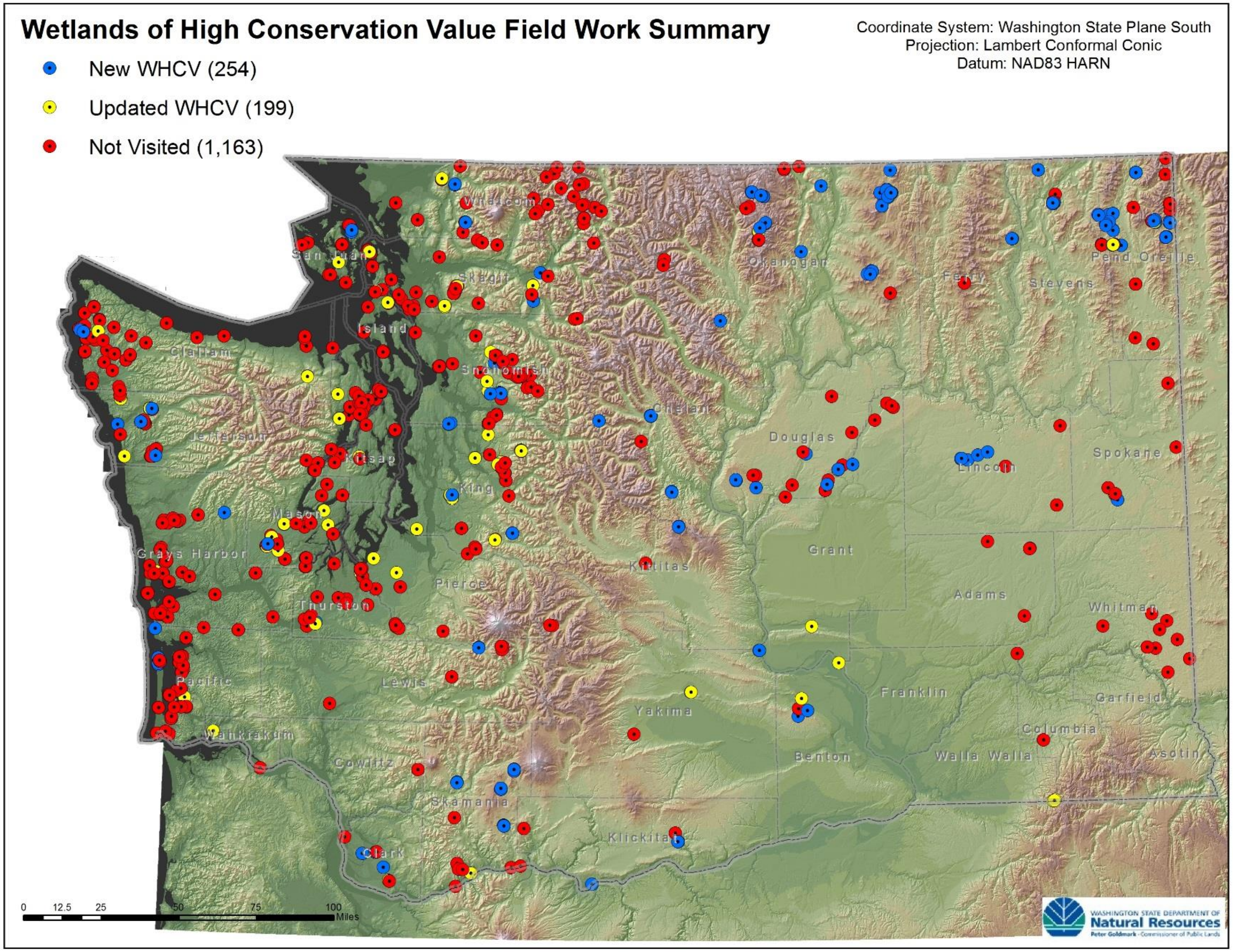

Figure 5. Distribution of Plant Association-Based Wetlands of High Conservation Value in Washington

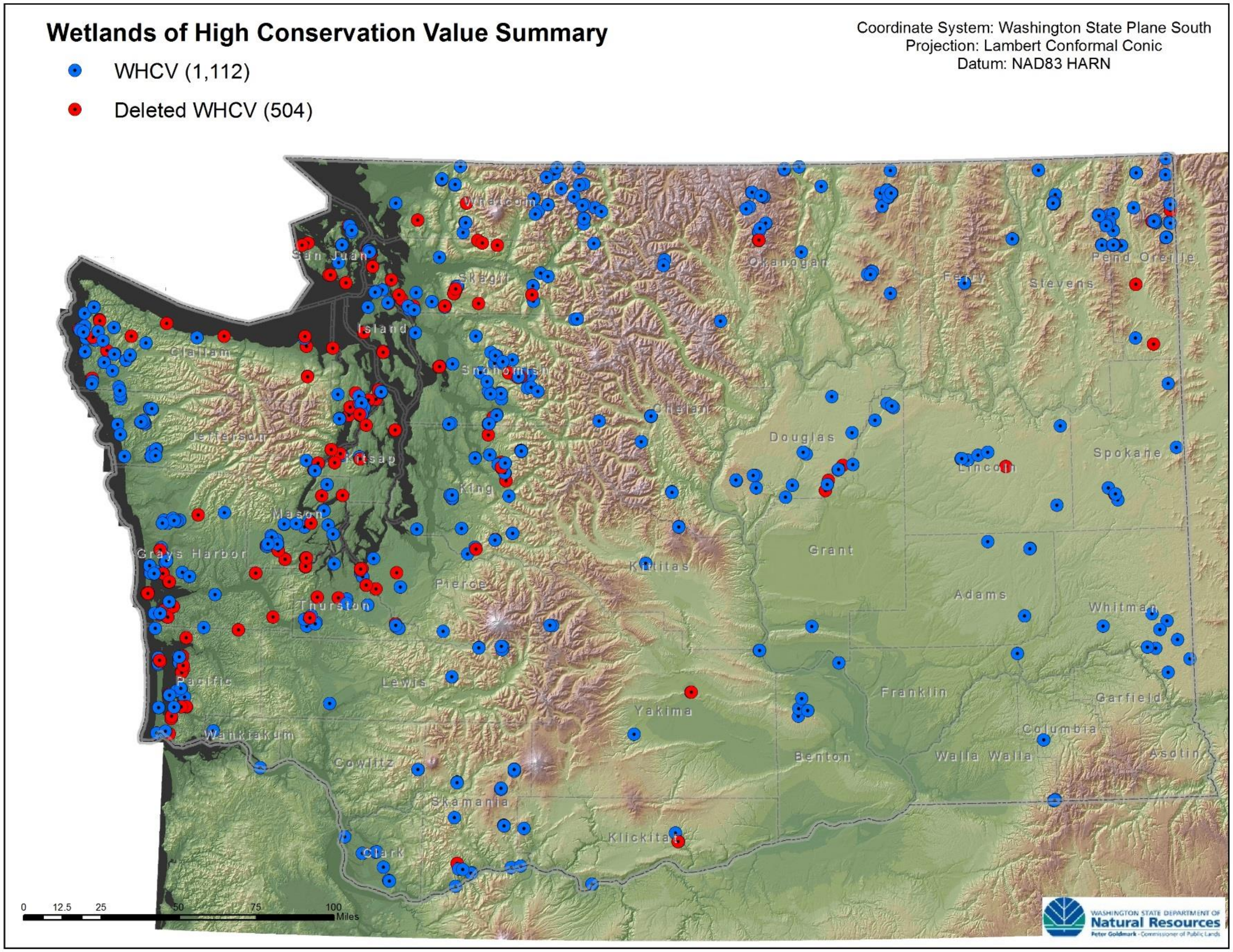

Figure 6. Wetlands of High Conservation Value Deleted and Retained in WNHP's Information System

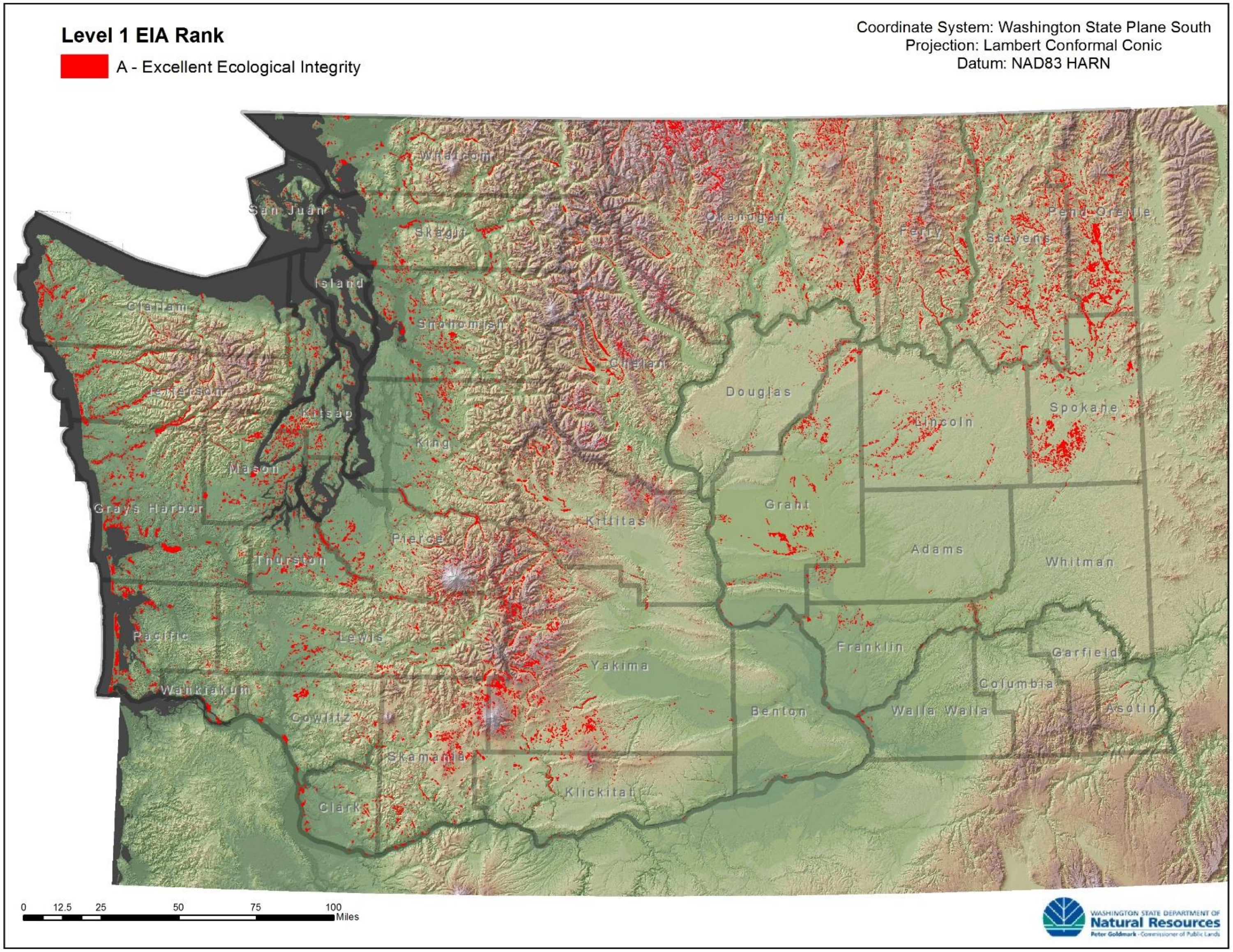

Figure 7. Predicted Locations of Wetlands with Excellent Ecological Integrity in Washington

The results of the Level 1 EIA do not mean these wetlands will qualify as WHCV, only that the integrity of the immediate and surrounding landscape is of sufficient quality to suggest onsite ecological conditions may have excellent ecological integrity (one criterion of a plant association-based Wetland of High Conservation Value). However, the analysis is coarse and based only on adjacent land cover/land use as represented in the Ecological Systems base map. The analysis did not attempt to model what wetland type (and its conservation status) a given NWI polygon may represent, which is another criterion used to determine plant association-based Wetland of High Conservation Value status (see Section 2.2). Despite these shortcomings, this analysis may prove useful in prioritizing future field surveys toward those sites more likely to meet WHCV criteria.

The Level 1 rank also provides coarse information about the overall range of ecological conditions of NWI-mapped wetlands in a particular landscape. As such, the Level 1 EIA ranks can be used for a variety of landscape or watershed-scale analyses including creating watershed wetland profiles (Johnson 2005), designing watershed wetland ambient monitoring protocols (Lemly et al. 2011), guiding site-level field surveys (Rocchio and Crawford 2009; Faber-Langendoen et al. 2012a), and identifying a potential reference network of wetlands (Faber-Langendoen et al. 2012a).

3.6 FQA Results

A detailed description of the approach used to assign coefficients of conservatism for this project is found in Rocchio and Crawford (2013). Below is a brief summary of results from that effort.

The total number of species occurring in western Washington, as recorded in the FQA database, is 2,721, of which 74% are native species (Table 12). Of the 2,025 native species in the flora, 1,523 (75%) were assigned C values by the Panel (Table 12). The Panel was not able to assign C values to 502 native species (25% of native species) due to lack of familiarity with those species. The 696 non-native species, which did not receive a C value assignment (they default to 0 in any conservatism-based index which includes non-native species), comprise 26% of the flora. The C value assignments are stored in the Western Washington Floristic Quality Assessment Database and Calculator, which can be downloaded from WNHP's website.

Table 12. Results of C value Assignments for Western Washington

Total Species in Database (native + non-native)	**2,721**
Total native species	2,025 (74%)
Total non-native species	696 (26%)
Native Species Assigned C values	**1,523 (75%)**
Species with assigned C value range ≤ 3	1,008 (66%)
Species with assigned C value range ≥ 4	515 (34%)
Native Species Not Assigned C value	**502 (25%)**

The total number of species occurring in eastern Washington, as recorded in the FQA database, is 3,445, of which 81% are native species (Table 13). Of the 2,794 native species in the flora, 2,085 (75%) were assigned C values by the Panel (Table 13). The Panel was not able to assign C values to 709 native species (25% of native species) due to lack of familiarity with those species. The 651 non-native species, which do not receive a C value assignment (they default to 0 in any conservatism-based index which includes non-native species), comprise 19% of the flora. The C value assignments are stored in the Eastern Washington Floristic Quality Assessment Database and Calculators, which can be downloaded from WNHP's website.

Table 13. Results of C value Assignments for Eastern Washington

Total Species in Database (native + non-native)	**3,445**
Total native species	2,794 (81%)
Total non-native species	651 (19%)
Native Species Assigned C values	**2,085 (75%)**
Species with assigned C value range ≤ 3	1,449 (69%)
Species with assigned C value range ≥ 4	636 (31%)
Native Species Not Assigned C value	**709 (25%)**

Data collected for this project allowed a preliminary assessment of the range of Mean C values (average coefficient of conservatism for native species) across a range of human stressors (Figure 8). The correlation can vary between different wetland types, so it was assessed separately for various wetland types (Figure 8). The results shown in Figure 8 suggest more analysis and potentially calibration is needed to improve the performance of Mean C values as a predictor of wetland condition. There are a couple of factors that could be responsible for the noisy scatterplots, including: (1) varying scales of data collection between Mean C values (releve plots) and the human stressor index (site-based); (2) data points are not well distributed across the range of potential stressor impacts (i.e., the majority of data points are from sites with low overall stressor scores); and (3) classification factors may play a role (e.g., separating forested from herbaceous types, montane from lowland, etc. Although the results of Figure 8 are not encouraging, additional analysis, validation, and calibration (potentially revising C values of some species) is needed. WNHP has received many inquiries from tribal wetland & monitoring programs, consultants, and other natural resource agencies about using the FQA tool for wetland monitoring and assessment work. <u>As such, it is imperative that additional analysis, validation, and calibration of the FQA tool occurs to ensure it provides an effective approach for monitoring wetland conditions.</u>

3.7 EcoObs Database

With WNHP input, NatureServe made technical adjustments to the EcoObs database so that it can specifically house data collected as part of this project. EIA and stressor data collected for this project have been entered into EcoObs. The database accompanies this report (Appendix E).

