US Army Corps
of Engineers ®
Walla Walla District
BUILDING STRONG®

AQUATIC PLANT CONTROL PROGRAM
SECTION 104 OF THE RIVER AND HARBOR ACT OF 1958
(33 U.S.C. §610), AS AMENDED

FLOWERING RUSH CONTROL

WASHINGTON, IDAHO, OREGON, MONTANA

PROGRAMMATIC ENVIRONMENTAL ASSESSMENT

In compliance with the
National Environmental Policy Act of 1970

ADMINISTRATIVE RECORD – DO NOT DESTROY

PROJECT FILE NUMBER: PPL-C-2018-0102

June 2019

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Acronyms

ALS	Acetolactate Synthase (plant enzyme)
APC	Aquatic Plant Control
ATV	All-Terrain Vehicle
AVR	Aquatic Vegetative Rake
BMP	Best Management Practices
CFR	Code of Federal Regulations
Corps	U.S. Army Corps of Engineers
CRB	Columbia River Basin
DASH	Diver Assisted Suction Harvesting
EA	Environmental Assessment
EDRR	Early Detection And Rapid Response
EPA	Environmental Protection Agency
ER	Engineering Regulation
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
FSA	Four-State Area
L	Liter
LOC	Levels of Concern
MBTA	Migratory Bird Treaty Act
Mg	milligram
MRB	Missouri River Basin
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAEC	No Observed Adverse Effect Concentration
NPDES	National Pollutant Discharge Elimination System
ODA	Oregon Department of Agriculture
PL	Public Law
Ppb	Parts per Billion
Ppm	Parts per Million
PSMFC	Pacific States Marine Fisheries Commission
Pt	Pint
RHA	River and Harbor Act
RQ	Risk quotients
SHPO	State Historic Preservation Office
U.S.C.	United States Code
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agricultural
USFWS	U.S. Fish and Wildlife Service
USGCRP	S. Global Change Research Program
USGS	U.S. Geological Survey
WDFW	Washington Department of Fish and Wildlife
WDNR	Wisconsin Department of Natural Resources
WSDE	Washington Department of Ecology
WIIN ACT	Water Infrastructure Improvements for the Nation Act
WRRDA	Water Resources and Reform Development Act

1 - Project Description

1.1 Project Name

Aquatic Plant Control Program, Flowering Rush Control, Washington, Idaho, Oregon, and Montana

1.2 References

a. Section 104 of the River and Harbor Act of 1958, as amended and codified at 33 U.S.C. §610
b. 40 C.F.R. Parts 1500-1508 Regulations for the Procedural Provisions of the National Environmental Policy Act
c. ER 200-2-2 (33 C.F.R. Part 230) Environmental Quality Procedures for Implementing the National Environmental Policy Act
d. ER-113-2-500 Project Operations Partners And Support (Work Management Policies)

1.3 Purpose and Need

The US Army Corps of Engineers, Walla Walla District (Corps), proposes to implement a Flowing Rush Control Cost Share Program to aid the states of Washington, Oregon, Idaho, and Montana in the control and treatment of an invasive aquatic plant, flowering rush (*Butomus umbellatus*). The purpose of the proposed action is to treat and control current and future flowering rush infestations within the four-state area (FSA) – Idaho, Montana, Oregon, and Washington, under Section 104 of the River and Harbor Act of 1958 (33 U.S.C. §610), as amended. The proposed action is needed to reduce the negative impacts of flowering rush, an invasive noxious and nuisance weed, in state waterways. Flowering rush converts diverse native plant communities into monocultures that provide excellent habitat for nonnative, warm-water fish including northern pike, walleye, smallmouth bass, and other aggressive, nonnative juvenile salmonid predators (Muhlfeld et al. 2008). Flowering rush also interferes with boating, swimming, fishing, and other recreational opportunities along rivers and lake shores. Additionally, flowering rush supports habitat for the great pond snail (*Lymnaea stagnalis*) that hosts parasites that can burrow into the skin of swimmers and waders, causing Cercarial Dermatitis. Flowering rush can also invade irrigation canals where it blocks flow and requires expensive herbicide and mechanical treatments to maintain the water conveyance system.