3.8 Preliminary List of Reference Standard Wetlands

For the Phase 2 Final Report (Rocchio et al. 2014), a subset of element occurrences (EOs) from western Washington were selected as potential reference standard sites. In this report, a subset of the statewide list of EOs was not identified. Because additional field work to identify reference standard wetlands will occur during Phase 4, the decision was made to publish a complete draft list after that work has been completed. This will avoid any confusion that might arise should the list of reference standard wetlands change. Instead, the number of EOs currently documented for each association are identified in Appendix F as potential reference standard wetlands. Those associations with few or no EOs will be the focus of field work during Phase 4. In addition, the Phase 4 analysis will include the Subgroup level in the analysis. For example, four element

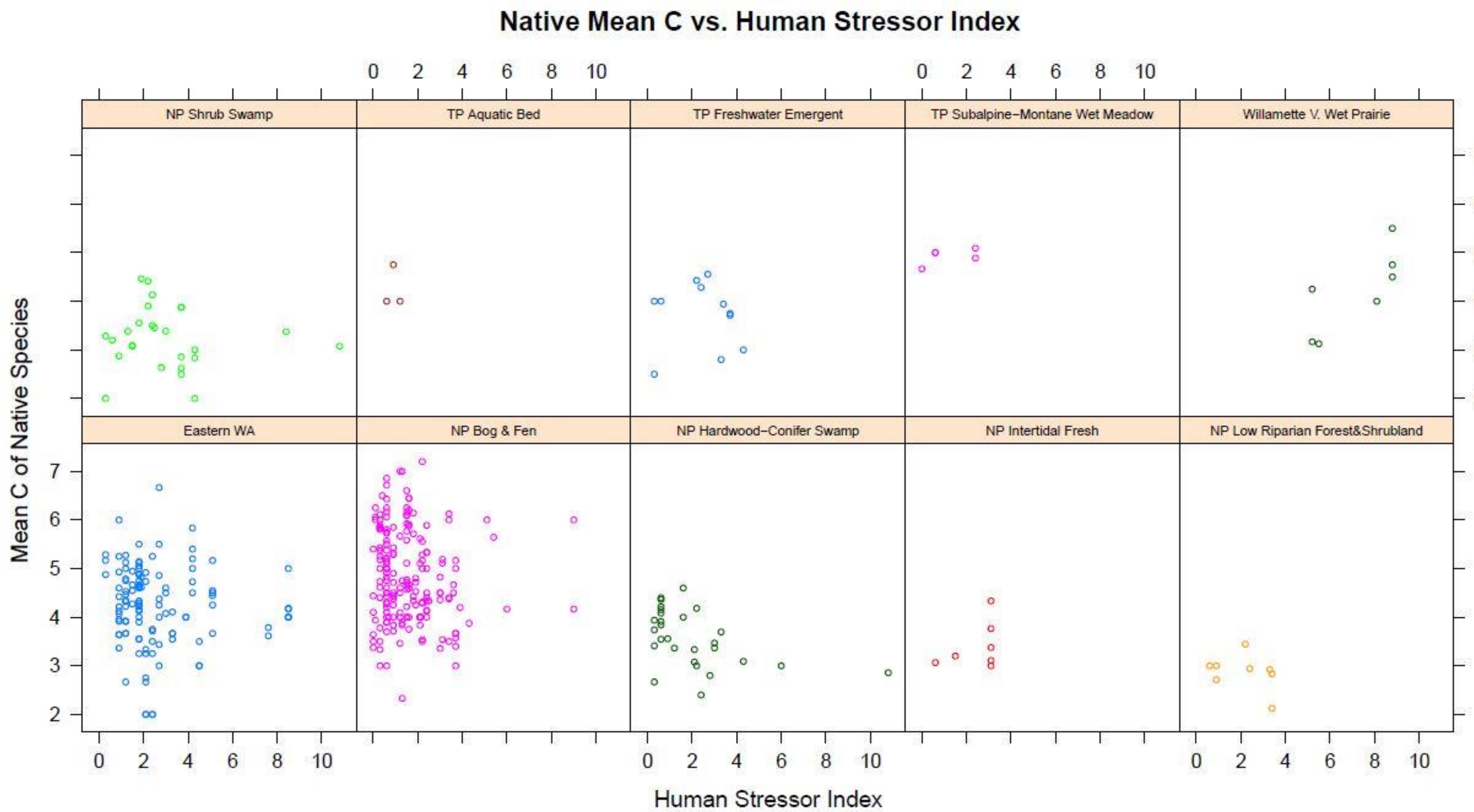

Figure 8. Correlation of Mean C vs. Human Stressors. Groupings are Ecological Systems (Comer et al. 2003).

occurrences of *Alnus incana* / *Carex utriculata* Shrubland have been documented in WNHP's information system. *Alnus incana* / *Carex utriculata* Shrubland occurs in four different Subgroups. Three of the four element occurrences occur in a single Subgroup. Thus, occurrences of *Alnus incana* / *Carex utriculata* Shrubland in the other Subgroups would be a target for field work during Phase 4.

Once Phase 4 work is completed, a tabular and spatial list of reference standard wetlands will be produced for the state. Figure 9 shows an example of the location of preliminary reference standard wetlands in the central Puget lowland area. In addition to a spatial dataset, such maps will be produced for the state as part of the Phase 4 report. In addition, any data about ecological characteristics and vegetation composition will be summarized for reference standard conditions of each wetland type.

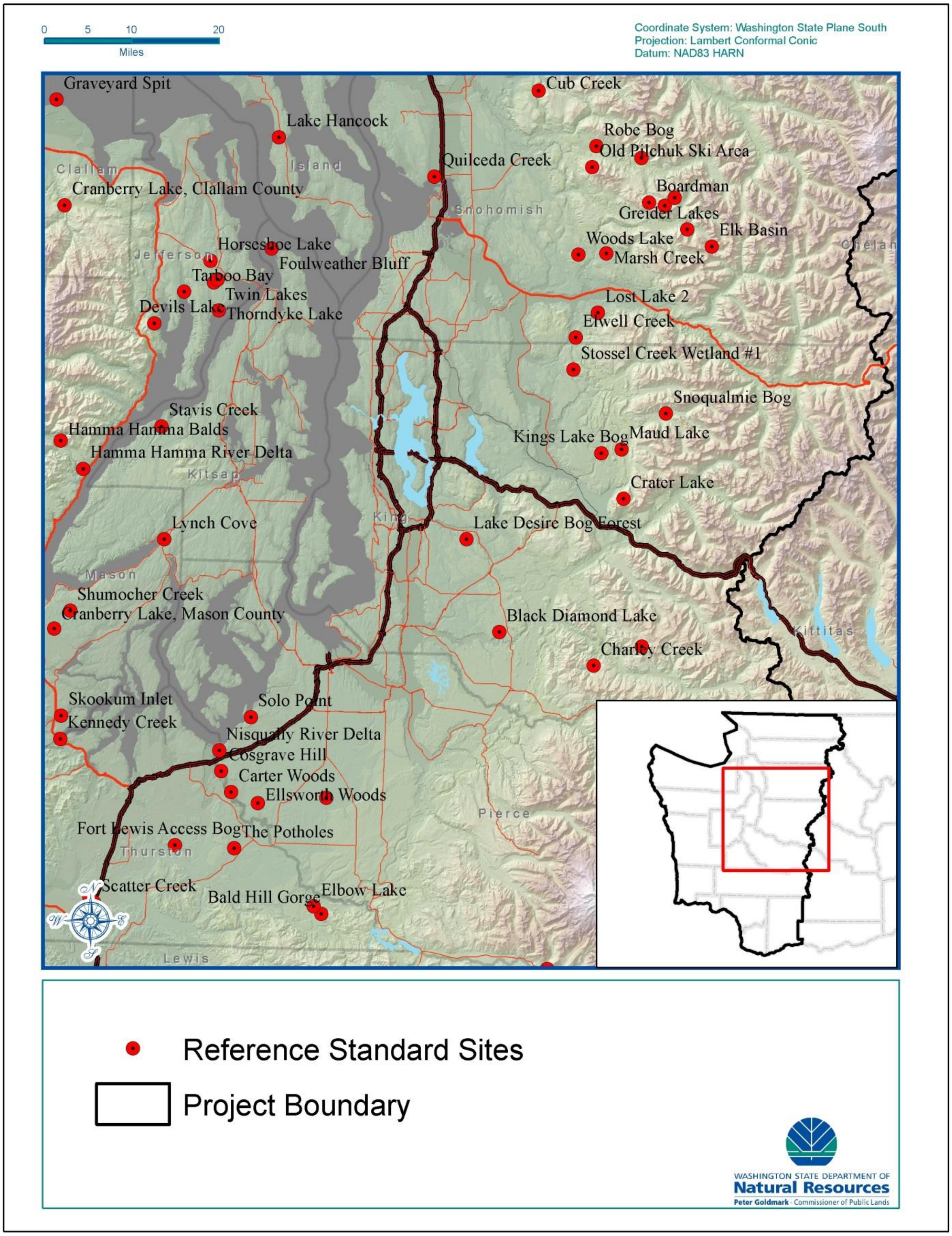

Figure 9. Potential Reference Standard Sites in the Central Puget Lowlands.

4.0 Summary

4.1 Contributions to Advancing Wetland Conservation

Documenting the specific locations of wetland conservation priorities (i.e. Wetlands of High Conservation Value) is one of the most important outcomes of this project, as they inform the application of the Washington Wetland Rating System. The presence of Wetlands of High Conservation Value qualifies a site as a Category 1 wetland, a status typically given the most stringent protection and buffer regulations by municipalities using the Rating System.

This project has also produced multiple products that contribute to wetland conservation in Washington. Incorporating a revised classification of wetland types within the U.S. National Vegetation Classification provides a systematic accounting of the ecological and vegetation diversity associated with Washington wetlands and riparian areas. The classification provides a means for tracking the distribution of ecological patterns across the landscape. A subsequent assessment of the conservation significance of each of the units associated with the classification and ongoing inventory for determining the location and ecological integrity of those wetlands has produced a dataset which can lead to more effective conservation actions, provide restoration benchmarks, and assist in regulatory decisions.

All of the information resulting from this project will assist WNHP in achieving its programmatic objectives of setting conservation priorities. This information is also used by many land trusts, conservation organizations and local, state, and federal agencies for conservation planning. This information will feed into the process of establishing Natural Heritage Plan priorities. Natural Heritage Plan priorities are a key component of evaluating sites for Washington Wildlife and Recreation Program (WWRP) funding. As such, information collected, analyzed, and synthesized for this project will influence where the State of Washington spends millions of dollars to voluntarily protect irreplaceable wetland habitat.

4.2 Limitations of Data

The information summarized in this report is based on data collected over a 30-year time frame and represents 1,112 plant association-based WHCV that span across the state (Figure 5). This is a substantial body of work, but data gaps persist.

WNHP has not visited every wetland in Washington, so additional sites that meet WHCV criteria may occur on the landscape. As seen in Figure 5, WHCVs are concentrated in western Washington. This is primarily an artifact of the disproportionate past inventory work performed in this region of the State. On the other hand, western Washington--especially the Puget lowlands, faces the greatest threats from development and other intensive land uses, so there is real urgency for conservation due in this area. The Columbia Basin has also undergone extensive land conversion and continues to experience numerous stressors. The reason for the paucity of WHCV in the Columbia Basin ecoregion is primarily due to a few factors: (1) wetlands are uncommon due to the dry climate; (2) the ecoregion has a long history of land conversion and grazing impacts; and (3) non-native species such as *Phalaris arundinaceae* dominate most freshwater wetlands in the ecoregion. Addressing gaps in knowledge of wetland types and conservation significance at higher elevations is recommended in order to fully understand the biodiversity values of Washington wetlands. This project provided abundant new insights into the types of wetland diversity in eastern Washington montane wetlands, but there is still more to discover in these high elevation areas. As part of the EPA-funded, Phase 4 grant, WNHP will produce online and field keys and descriptions of all the wetland and riparian types which occur in Washington State. In addition, some ecosystem types have received more inventory attention than others. Appendix F lists associations which currently have or lack element occurrences.

In the context of the Wetland Rating System, WNHP collaborated with Washington Department of Ecology to establish a protocol that will allow consultants and other ecologically trained individuals to propose sites to WNHP for consideration as a WHCV. WNHP will review submitted data and then work with those individuals to determine whether sites meet the WHCV criteria. This new process is described in the updated Wetland Rating System manuals accessible on Washington Department of Ecology's website. This process has the potential to increase the knowledge of wetland type distributions, conservation significance, and site priorities.

4.3 Outreach & Information Transfer

The products listed in Section 1.3 are available from WNHP's website (http://www1.dnr.wa.gov/nhp/refdesk/communities.html) or by contacting WNHP.

In addition, WNHP has presented various components of this project at numerous conferences since the project started in 2011. The presentation are listed below:

1. "Freshwater Wetland Conservation Priorities for Western Washington." Presented at Biodiversity Without Boundaries Conference. Portland, Oregon. April 26, 2012.

2. "Wetland Classification & Climate Change. Embracing Complexity to Face Uncertainty" Presented at the Pacific Northwest Wetlands Symposium. Seattle, Washington. November 8, 2012.

3. "Freshwater Wetland Conservation Priorities for Western Washington. Phase 1: Western Washington". Presented to U.S. EPA Region 10 staff. Seattle, Washington. March, 2012.

4. "Freshwater Wetland Conservation Priorities for Western Washington. Phase 1: Western Washington". Presented to Washington Department of Ecology staff. Olympia, Washingotn. June, 2012

5. "Wetland Reference Sites for Washington State. A U.S. National Vegetation Classification-based Approach". Presented at Biodiversity Without Boundaries Conference, Traverse City, Michigan. April 28, 2015

6. "Peatlands of Washington: Types, Distribuiton, and Conservation Values". Presented at Society of Wetland Scientists, Pacific Northwest Chapter Regional Conference. Olympia, Washington. October 6, 2015

7. "A Standardized Classification of Washington's Wetland & Riparian Vegetation Types". Presented at Society of Wetland Scientists, Pacific Northwest Chapter Regional Conference. Olympia, Washington. October 7, 2015

8. “Peatlands of Washington: Types, Distribuiton, and Conservation Values”. Presented at Washigton Dept. of Fish and Wildlife Lunchtime Seminar Series. Olympia, Washington. Februay 8, 2016.

9. “Peatlands of Washington State: Classification and Conservation Values.” Presented at Northwest Scientific Association, 87th Annual Meeting. Bend, Oregon. March 25, 2016.

WNHP ecologists are participating in a national workgroup moderated by NatureServe to develop a national wetland registry using Natural Heritage methods. This project is funded by an EPA Headquarters Wetland Program Development Grant awarded to NatureServe. Related to this effort, WNHP is currently working with Dr. Robert Brooks of Pennsylvania State University to submit a paper to the National Wetlands Newletter describing collaborative efforts to develop a national registry of wetland reference sites. WNHP’s role in the paper is to describe the program’s efforts in building a wetland reference standard network in Washington, efforts that are a direct result of this and other EPA-funded grants WNHP has received. WNHP will also seek to publish the classification results in a peer-reviewed publication.

5.0 Next Steps

This report summarizes work completed in fulfillment of our Phase 3 EPA Region 10 Wetland Program Development Grant (CD-00J64201). WNHP is currently working on Phase 4 of this multi-phased effort (CD-00J78501). Phase 4 is focused on completing a statewide reference standard wetland network, developing a publicly accessible web-based map viewer (to share locations of WHCV and reference standard wetlands), creating a web site with information about Washington's wetland biodiversity, and to develop and offer training for wetland professionals interested in learning how to apply the *Ecological Classification of Native Wetland & Riparian Vegetation of Washington* and Ecological Integrity Assessment method. Phase 4 is expected to be completed by December, 2016.

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Appendix A: Natural Heritage Methodology

Below is a summary of Natural Heritage Methodology, especially as it applies to the identification of Wetlands of High Conservation Value. The summary is primarily extracted from NatureServe's description of natural heritage methodology (NatureServe 2002; http://www.natureserve.org/prodServices/heritagemethodology.jsp). For additional details see those resources.

A.1 Natural Heritage Methodology

The Washington Natural Heritage Program employs Natural Heritage Methodology to implement its mandates established by the State Legislature. Natural Heritage Methodology unites the efforts of hundreds of individuals and dozens of institutions on two continents working to advance the knowledge needed to effectively conserve biodiversity. This is accomplished by using standard procedures for gathering, organizing and managing information on biodiversity. Over the past quarter-century, natural heritage methodology has evolved to keep pace with the growth in scientific knowledge and advances in information technologies. Natural heritage methodology provides a rigorous set of procedures for identifying, inventorying, and mapping species and ecosystems of conservation concern; for gathering related information on conservation sites and managed areas; and for setting conservation priorities.

Natural heritage methodology has several basic characteristics:

- It supports a decentralized database network that respects the principle of local custodianship of data.
- It supports the collection and management of data at multiple geographic scales, allowing decisions to be made based on detailed local information, yet within a global context.
- It encompasses both spatial and attribute data, but emphasizes the type of fine-scale mapping required to inform on-the-ground decisions.
- It includes multiple quality control and quality assurance steps to ensure that data products have the reliability needed to inform planning and regulatory actions.
- It incorporates explicit estimates of uncertainty and targets additional inventory work to reduce levels of uncertainty.
- It integrates multiple data types, including: species and ecological communities; collections and other forms of observational data; biological and non-biological data.

The basic units of Natural Heritage methodology are "elements" of biodiversity (e.g., species and ecosystem types). The Natural Heritage network has gathered and organized data on over 84,000 such elements, including animals, vascular and nonvascular plants, fungi, and terrestrial communities. Scientific names, local and global conservation status, basic biological and ecological characteristics, management requirements, and the location and condition of species populations and community occurrences are among the types of data collected. The information is housed in customized databases that employ sophisticated geographic information systems.

At the core of the methodology is the concept of the element occurrence, the spatial representation of a species or ecological community at a specific location. An element occurrence generally delineates a species population or ecological community patch, and represents the geo-referenced biological feature that is of conservation or management interest. In the context of this project, wetland element occurrences are referred to as Wetlands of High Conservation Value.

Natural Heritage Methodology addresses three essential conservation questions:

- What are the elements of biodiversity (i.e., classification)?
- Where do the various elements occur (e.g., inventory)?
- What needs to be done to protect the individual elements (e.g., conservation planning)?

To answer these questions, natural heritage programs carry out a series of repeated steps. Each time the steps are repeated, the data are refined to give a better picture of biodiversity and of problems and progress in its conservation. The basic steps are:

- Develop a list of the elements of biodiversity in a given jurisdiction, focusing on better-known species groups (e.g., vertebrate animals, vascular plants, butterflies, etc.), and on the ecological communities present. For this project, that list includes wetland ecosystem types and any rare plant that occurs in a wetland.
- Assess the relative risk of extinction of the elements to determine its biodiversity significance (e.g., conservation status rank) and set initial priorities for detailed inventory and protection.
- Gather information from all available sources for priority elements, focusing on known locations, possible locations, and ecological and management requirements.
- Conduct field inventories for these elements and collect data about their location, condition, and conservation needs.
- Process and manage all the data collected, using standard procedures that will allow compilation and comparison of data across federal, state, and local jurisdictional boundaries.
- Analyze the data with intent to refine previous conclusions about element rarity and risk, location, management needs, and other issues.
- Provide access to data and information products to interested parties so that it can be used to guide conservation, management planning, and other natural resource decision-making.

The following sections provide more detail about the components of Natural Heritage Methodology.

A.2 Elements of Biodiversity

Natural Heritage Methdology uses a “coarse filter / fine filter” approach to represent the different components of biodiversity in conservation planning. The coarse filter consists of all of the ecosystems (both terrestrial and aquatic) occurring within the state. The fine filter consists of rare species and rare ecosystems that may not be adequately protected via the coarse filter.

The basic assumption of this approach is that by ensuring the conservation of ecosystem types, the conservation of the common species that make up those types can be achieved in an efficient manner. Species and ecosystems that are rare or have very limited distributions warrant their own specific conservation efforts.

The success of this approach is dependent upon several factors, including having a well-developed classification of ecosystems, gaining protection for the full range of variability associated with each ecosystem type, and ensuring that the list of fine filter features includes all species and ecosystems that might not be 'captured' by applying the coarse filter. And of course, conservation efforts, if they are to be successful, must account for the various ecological processes that influence species and ecosystems.

A.2.1 Species

The Washington Natural Heritage Program primarily focuses on rare plant species. WNHP does have a zoologist on staff and maintains information on some animal species, but the Washington Department of Fish and Wildlife distributes most of the location information on Washington's animal species. As such, the following discussion is focused on rare plants.

Although all species are elements of biodiversity, for the purpose of setting fine-filter species conservation priorities, WNHP focuses only on rare species. Determining which of Washington's plant species are rare is based upon the accumulation of a large body of information about the distribution and abundance of individual species. Formal scientific study of our flora began with the earliest European explorers. Botanists continued to add to the body of knowledge by providing plant specimens to local, regional, and national herbaria. In the last few decades, more intensive field inventories have contributed to an even greater understanding of the Washington flora, providing the foundation for knowing which species are rare and which are common (Camp and Gamon 2011).

C. Leo Hitchcock, professor of botany and herbarium curator at the University of Washington, compiled one of the first lists of Washington's rare species. In 1974 the Smithsonian Institution organized a workshop to identify species to be considered under the newly enacted Endangered Species Act (Camp and Gamon 2011). Hitchcock's list and input from another University of Washington botany professor, Arthur Kruckeberg, resulted in 86 Washington plant species being included in *Endangered and Threatened Plants of the United States* (Ayensu and DeFilipps 1978). In 1977, Melinda Denton, another University of Washington botany professor, led a group of botanists in refining Hitchcock's list. This list resulted in a total of 280 species that became the first "working list of rare plants" used by the newly established Washington Natural Heritage Program (Camp and Gamon 2011).

WNHP continues to evaluate the conservation status of plant species and reviews the list of rare plants every two years. Additions, deletions, and changes in status reflect the dynamic nature of the landscape, human land-use practices, and increasing knowledge of the flora. Currently over 300 vascular plants, six mosses and one lichen species have been categorized as Endangered, Threatened, Sensitive, or Possibly Extinct/Extirpated.

A.2.2 Ecosystems

In order to assign conservation priorities to ecosystems, a standardized list of all ecosystem types needs to be developed. However, the term 'ecosystem' can characterize areas that vary in size from an individual stand of trees to large landscapes. In order to better understand the diversity of ecosystems, ecologists have developed various ecosystem classification systems. Classification results in a reasonably definitive list of ecosystem types, and a common language to refer to those types, which then allows the setting of priorities necessary for conservation planning.

The Natural Area Preserves Act (Section 79.70 R.C.W.) mandates the development and maintenance of a "classification of natural heritage resources" by WNHP. Since its establishment, WNHP has worked to develop the classification of ecosystem types by compiling and updating existing classifications of native ecosystems in the state. Where classifications did not exist, WNHP has worked to develop new ones.

The Natural Heritage Program uses several classification systems which vary somewhat according to specific ecosystem types or project objectives:

- **Marine and estuarine classification** - Developed by Dr. Megan Dethier in 1990, this classification defines marine ecosystems based on depth, substrate, wave energy and the plant and animal species associated with the combination of habitat variables.
- **Wetland natural community classification** - Developed by Linda Kunze over 20 years ago, this classification defines ecosystems based on geomorphic province, hydrology, water chemistry, soils and vegetation. Plant associations are components of the wetland natural community types. Natural Community types will be replaced by Subgroups associated with the *Ecological Classification of Native Wetladn & Riparian Vegetation of Washington*.
- **U.S. National Vegetation Classification** - Developed by NatureServe and its partners, including WNHP ecologists, this classification is a hierarchical system with physiognomic classes in the higher (coarser) levels and composition-based alliances and plant associations at the lowest (finest) levels (see Section 6.1.7). The USNVC is used to definite terrestrial ecosystem types, both upland and wetland (see Crawford et al. 2009 for an application of the USNVC).
- **Ecological Systems** – Developed by NatureServe (Comer et al. 2003), this classification reflects recurring groups of terrestrial plant communities that are found in similar climatic and physical environments and are influenced by similar dynamic ecological processes, such as fire or flooding. The classification facilitates mapping at meso-scales (1:24,000 – 1:100,000; Comer and Schulz 2007) and a comprehensive ecological systems map exists for Washington State (www.landscope.org or http://www.natureserve.org/getData/USecologyData.jsp). WNHP employs this classification for mapping, landscape-scale conservation planning, and as the basis for development of landscape- and site-scale ecological integrity assessments (see Section 4.2).
- **Ecological Classification of Native Wetland & Riparian Vegetation of Washington** – this is a new classification schemed described briefly in this document (see section 2.5.3 and 3.1). This classification uses the USNVC as the basis but establishes an additional unit in the hierarchy called the Subgroup (between Groups and Plant Associations). This unit is essentially a refinement of WNHP's current Natural Community types (see above).

A.3 Element Conservation Status Rank

The Conservation Status Rank, which is an integral part of Natural Heritage Methodology, indicates the conservation significance of an element and is used to assist in determining conservation priorities (NatureServe 2002; Master et al. 2012). The method used to assign a Conservation Status Rank facilitates a quick assessment of an element's rarity or risk of extinction. The conservation status of a species or ecosystem is designated by a number from 1 to 5, preceded by a letter reflecting the appropriate geographic scale of the assessment (G = Global and S = State or Subnational). The Global rank characterizes the relative rarity or endangerment of the element across its entire global range whereas the Subnational rank characterizes the relative rarity or endangerment within a subnational unit (in our case, the State of Washington.)

A G1 rank indicates critical imperilment on a global basis; the species (or ecosystem) is at great risk of extinction. S1 indicates critical imperilment within a particular state or province, regardless of its status elsewhere. Conversely, a G5 or S5 indicates that an element is demonstrably secure, widespread, and abundant throughout its global or state range.

Uncertainty in the Conservation Status Rank is expressed as a Range Rank. For example, G2G3 indicates a range of uncertainty such that there is a roughly equal chance of it being a G2 or G3 and that other ranks are less likely. A rank of GU or SU indicates that a rank is unable to be assigned due to a lack of information or due to conflicting information about status or trends. When the taxonomic distinctiveness of an element is questionable, it is given a modifier of "Q" in combination with a standard numerical G rank. For example G3Q, indicates that the element is considered globally vulnerable but that there is uncertainty about the taxonomic status of the element.

The ranks have the following meaning:

- **G1 or S1** = Critically imperiled throughout its global or state range because of extreme rarity or other factors making it especially vulnerable to extirpation. (Typically 5 or fewer occurrences or very few remaining individuals or acres)
- **G2** or **S2** = Imperiled throughout its global or state range because of rarity or other factors making it very vulnerable to extirpation from the state. (Typically 6 to 20 occurrences or few remaining individuals or acres)
- **G3 or S3** = Rare or uncommon throughout its global or state range. (Typically 21 to 100 occurrences)
- **G4 or S4** = Widespread, abundant, and apparently secure throughout its global or state range, with many occurrences, but the taxon is of long-term concern. (Usually more than 100 occurrences)
- **G5 or S5** = Demonstrably widespread, abundant, and secure throughout its global or state range; believed to be ineradicable under present conditions.
- **GU** or **SU =** Unrankable due to lack of information or due to substantially conflicting information about status or trends.
- **GH** or **SH** = Historical occurrences only are known, perhaps not verified in the past 20 years, but the taxon is suspected to still exist throughout its global or state range.
- **GNR** or **G?** or **SNR** or **S?** = Not yet ranked. Sufficient time and effort have not yet been devoted to ranking of this taxon.
- **GX or SX** = Believed to be extirpated throughout its global or state range with little likelihood that it will be rediscovered.

Global ranks are assigned through a collaborative process involving both NatureServe and individual Natural Heritage Program scientists. Subnational ranks are assigned by state or provincial scientists with the proviso that subnational rank cannot be rarer than indicated by the global rank. WNHP scientists have responsibility for assigning Washington's State ranks. A number of factors, such as the total range, the number of occurrences, severity of threats, and resilience contribute to the assignment of global and state ranks.

Natural Heritage scientists apply their field experience along with herbarium records, plot data, and published research to assign a G/S rank. Recently, NatureServe developed a Microsoft Excel-based calculator for systematically assigning Conservation Status Ranks (Faber-Langendoen et al. 2009a) which has improved repeatability and standardization of factors used to assign conservation status ranks.

A.3.1 Conservation Status of Rare Plants

WNHP utilizes the G/S ranks to inform a designation of Endangered, Threatened, or Sensitive status for plant species. In addition to G/S ranks, other factors are sometimes considered, including whether the species is suspected of being more widespread than the data indicate, whether the distribution pattern indicates more, or less, concern (e.g., local endemic vs. peripheral), whether there are significant demographic issues, and if habitat issues or concerns exist. Consideration of these other factors results in there being some overlap in these categories (Table 14). Such cases are determined by the judgment of WNHP's rare plant botanist with input from appropriate experts.

Any occurrence (e.g. population) of an Endangered, Threatened, or Sensitive plant within a wetland would trigger that site as a Wetland of High Conservation Value.

A.3.2 Conservation Status of Ecosystem Elements

The global and state ranks of the 618 plant associations are listed in Appendix A. Global ranks had been previously assigned to 361 (58%) of the 618 wetland plant associations occurring in Washington. This tally includes those with GU ranks. No global ranks were assigned for this project as that process involves Natural Heritage scientists from each of the States and/or Provinces in which the element occurs and is outside the scope of this project. State ranks had been previously assigned to 344 (56%) of the 618 wetland Plant Associations occurring in Washington. For this project, WNHP assigned state ranks to 82 (30%) of the 274 associations that were missing state ranks (no rank had ever been attempted to be assigned). That leaves 193 associations (31%) of the 618 total without a State Conservation Status Rank (i.e. current status is SNR). The distribution of Global and State Conservation Status Ranks for the 618 wetland plant associations in Washington are shown in Figure 3 and Figure 4

A.4 Element Occurrences

Actual locations of elements, whether they are single organisms, populations, or plant associations, are referred to as element occurrences (NatureServe 2002). The element occurrence is considered the most fundamental unit of conservation interest and is at the heart of Natural Heritage Methodology. Because one of the primary objectives of WNHP is to prioritize conservation actions, <u>only those element occurrences thought to be the most important for conservation are entered into WNHP's database</u>.