This EA was prepared in accordance with Engineer Regulation (ER) 200-2-2, *Procedures for Implementing NEPA,* and the Council on Environmental Quality (CEQ) *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (NEPA),* Title 40 Code of Federal Regulations (CFR), Parts 1500-1508. The objective of the EA is to evaluate potential environmental effects of the proposed action. If such effects are relatively minor, a Finding of No Significant Impact (FONSI) will be issued and the Corps will proceed with the Federal action. If the environmental effects are determined to be significant, an Environmental Impact Statement (EIS) will be prepared before a decision is reached on whether to implement the proposed action. Applicable laws under which these effects will be evaluated include, but are not limited to, NEPA, the Endangered Species Act, the Clean Water Act, the Clean Air Act, and the National Historic Preservation Act.

The National Environmental Policy Act is a *full disclosure* law, providing for public involvement in the NEPA process. All persons and organizations that have a potential interest in this proposed action – including the public, other Federal agencies, state and local agencies, Native American tribes, and interested stakeholders – are encouraged to participate in the NEPA process.

1.4 Project Location

This Programmatic Environmental Assessment (EA) evaluates control of the aquatic invasive plant, flowering rush (*Butomus umbellatus*), in waters of the four-state area (FSA - Washington, Idaho, Oregon, and Montana). In the Northwest, the introduction of flowering rush is believed to originate from an invasion in Peaceful Bay, Flathead Lake, Montana, in 1964. From there it was carried along the Flathead River and Clark Fork River to Lake Pend Oreille in Idaho. The Pend Oreille River then continued to carry the plant into Washington State waters in the late 1990s (WSDE 2008 and Jacobs 2011).

The three watersheds of focus for flowering rush treatment in the FSA currently are the Columbia River Basin (CRB), Missouri River Basin (MRB), and Puget Sound Basin (PSB). However, it is reasonable to assume not all flowering rush invasion sites have been located and that new sites will emerge throughout different watersheds in the FSA. The FSA is also home to extensive aquatic resources outside the CRB, including the Rouge River Basin in Oregon and numerous small coastal drainages throughout western Oregon and Washington, all of which are susceptible to an invasion of flowering rush.

Columbia River Basin

The CRB drains more than 250,000 square miles and includes the southeastern portion of the Canadian province of British Columbia, most of the U.S. states of Idaho, Oregon, and Washington, the western part of Montana, and very small portions of three other states. The Columbia Basin extends from the Rocky Mountains in the east through the Cascade Range to the Columbia River's outflow at the Pacific Ocean in the west (Figure 1-1).

Figure 1-1. Columbia River Basin

Missouri River Basin

The Missouri River Basin (MRB) is more than 500,000 square miles, includes portions of 10 states and one Canadian province, and encompasses approximately one-sixth of the United States. The Missouri River flows 2,341 miles from the Rocky Mountains in Montana to the confluence with the Mississippi River near St. Louis, Missouri (Figure 1-2).

Figure 1-2. Map of the Missouri River Basin

Puget Sound Basin

The waters of Puget Sound receive all of the drainage from surrounding watersheds that cover more than 16,988 square miles, collectively referred to as the Puget Sound Basin. This basin is bordered on the east by the Cascade Mountains and on the west by the Olympic Mountains. The Puget Sound area consists of the nearshore zone of the Puget Sound Basin including Puget Sound, the Strait of Juan de Fuca, and southern portions of the Strait of Georgia that occur within the borders of the United States (Figure 1-3). While the basin occurs largely within northwestern Washington State, two of its headwater drainages originate in Canada. The basin is roughly 80 percent land and 20 percent water. The total water area covers nearly 3,090 square miles at mean high water.