An element occurrence is represented spatially (either on maps or in a GIS) by a point (if specific spatial boundaries are unknown) or polygon. An element occurrence is sometimes represented by more than one polygon. Even though two or more polygons may be spatially distinct, if they are

Table 14. Determination of Endangered, Threatened, and Sensitive Status for Plant Species.

Global Conservation Status Rank	State Conservation Status Rank				
	S1	S2	S3	S4	S5
G1	G1S1	*	*	*	*
G2	G2S1	G2S2	*	*	*
G3	G3S1	G3S2	G3S3	*	*
G4	G4S1	G4S2	G4S3	G4S4	*
G5	G5S1	G5S2	G5S3	G5S4	G5S5

Endangered	**Wetland of High Conservation Value (if plant occurs in a wetland)**
Endangered, Threatened, Sensitive	
Threatened	
Threatened or Sensitive	
Sensitive	
Not of conservation concern	

considered to be ecologically or genetically connected they are considered part of the same element occurrence.

A.4.1 Rare Plant Element Occurrences

Known locations of any plant species considered to be Endangered, Threatened, or Sensitive are entered in WNHP's information system as an element occurrence as such information becomes available. The locations of rare plants are obtained from a variety of sources including herbarium records, private consultants, government agency scientists, citizen scientists, and field inventory by WNHP staff.

A.4.2 Ecosystem Element Occurrences

Ecosystem element occurrences are prioritized for inclusion in WNHP's information system based on a combination of the ecosystem element's G/S rank and the occurrence's ecological integrity rank (see Section 2.2). A decision matrix is used to determine whether a site-specific occurrence of a wetland plant association qualifies as an element occurrence and thus a "Wetland of High Conservation Value" (Table 15). Basically, all occurrences of rare wetland types, regardless of their condition, are considered element occurrences or Wetlands of High Conservation Value, while more common wetland types must be in good to excellent condition to receive consideration as element occurrences.

A.5 Element Occurrence Ranks (Ecological Integrity Assessment Rank)

To assist in prioritizing element occurrences of a given species or ecosystem for conservation, an element occurrence rank (EO rank) is assigned according to the ecological viability (species) or integrity (ecosystem) of the occurrence (NatureServe 2002). This element occurrence rank is intended to indicate which occurrences are most ecologically viable (i.e. ecologically intact), thus focusing conservation efforts where they will be most successful. Generally speaking, EO ranks consider the following factors:

Table 15. Decision Matrix to Determine Ecosystem Element Occurrences

Conservation Status Ranks		Ecological Integrity Assessment Rank			
Global Rank	State Rank	A Excellent integrity	B Good Integrity	C Fair integrity	D Poor integrity
G1/G2/GU	S1/S2				
G3/GU	S1/S2/S3				
G4/G5/GU	S1/S2				
G4/G5/GU	S3/S4/S5				
Red Shading = Element Occurrence/Wetland of High Conservation Value					

- **Size** – a measure of the area or abundance of the occurrence, relative to other known, and/or presumed viable, examples. Factors such as area of occupancy, population abundance, population density, population fluctuation, and minimum dynamic area (area needed to ensure survival or re-establishment after natural disturbance) are considered.
- **Condition/Quality** – an integrated measure of the composition, structure, and biotic interactions that characterize the occurrence. Includes factors such as reproduction, age structure, biological composition, structure, ecological processes, and biotic interactions.
- **Landscape Context** – an integrated measure of fragmentation, land use, and condition of the landscape surrounding and element occurrence to the extent that they may impact ecological processes or disturbance regimes and connectivity. Connectivity includes such factors as a species having access to habitats and resources needed for life cycle completion, fragmentation of ecological associations and systems, and the ability of the species to respond to environmental change through dispersal, migration, or re-colonization.

Each of these factors is rated on a scale of A through D, with an "A" rank representing excellent viability/integrity and a "D" rank representing poor viability/integrity. These ranks are then averaged to determine an overall EO Rank for the occurrence (also rated on the A-D scale). If not enough information is available to rank an element occurrence, an EO Rank of "E" is assigned.

Due to varying factors associated with species viability versus ecosystem integrity, different methodologies have been developed for assigning EO ranks to species and ecosystems.

A.5.1 Rare Plant Element Occurrence Rank

All occurrences of endangered, threatened and sensitive plant species are entered into the WNHP's database. As such, EO Ranks have not had widespread use in Washington for rare plant occurrences. Those occurrences which are extant are used in the process of identifying Wetlands of High Conservation Value.

A.5.2 Ecosystem Element Occurrence Rank (=Ecological Integrity Rank)

An ecosystem element occurrence is assigned an EO rank according to the integrity of the ecosystem's composition, structure, and ecological function relative to its natural range of variability. In the past, the method used to assign EO ranks was based on a guided, best professional judgment approach, where Natural Heritage ecologists applied their field experience along with data they collected or located in published research to assign the rank (NatureServe 2002). In 2004, NatureServe formed the Ecological Integrity Assessment Workgroup to develop a more transparent and standardized approach for assigning EO ranks, the Ecological Integrity Assessment (EIA).

The EIA is scaled both in terms of the scale of ecosystem type being assessed and the level of information required to conduct the assessment (Faber-Langendoen et al. 2006, 2008; Rocchio and Crawford 2011). WNHP has developed EIAs for nearly all Ecological Systems in Washington (WNHP 2010; http://www1.dnr.wa.gov/nhp/refdesk/communities/eia_list.html). The EIA was used for this project to determine ecological condition of sites visited during field work. The EIA is described in more detail in Section 4.

Appendix B: Ecological Classification of Native Wetland & Riparian Vegetation of Washington (December 2015 Version)

(Accompanying Microsoft Excel spreadsheet)

Appendix C: Level 1 EIA GIS Protocol Development

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To create an efficient way to calculate Level 1 EIA metrics, the Python programming language was employed to batch process GIS data. This document describes the methods used for this analysis but assumes an understanding of GIS analysis using ArcGIS and scripting language, which is used to loop through small subsets of the data.

Inputs:

1) 30m land cover Grid
2) Coefficient table for land cover types. In this case two parameters were used. One, a scale of 0 to 1 by tenths, represents fuzzy naturalness, and the other, a Boolean 0 or 1 representing non-natural or natural.
3) Wetland polygons (can be overlapping)

Software:

- ArcGIS 9.3.1 sp2
- Python 2.5
- PythonWin 2.5.216.0

Main steps for calculating community naturalness metrics:

- Convert land cover Grid to polygon and join in tables
- Tile community data if needed
- Create community buffers and community edges
- Intersect buffers and edges with the land cover
- Calculate area-weighted naturalness metrics
- Merge tabular data into one final table

Preprocess your land cover Grid in ArcGIS if needed. For instance, it may be necessary to tile the grid for processing, making sure to set the same registration coordinates. Convert the grid or the pieces of the grid to file geodatabase polygons without simplifying. Join up the original land cover tabular information back to the polygons and then join in the coefficient table. Merge all polygonized grid data back together to create one final land cover feature class.

Determine what buffer sized will be needed. In this case, when analyzing the US Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) polygons, the following buffers were used:

1. Wetland boundaries (edges of wetlands)
2. Wetland buffer rings (non-overlapping):
    a. Buffer: 0 to 50m from edge of wetland
    b. Core Landscape: 50 to 250m from edge of wetland

c. Supporting Landscape: 250 to 500m from edge of wetland

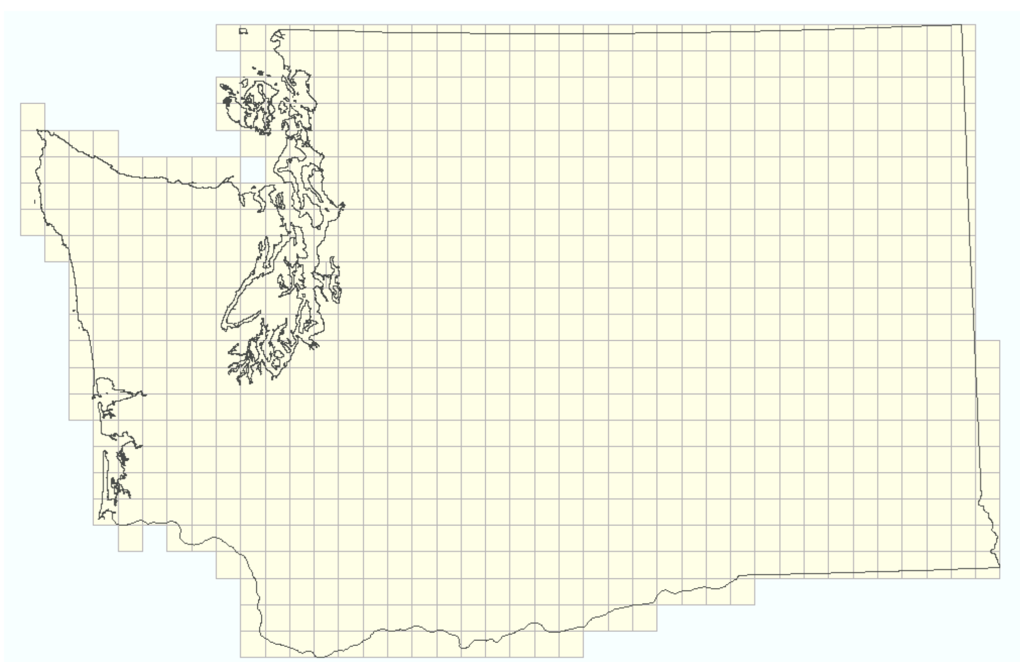
The NWI dataset was pared down using a definition query to analyzed only a subset of the data: "ATTRIBUTE LIKE 'P%RB%' OR ATTRIBUTE LIKE 'P%AB%' OR ATTRIBUTE LIKE 'P%US%' OR ATTRIBUTE LIKE 'P%ML%' OR ATTRIBUTE LIKE 'P%EM%' OR ATTRIBUTE LIKE 'P%SS%' OR ATTRIBUTE LIKE 'P%FO%' OR ATTRIBUTE LIKE 'L%AB%' OR ATTRIBUTE LIKE 'L%EM%' OR ATTRIBUTE LIKE 'R%AB%' OR ATTRIBUTE LIKE 'R%EM%'"

Each wetland and its edge and buffers are tracked by a unique ID which needed to be added to the wetland feature class. Calculate wetland edge lengths (perimeters) to hold the length of each wetland boundary.

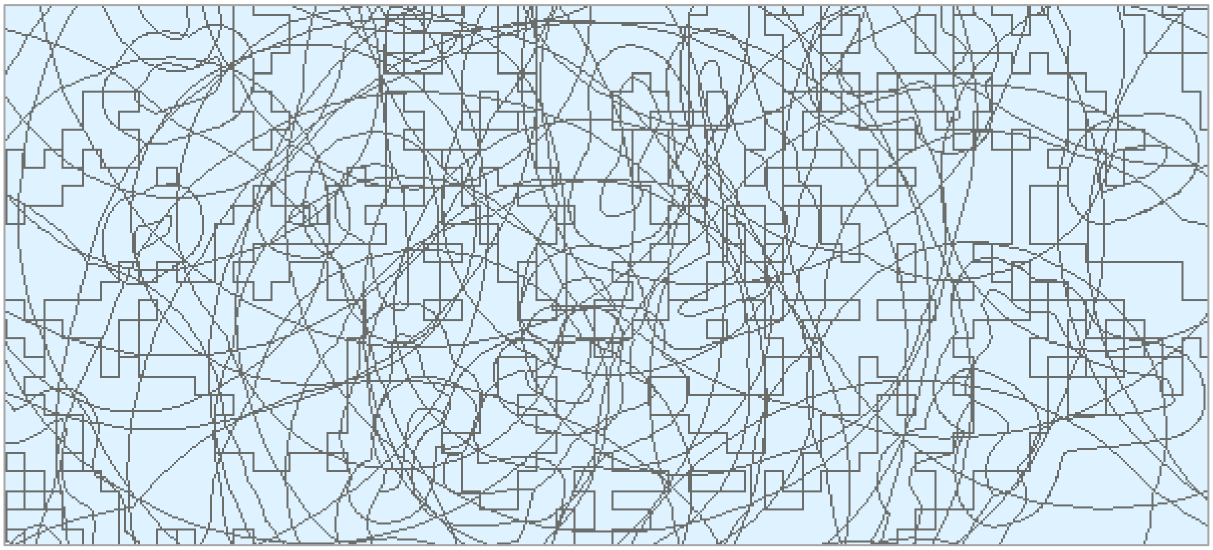
The NWI dataset is too large for ArcGIS to be able to analyze the whole thing at once. At this point, only the wetlands on the western half of the state have been analyzed. Beyond this, it is best to extract a small subset of the wetlands to loop through via a tiling scheme. After extracting a small subset of the wetlands, create the buffers. This is done by looping through each individual polygon, creating each buffer, and clipping out the overlapping part of the previous buffer to create individual, non-overlapping buffers. Alternatively, use the Multi-Ring Buffer tool. Buffers of different wetlands can certainly, and must, overlap. After creating all the buffers for one tile's worth of wetlands, calculate the area for each buffer area.

Note that the tiles don't need to be any particular shape or size. Use whatever works best for your data and computer.

Tiles for processing data



If your communities are close together, the geometry can become quite complex. The example shown below is at a 1:12,000 scale.



It is best to extract a tile's worth of the land cover feature class before doing the overlay with the buffers. To do this, you need to buffer the tile so that you get a tile's worth plus a little extra to account for buffered areas that end up outside the original tile polygon. Clip out the buffered tile's extent of the land cover.

Intersect the buffers with the land cover. If there are problems with the geometry, try running a Repair Geometry command and then possibly an Integrate. Then try the Intersect again.

Using the Feature to Line command, create the perimeters of the wetlands within the tile. Intersect this new line feature class with the tile's worth of land cover.

In both the intersected line and polygon layers, add fields to hold the final metrics. To calculate the area weighted metrics (see table below for weights), multiply your value by the area of the individual polygon and then divide that by the area of the whole buffer. Same thing goes for the perimeter; multiply the value by the individual segment and then divide that by the length of the entire perimeter.

Append each loop's output to a new feature class and keep looping through all of the tiles. If you calculate only a subset of the tiles and then would like to append all of the resulting tiles together, there was a separate script that will go into each geodatabase and append all of the tabular information together.

Please refer to the scripts for detailed information.

> ***Tip***: Setting a very small tolerance and resolution helps when dealing with small polygons. It takes longer to process, but there may be less cleanup in the end.

This general procedure could be used to analyze any sort of community or even point locations as long as you have a high resolution land cover Grid.

The following table shows which land cover types are considered natural/non-natural as well as the land use coefficients assigned to each land cover type (note: all natural types were assigned a "1" while non-native types were assigned a weight based on their perceived impact to ecological integrity (lower scores = assumed higher impact).

Ecological System Land Cover Unit	L.U. Coefficient	Natural / Non-Natural
Columbia Basin Foothill and Canyon Dry Grassland	1.0	1
Columbia Basin Foothill Riparian Woodland and Shrubland	1.0	1
Columbia Basin Palouse Prairie	1.0	1
Columbia Plateau Ash and Tuff Badland	1.0	1
Columbia Plateau Low Sagebrush Steppe	1.0	1
Columbia Plateau Scabland Shrubland	1.0	1
Columbia Plateau Steppe and Grassland	1.0	1
Columbia Plateau Vernal Pool	1.0	1
Columbia Plateau Western Juniper Woodland and Savanna	1.0	1
CRP	0.7	0
Cultivated Cropland	0.2	0
Developed, High Intensity	0.0	0
Developed, Low Intensity	0.1	0
Developed, Medium Intensity	0.0	0
Developed, Open Space	0.2	0
East Cascades Mesic Montane Mixed-Conifer Forest and Woodland	1.0	1
East Cascades Oak-Ponderosa Pine Forest and Woodland	1.0	1
Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland	1.0	1
Harvested forest-grass regeneration	0.4	1
Harvested forest-shrub regeneration	0.4	1
Harvested forest-tree regeneration	0.7	1
Inter-Mountain Basins Active and Stabilized Dune	1.0	1
Inter-Mountain Basins Alkaline Closed Depression	1.0	1
Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	1.0	1
Inter-Mountain Basins Big Sagebrush Shrubland	1.0	1
Inter-Mountain Basins Big Sagebrush Steppe	1.0	1
Inter-Mountain Basins Cliff and Canyon	1.0	1
Inter-Mountain Basins Greasewood Flat	1.0	1
Inter-Mountain Basins Mixed Salt Desert Scrub	1.0	1
Inter-Mountain Basins Montane Sagebrush Steppe	1.0	1
Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland	1.0	1

Ecological System Land Cover Unit	L.U. Coefficient	Natural / Non-Natural
Inter-Mountain Basins Playa	1.0	1
Inter-Mountain Basins Semi-Desert Grassland	1.0	1
Inter-Mountain Basins Semi-Desert Shrub-Steppe	1.0	1
Introduced Riparian and Wetland Vegetation	0.5	1
Introduced Upland Vegetation - Annual Grassland	0.5	1
Introduced Upland Vegetation - Forbland	0.5	1
Introduced Upland Vegetation - Perennial Grassland	0.5	1
Introduced Upland Vegetation - Shrub	0.5	1
Introduced Upland Vegetation - Treed	0.5	1
Middle Rocky Mountain Montane Douglas-fir Forest and Woodland	1.0	1
Non-specific Disturbed	0.5	1
North American Alpine Ice Field	1.0	1
North American Arid West Emergent Marsh	1.0	1
North Pacific Alpine and Subalpine Bedrock and Scree	1.0	1
North Pacific Alpine and Subalpine Dry Grassland	1.0	1
North Pacific Avalanche Chute Shrubland	1.0	1
North Pacific Bog and Fen	1.0	1
North Pacific Broadleaf Landslide Forest and Shrubland	1.0	1
North Pacific Coastal Cliff and Bluff	1.0	1
North Pacific Dry and Mesic Alpine Dwarf-Shrubland, Fell-field and Meadow	1.0	1
North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	1.0	1
North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest	1.0	1
North Pacific Hardwood-Conifer Swamp	1.0	1
North Pacific Herbaceous Bald and Bluff	1.0	1
North Pacific Hypermaritime Shrub and Herbaceous Headland	1.0	1
North Pacific Hypermaritime Sitka Spruce Forest	1.0	1
North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest	1.0	1
North Pacific Intertidal Wetland	1.0	1
North Pacific Lowland Mixed Hardwood Conifer Forest and Woodland	1.0	1
North Pacific Lowland Riparian Forest and Shrubland	1.0	1
North Pacific Maritime Coastal Sand Dune and Strand	1.0	1
North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	1.0	1
North Pacific Maritime Eelgrass Bed	1.0	1
North Pacific Maritime Mesic Subalpine Parkland	1.0	1
North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	1.0	1
North Pacific Mesic Western Hemlock-Silver Fir Forest	1.0	1
North Pacific Montane Massive Bedrock, Cliff and Talus	1.0	1
North Pacific Montane Riparian Woodland and Shrubland	1.0	1

Ecological System Land Cover Unit	L.U. Coefficient	Natural / Non-Natural
North Pacific Montane Shrubland	1.0	1
North Pacific Mountain Hemlock Forest	1.0	1
North Pacific Oak Woodland	1.0	1
North Pacific Serpentine Barren	1.0	1
North Pacific Shrub Swamp	1.0	1
North Pacific Volcanic Rock and Cinder Land	1.0	1
North Pacific Wooded Volcanic Flowage	1.0	1
Northern Rocky Mountain Conifer Swamp	1.0	1
Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest	1.0	1
Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland	1.0	1
Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland	1.0	1
Northern Rocky Mountain Mesic Montane Mixed Conifer Forest	1.0	1
Northern Rocky Mountain Montane-Foothill Deciduous Shrubland	1.0	1
Northern Rocky Mountain Ponderosa Pine Woodland and Savanna	1.0	1
Northern Rocky Mountain Subalpine Deciduous Shrubland	1.0	1
Northern Rocky Mountain Subalpine Woodland and Parkland	1.0	1
Northern Rocky Mountain Subalpine-Upper Montane Grassland	1.0	1
Northern Rocky Mountain Western Larch Savanna	1.0	1
Open Water	1.0	1
Pasture/Hay	0.4	0
Quarries, Mines and Gravel Pits	0.0	0
Recently burned forest	0.5	1
Recently burned grassland	0.5	1
Recently burned shrubland	0.5	1
Rocky Mountain Alpine Bedrock and Scree	1.0	1
Rocky Mountain Alpine Fell-Field	1.0	1
Rocky Mountain Alpine Tundra/Fell-field/Dwarf-shrub Map Unit	1.0	1
Rocky Mountain Alpine-Montane Wet Meadow	1.0	1
Rocky Mountain Aspen Forest and Woodland	1.0	1
Rocky Mountain Cliff, Canyon and Massive Bedrock	1.0	1
Rocky Mountain Lodgepole Pine Forest	1.0	1
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland	1.0	1
Rocky Mountain Poor-Site Lodgepole Pine Forest	1.0	1
Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	1.0	1
Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	1.0	1
Rocky Mountain Subalpine-Montane Fen	1.0	1
Rocky Mountain Subalpine-Montane Mesic Meadow	1.0	1
Rocky Mountain Subalpine-Montane Riparian Shrubland	1.0	1

Ecological System Land Cover Unit	L.U. Coefficient	Natural / Non-Natural
Rocky Mountain Subalpine-Montane Riparian Woodland	1.0	1
Temperate Pacific Aquatic Bed	1.0	1
Temperate Pacific Emergent Marsh	1.0	1
Temperate Pacific Mudflat	1.0	1
Temperate Pacific Intertidal Mudflat	1.0	1
Temperate Pacific Subalpine-Montane Wet Meadow	1.0	1
Temperate Pacific Tidal Salt and Brackish Marsh	1.0	1
Unconsolidated Shore	1.0	1
Willamette Valley Upland Prairie and Savanna	1.0	1
Willamette Valley Wet Prairie	1.0	1

Appendix D: Field Forms

Ecological Integrity Assessment Form

Appendix E: EcoObs Database

(included as accompanying Microsoft Access file)

Appendix F: Potential Number of Wetland Reference Standard Sites for Washington

USNVC Element	Potential Wetland Reference Standard Sites
1 Forest & Woodland Class	
1.B Temperate & Boreal Forest & Woodland Subclass	
1.B.2 Cool Temperate Forest & Woodland Formation	
1.B.2.Nb Rocky Mountain Cool Temperate Forest Division	
Central Rocky Mountain Mesic Lower Montane Forest Macrogroup	
Central Rocky Mountain Inland Western Red-cedar - Western Hemlock Forest Group	
Thuja plicata / Aralia nudicaulis Forest	1
Thuja plicata / Asarum caudatum Forest	0
Thuja plicata / Clintonia uniflora Forest	1
Tsuga heterophylla / Aralia nudicaulis Forest	1
Tsuga heterophylla / Asarum caudatum Forest	0
Tsuga heterophylla / Clintonia uniflora Forest	7
Central Rocky Mountain Mesic Grand Fir - Douglas-fir Forest Group	
Abies grandis / Acer glabrum Forest	0
Abies grandis / Trautvetteria caroliniensis Forest	0
East Cascades Mesic Grand Fir - Douglas-fir Forest Group	
Abies grandis / Acer circinatum Forest	2
Abies grandis / Achlys triphylla Forest	1
Rocky Mountain Subalpine-High Montane Conifer Forest Macrogroup	
Rocky Mountain Subalpine Dry-Mesic Spruce - Fir Forest & Woodland Group	
Abies lasiocarpa / Paxistima myrsinites Woodland	0
Rocky Mountain Subalpine Moist Spruce - Fir Forest & Woodland Group	
Abies lasiocarpa / Cornus canadensis Forest	0

USNVC Element	Potential Wetland Reference Standard Sites
Abies lasiocarpa / Vaccinium membranaceum Forest	0
1.B.2.Nc Western North American Cool Temperate Woodland & Scrub Division	
Intermountain Singleleaf Pinyon - Utah Juniper - Western Juniper Woodland Macrogroup	
Columbia Plateau Western Juniper Woodland & Savanna Group	
Juniperus occidentalis / Artemisia tridentata / Pseudoroegneria spicata Wooded Herbaceous Vegetation	0
1.B.2.Nd Vancouverian Cool Temperate Forest Division	
Vancouverian Lowland & Montane Rainforest Macrogroup	
North Pacific Maritime Silver Fir - Western Hemlock Forest Group	
Abies amabilis / Menziesia ferruginea Forest	2
Abies amabilis / Rhododendron albiflorum Forest	2
Vancouverian Subalpine Forest Macrogroup	
North Pacific Mountain Hemlock - Silver Fir Forest & Tree Island Group	
Tsuga mertensiana - Abies amabilis / Phyllodoce empetriformis - Vaccinium deliciosum Woodland	11
Tsuga mertensiana - Abies amabilis / Vaccinium membranaceum - Vaccinium ovalifolium Forest	2
1.B.3 Temperate Flooded & Swamp Forest Formation	
1.B.3.Nc Rocky Mountain & Great Basin Montane Flooded & Swamp Forest Division	
Rocky Mountain & Great Basin Montane Riparian Forest Macrogroup	
Northern Rocky Mountain Lowland & Foothill Riparian Forest Group	
Acer macrophyllum / Holodiscus discolor Woodland	0
Alnus rhombifolia / Betula occidentalis Forest	0
Alnus rhombifolia / Celtis laevigata var. reticulata Forest	0
Alnus rhombifolia / Cornus sericea Forest	0
Alnus rhombifolia / Equisetum arvense Forest	0
Alnus rhombifolia / Philadelphus lewisii Forest	0
Juniperus occidentalis / Philadelphus lewisii - Salix lasiolepis Intermittently Flooded Woodland [Provisional]	0

USNVC Element	Potential Wetland Reference Standard Sites
Pinus ponderosa - Quercus garryana / Symphoricarpos albus Woodland	0
Pinus ponderosa / Camassia quamash Woodland	0
Pinus ponderosa / Crataegus douglasii Woodland	0
Pinus ponderosa / Lomatium nudicaule Woodland	0
Pinus ponderosa / Symphoricarpos albus Temporarily Flooded Woodland	2
Populus balsamifera (ssp. trichocarpa, ssp. balsamifera) / Symphoricarpos (albus, oreophilus, occidentalis) Forest	0
Populus balsamifera ssp. trichocarpa - Alnus rhombifolia Forest	0
Populus balsamifera ssp. trichocarpa - Betula occidentalis / Philadelphus lewisii Forest	0
Populus balsamifera ssp. trichocarpa / Acer glabrum Woodland	0
Populus balsamifera ssp. trichocarpa / Alnus incana - Cornus sericea Forest	0
Populus balsamifera ssp. trichocarpa / Alnus incana Forest	0
Populus balsamifera ssp. trichocarpa / Alnus rhombifolia Forest	0
Populus balsamifera ssp. trichocarpa / Cicuta douglasii Forest	1
Populus balsamifera ssp. trichocarpa / Cornus sericea Forest	0
Populus balsamifera ssp. trichocarpa / Crataegus douglasii Forest	0
Populus balsamifera ssp. trichocarpa / Equisetum hyemale Forest	0
Populus balsamifera ssp. trichocarpa / Juniperus scopulorum Forest	0
Populus balsamifera ssp. trichocarpa / Philadelphus lewisii Forest	0
Populus balsamifera ssp. trichocarpa / Salix exigua Forest	2
Populus balsamifera ssp. trichocarpa / Salix lucida ssp. caudata Woodland	0
Pseudotsuga menziesii / Symphoricarpos albus Temporarily Flooded Woodland	0
Pseudotsuga menziesii / Trautvetteria caroliniensis Woodland	0
Quercus garryana / Corylus cornuta - Symphoricarpos albus Woodland	0
Quercus garryana / Elymus glaucus Woodland	2
Quercus garryana / Symphoricarpos albus Woodland	2
Salix amygdaloides / Salix exigua Woodland	2

USNVC Element	Potential Wetland Reference Standard Sites
Rocky Mountain & Great Basin Montane Riparian Forest Group	
Abies grandis - Thuja plicata / Alnus viridis ssp. sinuata / Achlys triphylla Forest	0
Abies grandis / Athyrium filix-femina Forest	0
Abies grandis / Gymnocarpium dryopteris Forest	0
Abies grandis / Symphoricarpos albus Riparian Forest	0
Abies lasiocarpa - Picea engelmannii / Oplopanax horridus Forest	0
Abies lasiocarpa - Picea engelmannii / Streptopus amplexifolius Forest	0
Abies lasiocarpa / Athryium filix-femina Woodland	0
Abies lasiocarpa / Gymnocarpium dryopteris Forest	0
Abies lasiocarpa / Ledum glandulosum Forest	1
Abies lasiocarpa / Rhododendron albiflorum / Luzula glabrata var. hitchcockii Forest	0
Abies lasiocarpa / Rhododendron albiflorum / Senecio triangularis Woodland	0
Abies lasiocarpa / Rubus lasiococcus Forest	0
Abies lasiocarpa / Senecio triangularis - Saxifraga odontoloma Forest	0
Abies lasiocarpa / Trautvetteria caroliniensis Forest	0
Abies lasiocarpa / Vaccinium caespitosum Forest	0
Larix lyallii / Cassiope mertensiana - Phyllodoce empetriformis Riparian Woodland	0
Picea engelmannii - (Abies lasiocarpa) / Trollius laxus Forest	0
Picea engelmannii - Abies lasiocarpa / Valeriana sitchensis Forest	0
Picea engelmannii - Thuja plicata / Vaccinium membranaceum Riparian Forest	0
Picea engelmannii / Alnus viridis ssp. sinuata Forest	0
Picea engelmannii / Aralia nudicaulis Forest	0
Picea engelmannii / Athyrium filix-femina Woodland	0
Picea engelmannii / Cornus canadensis Forest	0
Picea engelmannii / Cornus sericea Woodland	0
Picea engelmannii / Gymnocarpium dryopteris Forest [Provisional]	0

USNVC Element	Potential Wetland Reference Standard Sites
Populus tremuloides / Cornus sericea Forest	1
Populus tremuloides / Symphoricarpos albus Forest	2
Thuja plicata - (Abies grandis) / Acer circinatum Riparian Forest	0
Thuja plicata - (Tsuga heterophylla) / Oplopanax horridus Forest	3
Thuja plicata / Alnus incana Forest	0
Thuja plicata / Gymnocarpium dryopteris Forest	0
Thuja plicata / Paxistima myrsinites / Clintonia uniflora Forest	0
Tsuga heterophylla / Acer circinatum Riparian Forest	0
Tsuga heterophylla / Gymnocarpium dryopteris Forest	1
Rocky Mountain & Great Basin Swamp Forest Group	
Abies lasiocarpa - Picea engelmannii / Calamagrostis canadensis Forest	0
Betula papyrifera / Alnus incana Woodland	0
Betula papyrifera / Aralia nudicaulis Woodland	0
Betula papyrifera / Cornus canadensis Forest	0
Betula papyrifera / Cornus sericea Forest	0
Picea (engelmannii x glauca, engelmannii) / Carex disperma Forest	0
Picea engelmannii - Thuja plicata / Equisetum arvense Forest	3
Picea engelmannii - Tsuga heterophylla / Lysichiton americanus Forest	0
Picea engelmannii / Betula glandulosa / Tomentypnum nitens Woodland	0
Picea engelmannii / Carex interior Woodland	0
Picea engelmannii / Carex scopulorum var. prionophylla Woodland	1
Picea engelmannii / Equisetum arvense Forest	4
Pinus contorta / Betula glandulosa / Carex utriculata Woodland	0
Pinus contorta / Calamagrostis canadensis Forest	0
Pinus contorta / Spiraea douglasii Forest	0
Populus tremuloides / Calamagrostis canadensis Forest	0

USNVC Element	Potential Wetland Reference Standard Sites
Populus tremuloides / Carex pellita Forest	0
Thuja plicata / Athyrium filix-femina Forest	1
1.B.3.Nd Inland Lowland West Flooded & Swamp Forest Division	
Interior West Ruderal Flooded & Swamp Forest Macrogroup	
Inland West Ruderal Riparian Forest & Scrub Group	
Acer negundo Ruderal Woodland	0
Salix alba Ruderal Riparian Forest	0
Tamarix spp. Temporarily Flooded Ruderal Shrubland	0
Elaeagnus angustifolia Ruderal Woodland	0
1.B.3.Ng Vancouverian Flooded & Swamp Forest Division	
Vancouverian Flooded & Swamp Forest Macrogroup	
North Pacific Lowland Riparian Forest & Woodland Group	
Acer macrophyllum / Oxalis oregana Forest	0
Acer macrophyllum / Polystichum munitum - Tolmiea menziesii Forest	0
Acer macrophyllum / Rubus spectabilis Forest	2
Acer macrophyllum / Rubus ursinus Forest	0
Acer macrophyllum / Symphoricarpos albus / Urtica dioica ssp. gracilis Forest	0
Acer macrophyllum / Urtica dioica ssp. gracilis Forest	0
Alnus rubra / Acer circinatum / Claytonia sibirica Forest	0
Alnus rubra / Acer circinatum Forest	0
Alnus rubra / Achlys triphylla Forest	0
Alnus rubra / Alnus viridis ssp. sinuata Forest	0
Alnus rubra / Elymus glaucus Forest	0
Alnus rubra / Oplopanax horridus - Rubus spectabilis Forest	0
Alnus rubra / Oplopanax horridus / Athyrium filix-femina Forest	0
Alnus rubra / Oxalis (oregana, trilliifolia) Forest	0

USNVC Element	Potential Wetland Reference Standard Sites
Alnus rubra / Rubus parviflorus Forest	0
Alnus rubra / Rubus spectabilis Forest	9
Alnus rubra / Stachys chamissonis var. cooleyae - Tolmiea menziesii Forest	0
Fraxinus latifolia - (Populus balsamifera ssp. trichocarpa) / Cornus sericea Forest	2
Fraxinus latifolia - Populus balsamifera ssp. trichocarpa / Acer circinatum Forest	0
Fraxinus latifolia - Populus balsamifera ssp. trichocarpa / Carex deweyana - Urtica dioica ssp. gracilis Forest	1
Fraxinus latifolia - Populus balsamifera ssp. trichocarpa / Corylus cornuta - Physocarpus capitatus Forest	0
Fraxinus latifolia - Populus balsamifera ssp. trichocarpa / Rubus spectabilis Forest	0
Fraxinus latifolia - Populus balsamifera ssp. trichocarpa / Symphoricarpos albus Forest	0
Fraxinus latifolia / Symphoricarpos albus Forest	3
Populus balsamifera ssp. trichocarpa - Acer macrophyllum / Equisetum hyemale Forest	3
Populus balsamifera ssp. trichocarpa - Acer macrophyllum / Symphoricarpos albus Forest	3
Populus balsamifera ssp. trichocarpa - Alnus rubra / Carex obnupta Forest	0
Populus balsamifera ssp. trichocarpa - Alnus rubra / Rubus spectabilis Forest	5
Populus balsamifera ssp. trichocarpa - Alnus rubra / Symphoricarpos albus Forest	0
Populus balsamifera ssp. trichocarpa - Picea sitchensis - (Acer macrophyllum) / Oxalis oregana Forest	0
Populus balsamifera ssp. trichocarpa / Cornus sericea / Carex obnupta Forest	0
Populus balsamifera ssp. trichocarpa / Oplopanax horridus Woodland	0
Quercus garryana - (Fraxinus latifolia) / Symphoricarpos albus Forest	5
Salix lucida ssp. lasiandra / Salix fluviatilis Woodland	1
Salix lucida ssp. lasiandra / Urtica dioica ssp. gracilis Forest	0
North Pacific Maritime Hardwood-Conifer Swamp Group	
Abies amabilis / Gymnocarpum dryopteris Forest	0
Abies amabilis / Oplopanax horridus Forest	7
Alnus rubra / Athyrium filix-femina - Lysichiton americanus Forest	5
Alnus rubra / Glyceria striata Woodland	0

USNVC Element	Potential Wetland Reference Standard Sites
Alnus rubra / Rubus spectabilis / Carex obnupta - Lysichiton americanus Woodland	5
Alnus rubra / Rubus spectabilis / Chrysosplenium glechomifolium Forest	0
Fraxinus latifolia / Carex obnupta Forest	4
Fraxinus latifolia / Spiraea douglasii Forest	1
Picea sitchensis - (Alnus rubra) / Rubus spectabilis / Polystichum munitum Forest	0
Picea sitchensis - Alnus rubra / Lysichiton americanus - Chrysosplenium glechomifolium Forest	1
Picea sitchensis - Tsuga heterophylla - (Alnus rubra) / Oplopanax horridus / Polystichum munitum Forest	0
Picea sitchensis / Cornus sericea / Lysichiton americanus Forest	5
Picea sitchensis / Rubus spectabilis / Carex obnupta - Lysichiton americanus Forest	7
Pinus contorta var. contorta / Carex obnupta Forest	0
Populus balsamifera ssp. trichocarpa / Cornus sericea / Impatiens capensis Forest	1
Populus tremuloides / Carex obnupta Forest	0
Tsuga heterophylla - (Pseudotsuga menziesii - Thuja plicata) / Polystichum munitum - Athyrium filix-femina Forest	2
Tsuga heterophylla - (Thuja plicata - Alnus rubra) / Lysichiton americanus - Athyrium filix-femina Forest	18
Tsuga heterophylla - Abies amabilis / Vaccinium alaskaense / Lysichiton americanus Forest	1
Tsuga heterophylla - Pseudotsuga menziesii - (Thuja plicata) / Oplopanax horridus / Polystichum munitum Forest	8
Tsuga heterophylla - Thuja plicata / Gaultheria shallon / Lysichiton americanus Forest	14
Tsuga mertensiana - Abies amabilis / Caltha leptosepala ssp. howellii Forest	2
North Pacific Montane Riparian Woodland Group	
Abies amabilis - Picea engelmannii / Vaccinium membranaceum Forest	0
Abies amabilis - Tsuga heterophylla / Tiarella trifoliata var. unifoliata Forest	0
Abies amabilis / Acer circinatum Forest	0
Abies amabilis / Achlys triphylla Forest	1
Abies amabilis / Athyrium filix-femina Forest	0
Abies amabilis / Rubus spectabilis - Vaccinium alaskaense Forest [Provisional]	0

USNVC Element	Potential Wetland Reference Standard Sites
Abies lasiocarpa / Rubus spectabilis Forest [Provisional]	0
Alnus rubra / Alluvial Bar Forest	0
Alnus rubra / Athyrium filix-femina - Asarum caudatum Forest	0
Alnus rubra / Athyrium filix-femina Forest	0
Alnus rubra / Cornus sericea Forest	0
Alnus rubra / Petasites frigidus Forest	1
Alnus rubra / Physocarpus capitatus - Philadelphus lewisii Forest	0
Alnus rubra / Symphoricarpos albus Forest	0
Alnus rubra / Vaccinium ovalifolium / Trautvetteria caroliniensis Shrubland	0
Thuja plicata / Athyrium filix-femina - Stachys chamissonis var. cooleyae Forest	0
Thuja plicata / Rubus spectabilis / Oxalis oregana Forest	0
Tsuga mertensiana - Abies amabilis / Oplopanax horridus Forest	0
Vancouverian Ruderal Flooded & Swamp Forest (NEW) Macrogroup	
North Pacific Ruderal Riparian and Swamp Forest Group	
Alnus rubra / Carex obnupta Ruderal Flooded Forest	0
Alnus rubra / Non-native Grasses Ruderal Flooded Forest	0
Prunus emarginata Ruderal Flooded Forest	0
2 Shrubland & Herb Vegetation Class	
2.C Shrub & Herb Wetland Subclass	
2.C.2 Temperate to Polar Bog & Fen Formation	
2.C.2.Na North American Bog & Fen Division	
North American Boreal & Sub-Boreal Acidic Bog & Fen Macrogroup	
Rocky Mountain Acidic Fen Group	
Carex limosa / Sphagnum spp. Herbaceous Vegetation	0
Carex utriculata / Sphagnum spp. Herbaceous Vegetation	0

USNVC Element	Potential Wetland Reference Standard Sites
Salix pedicellaris / Rhynchospora alba / Sphagnum Dwarf-shrubland	0
North American Boreal & Sub-Boreal Alkaline Fen Macrogroup	
Rocky Mountain Neutral - Alkaline Fen Group	
Betula glandulosa / Calamagrostis canadensis Shrubland	0
Betula glandulosa / Carex lasiocarpa Shrubland	1
Betula glandulosa / Carex utriculata Shrubland	0
Carex aquatilis var. aquatilis Herbaceous Fen Vegetation	0
Carex buxbaumii Herbaceous Vegetation	0
Carex canescens Herbaceous Vegetation	0
Carex cusickii Herbaceous Vegetation	2
Carex diandra / Hamatocaulis vernicosus Herbaceous Fen Vegetation	0
Carex interior - Carex hystricina Herbaceous Seep Vegetation	0
Carex lasiocarpa Herbaceous Vegetation	4
Carex limosa Herbaceous Vegetation	2
Carex luzulina Rocky Mountain Herbaceous Vegetation	0
Carex pellita - Carex simulata Herbaceous Vegetation	0
Carex rostrata Herbaceous Vegetation	0
Carex saxatilis Herbaceous Vegetation	0
Carex scopulorum var. prionophylla Herbaceous Vegetation	0
Carex simulata Herbaceous Vegetation	0
Carex utriculata Herbaceous Vegetation	6
Deschampsia caespitosa - (Ligusticum grayi) Herbaceous Vegetation	0
Deschampsia caespitosa - (Symphyotrichum spathulatum) Herbaceous Vegetation	0
Deschampsia caespitosa - Carex aquatilis var. aquatilis Herbaceous Vegetation	0
Deschampsia caespitosa Herbaceous Fen Vegetation	0
Eleocharis quinqueflora Herbaceous Vegetation	1

USNVC Element	Potential Wetland Reference Standard Sites
Eleocharis rostellata - Epipactis gigantea Herbaceous Seep Vegetation	0
Eleocharis rostellata Herbaceous Fen Vegetation	0
Eriophorum angustifolium ssp. angustifolium - Eleocharis quinqueflora / Sphagnum spp. Herbaceous Vegetation	2
Rhynchospora alba / Sphagnum spp. Rocky Mountain Herbaceous Vegetation [Provisional]	0
Salix (farriae, planifolia) / Carex utriculata Shrubland	0
Salix farriae / Eleocharis quinqueflora Saturated Shrubland	0
Salix planifolia / Carex scopulorum Shrubland	1
North Pacific Bog & Fen Macrogroup	
North Pacific Bog & Acidic Fen Group	
Carex (livida, utriculata) / Sphagnum spp. Herbaceous Vegetation	8
Carex cusickii - (Carex aquatilis var. dives) / Sphagnum spp. Herbaceous Vegetation	9
Carex exsiccata Poor Fen Herbaceous Vegetation [Provisional]	0
Carex lasiocarpa / (Sphagnum spp.) Herbaceous Vegetation [Provisional]	0
Carex luzulina Pacific Coast Herbaceous Vegetation	0
Carex utriculata - Carex aquatilis var. dives - Sanguisorba officinalis / Sphagnum spp. Herbaceous Vegetation	7
Dulichium arundinaceum Poor Fen Herbaceous Vegetation [Provisional]	0
Eriophorum angustifolium ssp. angustifolium / Sphagnum spp. Herbaceous Vegetation	2
Eriophorum chamissonis / Sphagnum spp. Herbaceous Vegetation	3
Juncus balticus - Comarum palustre / Sphagnum spp. Herbaceous Vegetation [Provisional]	5
Juncus supiniformis - (Carex livida, Rhynchospora alba) Herbaceous Vegetation	0
Kalmia microphylla - Ledum groenlandicum - Gaultheria shallon - Pteridium aquilinum / Sphagnum spp. Shrubland	0
Kalmia microphylla - Ledum groenlandicum / Carex utriculata / Sphagnum spp. Shrubland	1
Kalmia microphylla - Ledum groenlandicum / Xerophyllum tenax Shrubland	4
Kalmia microphylla - Vaccinium oxycoccos / Carex (livida, obnupta) / Sphagnum spp. Dwarf-shrubland	4
Kalmia microphylla - Vaccinium oxycoccos / Empetrum nigrum / Sphagnum spp. Dwarf-shrubland	2

USNVC Element	Potential Wetland Reference Standard Sites
Kalmia microphylla - Vaccinium oxycoccos / Sphagnum spp. Dwarf-shrubland	15
Kalmia microphylla / Carex spp. - Caltha leptosepala ssp. howellii / Sphagnum spp. Dwarf-shrubland	4
Ledum groenlandicum - Gaultheria shallon / Sphagnum spp. Shrubland	0
Ledum groenlandicum - Kalmia microphylla / Sphagnum spp. Shrubland	25
Ledum groenlandicum - Myrica gale / Sphagnum spp. Shrubland	7
Ledum groenlandicum / Carex utriculata / Sphagnum spp. Shrubland	6
Ledum groenlandicum / Typha latifolia / Sphagnum spp. Shrubland [Provisional]	1
Myrica gale - Spiraea douglasii / Sphagnum spp. Shrubland	0
Myrica gale / Carex (aquatilis var. dives, utriculata) Shrubland	8
Myrica gale / Sanguisorba officinalis / Sphagnum spp. Shrubland	8
Rhynchospora alba - (Vaccinium oxycoccos) / Sphagnum spp. Herbaceous Vegetation	20
Spiraea douglasii / Carex aquatilis var. dives Shrubland	10
Spiraea douglasii / Sphagnum spp. Shrubland	8
Vaccinium uliginosum / (Carex aquatilis var. dives) Dwarf-shrubland	4
North Pacific Maritime Wooded Bog & Poor Fen Group	
Pinus contorta var. contorta - Betula papyrifera / Ledum groenlandicum Woodland [Provisional]	0
Pinus contorta var. contorta - Thuja plicata / Alnus incana / Carex (aquatilis var. dives, echinata ssp. echinata) Woodland	1
Pinus contorta var. contorta - Thuja plicata / Myrica gale / Sphagnum spp. Woodland	5
Pinus contorta var. contorta - Tsuga heterophylla / Gaultheria shallon / Sphagnum spp. Woodland	4
Pinus contorta var. contorta / Ledum glandulosum / Sphagnum spp. Woodland	1
Pinus contorta var. contorta / Ledum groenlandicum / Sphagnum spp. Woodland	16
Pinus contorta var. contorta / Ledum groenlandicum / Xerophyllum tenax / Sphagnum spp. Woodland	1
Pinus monticola / Ledum groenlandicum / Sphagnum spp. Woodland	0
Thuja plicata - Tsuga heterophylla / Lysichiton americanus / Sphagnum spp. Woodland	7
Tsuga heterophylla - (Thuja plicata) / Ledum groenlandicum / Carex (obnupta, utriculata) / Sphagnum spp. Woodland	10

USNVC Element	Potential Wetland Reference Standard Sites
Tsuga heterophylla - (Thuja plicata) / Ledum groenlandicum / Sphagnum spp. Woodland	20
Tsuga heterophylla - (Thuja plicata) / Sphagnum spp. Forest	3
North Pacific Neutral - Alkaline Fen Group	
Betula glandulosa / Carex aquatilis var. dives Shrubland	1
Carex (aquatilis var. dives, nigricans, utriculata) - Caltha leptosepala ssp. howellii Herbaceous Vegetation [Provisional]	10
Carex aquatilis var. dives - (Eleocharis quinqueflora) Herbaceous Vegetation	3
Carex aquatilis var. dives - Carex utriculata Herbaceous Vegetation	12
Carex aquatilis var. dives Herbaceous Vegetation	16
Carex cusickii - (Menyanthes trifoliata) Herbaceous Vegetation	7
Carex interior - Hypericum anagalloides Herbaceous Vegetation	1
Carex obnupta - (Carex cusickii) Herbaceous Vegetation	4
Carex scopulorum - Eleocharis quinqueflora Herbaceous Vegetation [Provisional]	0
Carex utriculata Pacific Coast Herbaceous Vegetation	6
Dulichium arundinaceum Rich Fen Herbaceous Vegetation [Provisional]	0
Equisetum arvense Fen Herbaceous Vegetation [Provisional]	0
Eriophorum chamissonis - Carex interior Herbaceous Vegetation	2
Juncus balticus - Festuca rubra - Carex cusickii Herbaceous Vegetation [Provisional]	5
Ledum groenlandicum / Carex (cusickii, interior, utriculata) - Festuca rubra Shrubland [Provisional]	4
Ledum groenlandicum / Carex cusickii Shrubland [Provisional]	1
Spiraea douglasii / Carex obnupta Shrubland [Provisional]	1
Trichophorum caespitosum - (Hypericum anagalloides) Herbaceous Vegetation	1
Vaccinium uliginosum / Dodecatheon jeffreyi - Caltha leptosepala ssp. howellii Dwarf-shrubland	0
2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland Formation	
2.C.4.Nb Western North American Freshwater Shrubland, Wet Meadow & Marsh Division	
Arid West Inland Freshwater Emergent Marsh Macrogroup	

USNVC Element	Potential Wetland Reference Standard Sites
Arid West Inland Freshwater Emergent Marsh Group	
Apocynum cannabinum - Artemisia (lindleyana, ludoviciana) Herbaceous Vegetation	0
Artemisia ludoviciana Herbaceous Vegetation	0
Bolboschoenus fluviatilis Western Herbaceous Vegetation	0
Carex atherodes Western Herbaceous Vegetation	0
Carex nebrascensis - Argentina anserina Herbaceous Vegetation	0
Carex pellita - Argentina anserina Herbaceous Vegetation	0
Carex pellita - Eleocharis palustris Herbaceous Vegetation	0
Carex praegracilis Herbaceous Vegetation	0
Carex utriculata - Mimulus guttatus Herbaceous Vegetation [Provisional]	0
Deschampsia caespitosa - Juncus balticus Herbaceous Vegetation	0
Eleocharis palustris Arid Marsh Herbaceous Vegetation	0
Equisetum arvense - Juncus balticus Herbaceous Vegetation	0
Hordeum brachyantherum Herbaceous Vegetation	0
Juncus balticus - Argentina anserina Herbaceous Vegetation	0
Lomatium grayi Herbaceous Vegetation	0
Phragmites australis Western North America Temperate Native Herbaceous Vegetation	0
Schoenoplectus acutus Herbaceous Vegetation	8
Schoenoplectus americanus Western Herbaceous Vegetation	0
Schoenoplectus maritimus Herbaceous Vegetation	0
Schoenoplectus tabernaemontani Temperate Herbaceous Vegetation	2
Scirpus microcarpus Herbaceous Vegetation	1
Spartina pectinata Western Herbaceous Vegetation	0
Typha latifolia Western Herbaceous Vegetation	25
Vancouverian Lowland Wet Shrubland, Wet Meadow & Marsh Macrogroup	
Temperate Pacific Freshwater Wet Mudflat Group	

USNVC Element	Potential Wetland Reference Standard Sites
Eleocharis obtusa Herbaceous Vegetation [Provisional]	0
Eleocharis ovata - Ludwigia palustris Herbaceous Vegetation	0
Eragrostis hypnoides - Gnaphalium palustre Herbaceous Vegetation [Provisional]	0
Lilaeopsis occidentalis Herbaceous Vegetation [Provisional]	0
Vancouverian Freshwater Wet Meadow & Marsh Group	
Adiantum pedatum Pacific Coast Herbaceous Vegetation [Provisional]	0
Athyrium filix-femina Coastal Herbaceous Vegetation	3
Bidens cernua Herbaceous Vegetation [Provisional]	0
Bidens frondosa Herbaceous Vegetation	0
Caltha palustris - Lysichiton americanus Herbaceous Vegetation	0
Camassia quamash - Triteleia hyacinthina Herbaceous Vegetation	0
Camassia quamash Wet Prairie Herbaceous Vegetation	0
Carex aperta Herbaceous Vegetation	0
Carex aquatilis var. dives - Comarum palustre Herbaceous Vegetation	4
Carex densa - Deschampsia cespitosa Herbaceous Vegetation [Provisional]	0
Carex densa - Eleocharis palustris Herbaceous Vegetation [Provisional]	0
Carex deweyana ssp. leptopoda Herbaceous Vegetation [Provisional]	0
Carex exsiccata Herbaceous Vegetation	10
Carex feta Herbaceous Vegetation [Provisional]	0
Carex interrupta Herbaceous Vegetation	0
Carex lyngbyei Herbaceous Vegetation	22
Carex obnupta - (Carex aquatilis var. dives, utriculata) Herbaceous Vegetation	4
Carex obnupta - Argentina egedii ssp. egedii Herbaceous Vegetation	1
Carex obnupta Herbaceous Vegetation	1
Carex pachystachya Herbaceous Vegetation	0
Carex pellita Wet Prairie Herbaceous Vegetation	0

USNVC Element	Potential Wetland Reference Standard Sites
Carex unilateralis - Hordeum brachyantherum Herbaceous Vegetation	1
Deschampsia caespitosa - Artemisia lindleyana Herbaceous Vegetation	0
Deschampsia caespitosa - Danthonia californica Herbaceous Vegetation	4
Dulichium arundinaceum Herbaceous Vegetation	10
Eleocharis palustris - Carex unilateralis Herbaceous Vegetation	0
Eleocharis palustris Pacific Coast Herbaceous Vegetation	3
Equisetum fluviatile Pacific Coast Herbaceous Vegetation	3
Equisetum telmateia Herbaceous Vegetation	0
Euthamia occidentalis Herbaceous Vegetation	0
Glyceria striata Pacific Coast Herbaceous Vegetation	2
Hippuris vulgaris Herbaceous Vegetation	2
Isoetes nuttallii Herbaceous Vegetation	0
Juncus articulatus Herbaceous Vegetation	0
Juncus balticus Pacific Coast Herbaceous Vegetation	2
Juncus bufonius Herbaceous Vegetation	0
Juncus effusus var. brunneus Pacific Coast Herbaceous Vegetation	0
Juncus falcatus - Juncus (lesueurii, nevadensis) Herbaceous Vegetation	1
Ludwigia palustris - Polygonum hydropiperoides Herbaceous Vegetation	0
Mimulus guttatus - Bryum miniatum Herbaceous Vegetation	2
Mimulus guttatus Seep Herbaceous Vegetation [Provisional]	0
Oenanthe sarmentosa Herbaceous Vegetation	0
Paspalum distichum Herbaceous Vegetation	0
Petasites frigidus Herbaceous Vegetation	0
Ranunculus flammula - Juncus nevadensis - Carex lenticularis Herbaceous Vegetation	0
Rosa nutkana / Deschampsia cespitosa Shrubland [Provisional]	0
Schoenoplectus (acutus, tabernaemontani) Pacific Coast Herbaceous Vegetation	8
Scirpus atrocinctus Herbaceous Vegetation [Provisional]	0

USNVC Element	Potential Wetland Reference Standard Sites
Scirpus microcarpus Pacific Coast Herbaceous Vegetation	1
Stachys ciliata Herbaceous Vegetation	0
Triteleia hyacinthina Herbaceous Vegetation	0
Typha latifolia Pacific Coast Herbaceous Vegetation	25
Vancouverian Wet Shrubland Group	
(Rubus spectabilis) / Athyrium filix-femina Shrubland	0
Acer circinatum - Alnus incana Shrubland	0
Acer circinatum - Rubus parviflorus Shrubland	0
Acer circinatum / Athyrium filix-femina - Tolmiea menziesii Shrubland	0
Acer circinatum Shrubland	0
Alnus (incana, viridis ssp. sinuata) / Lysichiton americanus - Oenanthe sarmentosa Shrubland	2
Alnus incana / Carex (aquatilis, deweyana, lenticularis, luzulina, pellita) Shrubland	1
Alnus viridis ssp. sinuata / Acer circinatum Shrubland	5
Alnus viridis ssp. sinuata / Oplopanax horridus Shrubland	0
Alnus viridis ssp. sinuata / Rubus spectabilis / Athyrium filix-femina Shrubland	1
Cornus sericea - Salix (hookeriana, sitchensis) Shrubland	1
Cornus sericea - Salix spp. - Spiraea douglasii Shrubland	5
Cornus sericea Pacific Coast Shrubland [Provisional]	0
Cupressus nootkatensis / Oplopanax horridus - (Alnus viridis ssp. sinuata) Forest	0
Malus fusca - (Salix hookeriana) / Carex obnupta Shrubland	2
Malus fusca / Boykinia major / Carex obnupta Shrubland	0
Malus fusca Shrubland	13
Myrica gale / Boykinia intermedia - Carex obnupta Shrubland	2
Myrica gale / Boykinia intermedia - Deschampsia cespitosa Shrubland	1
Myrica gale / Lysichiton americanus Shrubland	3
Oplopanax horridus Interior Shrubland	0

USNVC Element	Potential Wetland Reference Standard Sites
Oplopanax horridus Pacific Coast Shrubland	0
Physocarpus capitatus Shrubland	0
Ribes bracteosum - Rubus spectabilis Shrubland	0
Ribes bracteosum / Athyrium filix-femina Shrubland	0
Ribes spectabilis - Ribes hudsonianum Shrubland	0
Rubus spectabilis Wet Shrubland	0
Salix (hookeriana, lucida ssp. lasiandra, sitchensis) Shrubland [Provisional]	7
Salix commutata Shrubland	0
Salix geyeriana - Salix hookeriana Shrubland	0
Salix hookeriana - (Salix sitchensis) Shrubland	0
Salix hookeriana - Spiraea douglasii Shrubland	1
Salix hookeriana / Carex obnupta - (Argentina egedii ssp. egedii) Shrubland	3
Salix sitchensis / Equisetum arvense - Petasites frigidus Shrubland	0
Salix sitchensis Shrubland	2
Salix spp. - Spiraea douglasii / Carex (aquatilis var. dives, obnupta, utriculata) Shrubland	12
Spiraea douglasii Inland Maritime Shrubland	0
Spiraea douglasii Shrubland	50
Western North American Montane-Subalpine Wet Shrubland & Wet Meadow Macrogroup	
Rocky Mountain & Great Basin Lowland & Foothill Riparian Shrubland Group	
(Populus tremuloides) / Crataegus douglasii / Heracleum maximum Shrubland	6
(Populus tremuloides) / Crataegus douglasii / Symphoricarpos albus Shrubland	4
Acer glabrum var. douglasii - (Symphoricarpos albus) Shrubland	0
Amelanchier alnifolia - Philadelphus lewisii / Pseudoroegneria spicata Shrubland	0
Amelanchier alnifolia / Toxicodendron rydbergii Shrubland	0
Betula occidentalis / Celtis laevigata var. reticulata Shrubland	0
Betula occidentalis / Cornus sericea Shrubland	1

USNVC Element	Potential Wetland Reference Standard Sites
Betula occidentalis / Crataegus douglasii Shrubland	0
Betula occidentalis / Equisetum arvense Shrubland (Provisional)	0
Betula occidentalis / Maianthemum stellatum Shrubland	0
Betula occidentalis / Philadelphus lewisii - Symphoricarpos albus Shrubland	0
Betula occidentalis / Philadelphus lewisii Shrubland	0
Betula occidentalis / Rosa woodsii Shrubland	0
Celtis laevigata var. reticulata / Philadelphus lewisii Woodland	0
Celtis laevigata var. reticulata / Toxicodendron rydbergii Woodland	0
Crataegus douglasii / Rosa woodsii Shrubland	2
Philadelphus lewisii / Clematis ligusticifolia Shrubland	0
Philadelphus lewisii / Symphoricarpos albus Shrubland	0
Philadelphus lewisii Intermittently Flooded Shrubland	3
Prunus virginiana Temporarily Flooded Shrubland	0
Rhamnus alnifolia Shrubland	0
Salix (melanopsis, sitchensis) Alluvial Bar Shrubland	0
Salix exigua / Barren Shrubland	0
Salix exigua / Equisetum arvense Shrubland	0
Salix exigua / Mesic Graminoids Shrubland	0
Salix exigua Temporarily Flooded Shrubland	0
Salix lasiolepis / Barren Ground Shrubland	0
Salix lucida ssp. caudata Shrubland [Provisional]	1
Salix lutea - Salix exigua Shrubland	0
Salix lutea / Cornus sericea Shrubland	0
Vancouverian & Rocky Mountain Montane Wet Meadow Group	
Adiantum pedatum Rocky Mountain Herbaceous Vegetation	0
Athyrium filix-femina - Gymnocarpum dryopteris Herbaceous Vegetation [Provisional]	0

USNVC Element	Potential Wetland Reference Standard Sites
Calamagrostis canadensis Western Herbaceous Vegetation	6
Camassia quamash Rocky Mountain Wet Meadow Herbaceous Vegetation	0
Carex amplifolia Herbaceous Vegetation	1
Carex aquatilis var. aquatilis Herbaceous Vegetation	1
Carex exsiccata Montane Herbaceous Vegetation [Provisional]	0
Carex lacustris Western Herbaceous Vegetation	0
Carex lenticularis Herbaceous vegetation	5
Carex nebrascensis - Carex pellita - Juncus balticus Herbaceous Vegetation	0
Carex nebrascensis Herbaceous Vegetation	0
Carex pellita Herbaceous Vegetation	1
Carex scopulorum var. bracteosa Herbaceous Vegetation	2 (check)
Carex utriculata Marsh Herbaceous Vegetation [Provisional]	0
Carex vesicaria Herbaceous Vegetation	0
Corydalis scouleri Herbaceous Vegetation	0
Danthonia californica - Senecio hydrophiloides Wet Meadow Herbaceous Vegetation	0
Danthonia intermedia Wet Meadow Herbaceous Vegetation	0
Deschampsia caespitosa - Carex nebrascensis Herbaceous Vegetation	0
Deschampsia caespitosa - Danthonia intermedia Rocky Mountain Wet Meadow Herbaceous Vegetation	0
Deschampsia caespitosa Herbaceous Vegetation	4
Eleocharis acicularis Herbaceous Vegetation	0
Eleocharis palustris Herbaceous Vegetation	3
Equisetum arvense Herbaceous Vegetation	0
Equisetum fluviatile Herbaceous Vegetation	3
Glyceria borealis Herbaceous Vegetation	0
Glyceria elata Herbaceous Vegetation	0
Glyceria grandis Herbaceous Vegetation	0
Glyceria striata Herbaceous Vegetation	2

USNVC Element	Potential Wetland Reference Standard Sites
Juncus balticus Herbaceous Vegetation	0
Lysichiton americanus Herbaceous Vegetation	1
Mimulus guttatus - (Mimulus spp.) Herbaceous Vegetation	0
Mimulus guttatus Herbaceous Vegetation	0
Saussurea americana - Heracleum maximum Herbaceous Vegetation	0
Torreyochloa pallida var. pauciflora Herbaceous Vegetation	0
Trautvetteria caroliniensis - (Senecio triangularis) Herbaceous Vegetation	0
Veronica americana Herbaceous Vegetation	0
Wyethia amplexicaulis Wet Meadow	0
Vancouverian & Rocky Mountain Subalpine & Alpine Snowbed, Wet Meadow & Dwarf-Shrubland Group	
Caltha leptosepala ssp. howellii Herbaceous Vegetation	8
Carex illota Herbaceous Vegetation	0
Carex nigricans - (Petasites frigidus var. frigidus) / Philonotis fontana Herbaceous Vegetation [Provisional]	0
Carex nigricans Herbaceous Vegetation	8
Carex spectabilis - Carex nigricans - (Potentilla flabellifolia) Herbaceous Vegetation	0
Cassiope mertensiana - Carex nigricans Alpine Wet Dwarf-shrubland	0
Kalmia microphylla / Carex nigricans Dwarf-shrubland	0
Lupinus latifolius Herbaceous Vegetation	0
Marchantia polymorpha - Philonotis fontana Bryophyte Vegetation	0
Mimulus lewisii Herbaceous Vegetation	0
Phyllodoce empetriformis / Vaccinium deliciosum / Carex nigricans Dwarf-shrubland	0
Polytrichum commune Bryophyte Vegetation	0
Saxifraga odontoloma - Senecio triangularis Herbaceous Vegetation	0
Senecio triangularis Herbaceous Vegetation	0
Western Montane-Subalpine Riparian & Seep Shrubland Group	
Alnus incana - Betula occidentalis Shrubland	0

USNVC Element	Potential Wetland Reference Standard Sites
Alnus incana - Ribes (inerme, hudsonianum, lacustre) Shrubland	0
Alnus incana / Alluvial Bar Shrubland	0
Alnus incana / Athryium filix-femina Shrubland	0
Alnus incana / Calamagrostis canadensis Shrubland	1
Alnus incana / Carex (bolanderi, infirminervia, leptopoda) Shrubland	0
Alnus incana / Carex amplifolia Shrubland	4
Alnus incana / Carex pellita Shrubland	0
Alnus incana / Carex scopulorum var. prionophylla Shrubland	0
Alnus incana / Carex utriculata Shrubland	4
Alnus incana / Cornus sericea Shrubland	0
Alnus incana / Equisetum arvense Shrubland	0
Alnus incana / Glyceria striata Shrubland	0
Alnus incana / Gymnocarpium dryopteris Shrubland	0
Alnus incana / Lysichiton americanus Shrubland	1
Alnus incana / Mesic Forbs Shrubland	0
Alnus incana / Salix lutea Shrubland	0
Alnus incana / Scirpus microcarpus Shrubland	0
Alnus incana / Senecio triangularis Shrubland	0
Alnus incana / Spiraea douglasii Shrubland	0
Alnus incana / Symphoricarpos albus Shrubland	0
Alnus viridis ssp. sinuata - Cornus sericea Shrubland	0
Alnus viridis ssp. sinuata - Ribes lacustre Shrubland	0
Alnus viridis ssp. sinuata / Alluvial Bar Shrubland	0
Alnus viridis ssp. sinuata / Athyrium filix-femina - Cinna latifolia Shrubland	0
Alnus viridis ssp. sinuata / Mesic Forbs Shrubland	0
Alnus viridis ssp. sinuata Shrubland [Placeholder]	8
Cornus sericea / Athyrium filix-femina Shrubland	1

USNVC Element	Potential Wetland Reference Standard Sites
Cornus sericea / Equisetum arvense Shrubland	0
Cornus sericea / Heracleum maximum Shrubland	0
Cornus sericea / Saxifraga ondotoloma Shrubland	1
Cornus sericea / Symphoricarpos albus Shrubland	0
Cornus sericea Rocky Mountain Shrubland	1
Crataegus douglasii / Spiraea douglasii Shrubland	0
Dasiphora fruticosa ssp. floribunda / Deschampsia caespitosa Shrubland	0
Rhododendron albiflorum Shrubland [Provisional]	0
Ribes lacustre / Cinna latifolia Shrubland	0
Salix (boothii, geyeriana) / Carex aquatilis Shrubland	0
Salix bebbiana / Mesic Graminoids Shrubland	0
Salix boothii / Mesic Forbs Shrubland	0
Salix commutata / Carex scopulorum Shrubland	0
Salix commutata / Senecio triangularis Shrubland	0
Salix drummondiana / Calamagrostis canadensis Shrubland	1
Salix drummondiana / Carex scopulorum var. prionophylla Shrubland	1
Salix drummondiana / Carex utriculata Shrubland	1
Salix scouleriana / Elymus glaucus Shrubland	0
Salix scouleriana / Paxistima myrsinites Shrubland	0
Salix sitchensis - (Alnus incana) / Angelica arguta Shrubland	0
Salix sitchensis / Glyceria elata Shrubland	0
Spiraea douglasii - (Salix sitchensis, drummondiana) Shrubland	0
Spiraea douglasii / Calamagrostis canadensis Shrubland	0
Vaccinium caespitosum - (Salix farriae) / Danthonia intermedia Dwarf-shrubland	0
Western North American Ruderal Wet Shrubland, Meadow & Marsh Macrogroup	
Western North American Ruderal Wet Shrubland, Meadow & Marsh Group	

USNVC Element	Potential Wetland Reference Standard Sites
Agrostis (gigantea, stolonifera) Ruderal Herbaceous Vegetation	0
Alnus incana / Phalaris arundinacea Ruderal Shrubland	0
Alopecurus geniculatus Ruderal Wet Meadow	0
Amorpha fruticosa Shrubland	0
Carex leporina Ruderal Wet Meadow Herbaceous Vegetation	0
Crataegus monogyna / Mixed Forbs & Graminoids Ruderal Wet Shrubland	0
Elymus repens Ruderal Herbacoues Vegetation	0
Equisteum arvense - Mixed Graminoid Ruderal Wet Meadow Herbaceous Vegetation	0
Juncus gerrardii var. gerardii Ruderal Brackish Wet Meadow	0
Leymus cinereus - Bromus tectorum Ruderal Wet Meadow	0
Nasturtium officinale Herbaceous Vegetation	0
Phalaris arundinacea Western Herbaceous Ruderal Vegetation	0
Phragmites australis Western North America Temperate Ruderal Herbaceous Vegetation	0
Poa pratensis Seasonally Flooded Ruderal Herbaceous Vegetation	0
Rosa (woodsii, nutkana) Ruderal Wet Shrubland	0
Schedonorus pratensis Ruderal Wet Meadow Herbaceous Vegetation	0
Typha angustifolia Ruderal Herbaceous Vegetation	0
Western North American Vernal Pool Macrogroup	
North Pacific Vernal Pool Group	
Danthonia unispicata - Poa secunda Herbaceous Vegetation	0
Deschampsia danthonioides - Grindelia squarrosa Herbaceous Vegetation [Provisional]	0
Deschampsia danthonioides - Juncus bufonius Grassland [Provisional]	0
Deschampsia danthonoides Grassland [Provisional]	0
Eleocharis macrostachya - (Eleocharis acicularis, Carex douglasii) Herbaceous Vegetation	0
Eleocharis palustris Vernal Pool Vegetation	0
Navarretia leucocephala - Plagiobothrys leptocladus - (Downingia spp.) Herbaceous Vegetation	0

USNVC Element	Potential Wetland Reference Standard Sites
Plagiobothrys scouleri - Plantago bigelovii Herbaceous Vegetation	0
Polygonum polygaloides Vernal Pool Vegetation	0
2.C.5 Salt Marsh Formation	
2.C.5.Nc Temperate & Boreal Pacific Coastal Salt Marsh Division	
North American Pacific Coastal Salt Marsh Macrogroup	
Temperate Pacific Tidal Salt & Brackish Marsh Group	
Argentina egedii - Juncus balticus Herbaceous Vegetation	20
Argentina egedii - Symphyotrichum subspicatum Herbaceous Vegetation	5
Calamagrostis nutkaensis - Argentina egedii - Juncus balticus Herbaceous Vegetation	4
Carex lyngbyei - (Distichlis spicata, Triglochin maritima) Herbaceous Vegetation	10
Carex lyngbyei - Argentina egedii Herbaceous Vegetation	2
Deschampsia caespitosa - (Carex lyngbyei, Distichlis spicata) Herbaceous Vegetation	25
Deschampsia caespitosa - Argentina egedii Herbaceous Vegetation	16
Deschampsia caespitosa - Sidalcea hendersonii Herbaceous Vegetation	0
Distichlis spicata - (Salicornia virginica) Herbaceous Vegetation	29
Festuca rubra - (Argentina egedii) Herbaceous Vegetation	3
Festuca rubra - Juncus lesueurii Herbaceous Vegetation	1
Glaux maritima Herbaceous Vegetation [Provisional]	6
Ruppia maritima Estuarine Herbaceous Vegetation	0
Salicornia (bigelovii, virginica) Tidal Herbaceous Vegetation	20
Salicornia virginica - Distichlis spicata - Triglochin maritima - (Jaumea carnosa) Herbaceous Vegetation	10
Schoenoplectus (acutus, tabernaemontani) Brackish Coastal Herbaceous Vegetation	2
Schoenoplectus (americanus, pungens) Tidal Herbaceous Vegetation [Provisional]	5
Schoenoplectus maritimus Tidal Herbaceous Vegetation [Provisional]	3
TBD	0
Triglochin maritima - (Salicornia virginica) Herbaceous Vegetation	12

USNVC Element	Potential Wetland Reference Standard Sites
2.C.5.Nd North American Western Inland Brackish Marsh Division	
Warm & Cool Desert Alkali-Saline Wetland Macrogroup	
North American Desert Alkaline-Saline Herbaceous Wetland & Playa Group	
Distichlis spicata - (Scirpus nevadensis) Herbaceous Vegetation	0
Distichlis spicata / Carex (pragracilis, douglasii) Herbaceous Vegetation	0
Distichlis spicata Herbaceous Vegetation	7
Eleocharis rostellata Alkaline Herbaceous Vegetation	0
Hordeum jubatum Great Basin Herbaceous Vegetation	0
Leymus cinereus - Carex praegracilis Herbaceous Vegetation	0
Leymus cinereus - Distichlis spicata Herbaceous Vegetation	2
Leymus cinereus Herbaceous Vegetation	1
Puccinellia nuttalliana Herbaceous Vegetation	0
Salicornia rubra Herbaceous Vegetation	0
Spartina gracilis Herbaceous Vegetation	0
Sporobolus airoides Northern Intermountain Herbaceous Vegetation	0
Suaeda (calceoliformis, moquinii) Herbaceous Vegetation	0
North American Desert Alkaline-Saline Shrub Wetland Group	
Sarcobatus vermiculatus / Distichlis spicata Shrubland	3
Sarcobatus vermiculatus / Leymus cinereus Shrubland	0
5 Aquatic Vegetation Class	
5.A Saltwater Aquatic Vegetation Subclass	
5.A.3 Benthic Vascular Saltwater Vegetation Formation	
5.A.3.We Temperate Seagrass Aquatic Vegetation	
Temperate Pacific Seagrass Intertidal Vascular Vegetation Macrogroup	
Temperate Pacific Seagrass Group	

USNVC Element	Potential Wetland Reference Standard Sites
Zostera marina Pacific Coast Vegetation	0
5.B Freshwater Aquatic Vegetation Subclass	
5.B.2 Temperate & Boreal Freshwater Aquatic Vegetation Formation	
5.B.2.Na North American Freshwater Aquatic Vegetation Division	
Western North American Freshwater Aquatic Vegetation Macrogroup	
Western North American Temperate Freshwater Aquatic Bed Group	
Azolla (filiculoides, mexicana) Herbaceous Vegetation	0
Brasenia schreberi Western Herbaceous Vegetation	2
Callitriche (heterophylla, palustris) Herbaceous Vegetation (Proposed Name change)	0
Ceratophyllum demersum Western Herbaceous Vegetation	0
Elodea canadensis Herbaceous Vegetation	0
Fontinalis (antipyretica var. antipyretica, antipyretica var. oregonensis) Nonvascular Vegetation	0
Isoetes echinospora - (Lobelia dortmanna) Herbaceous Vegetation	0
Lemna minor Herbaceous Vegetation	1
Menyanthes trifoliata Herbaceous Vegetation	2
Myriophyllum hippuroides Herbaceous Vegetation [Provisional]	0
Myriophyllum sibiricum Herbaceous Vegetation	0
Nuphar lutea ssp. polysepala Herbaceous Vegetation	29
Polygonum amphibium Permanently Flooded Herbaceous Vegetation [Placeholder]	0
Potamogeton (foliosus, gramineus) - (Stuckenia filiformis) Herbaceous Vegetation	0
Potamogeton amplifolius Herbaceous Vegetation	0
Potamogeton natans Herbaceous Vegetation	3
Ranunculus aquatilis Herbaceous Vegetation	0
Sagittaria latifolia Herbaceous Vegetation	0
Schoenoplectus subterminalis Herbaceous Vegetation [Provisional]	4
Sparganium angustifolium Herbaceous Vegetation	1

USNVC Element	Potential Wetland Reference Standard Sites
Sparganium eurycarpum Herbaceous Vegetation	1
Utricularia macrorhiza Herbaceous Vegetation [Provisional]	0
Wolffia (borealis, columbiana) Herbaceous Vegetation [Provisional]	0
6 Open Rock Vegetation Class	
6.B Temperate & Boreal Open Rock Vegetation Subclass	
6.B.1 Temperate & Boreal Cliff, Scree & Other Rock Vegetation Formation	
6.B.1.Nb Western North American Temperate Cliff, Scree & Rock Vegetation Division	
Western North American Temperate Cliff, Scree & Rock Vegetation Macrogroup	
Rocky Mountain Cliff, Scree & Rock Vegetation Group	
Sullivantia hapemanii - Mimulus spp. Wet Rock Herbaceous Vegetation [Placeholder]	0