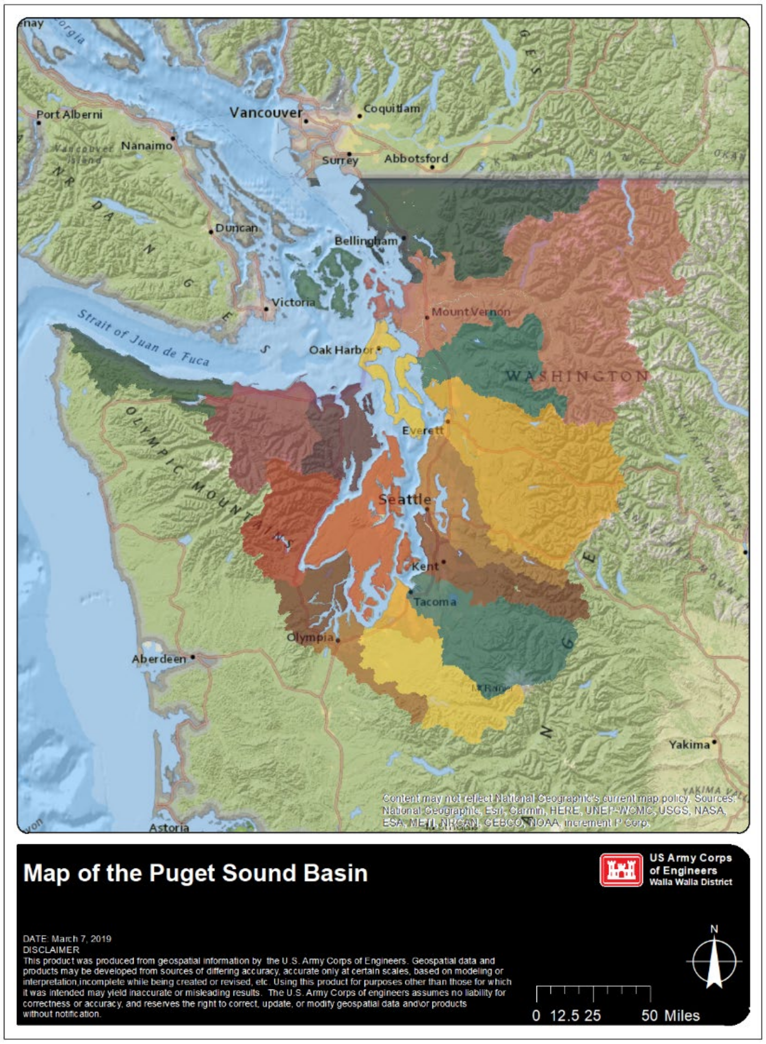

Figure 1-3. Map of the Puget Sound Basin

Known Locations of Flowering Rush Invasion

Today, flowering rush is reported along the shores of Flathead Lake, portions of the Flathead River, Thompson Falls Reservoir, Noxon Reservoir, Cabinet Gorge, and the Clark Fork River in Montana (Figure 1-4). The Pend Oreille watershed in northern Idaho (Figure 1-5) and the Snake and Blackfoot Rivers and canal systems in eastern Idaho (Figure 1-6) are the two primary areas of flowering rush infestation reported in Idaho. Flowering rush was first documented in Washington State at Silver Lake in Whatcom county in 1997 and is currently present in 11 Washington State counties including populations in the Yakima and Columbia Rivers (Figure 1-7).

Currently, the only place flowering rush occurs in Oregon is on Federal land in the McNary Reservoir. However, Flowering rush has been discovered at the initial stages of invasion at multiple locations in Lake Umatilla behind John Day Dam on the Columbia River. The U.S. Army Corps of Engineers, Portland District treated seven locations on Lake Umatilla in September 2016 with an Early Detection and Rapid Response (EDRR) method. The source of the Lake Umatilla plants is believed to be the Yakima River in

Washington. Efforts led by the Bureau of Reclamation are underway to reduce that river's flowering rush populations.

Flowering rush is primarily found throughout the CRB in Washington, Idaho, and Montana (Figure 1-8).

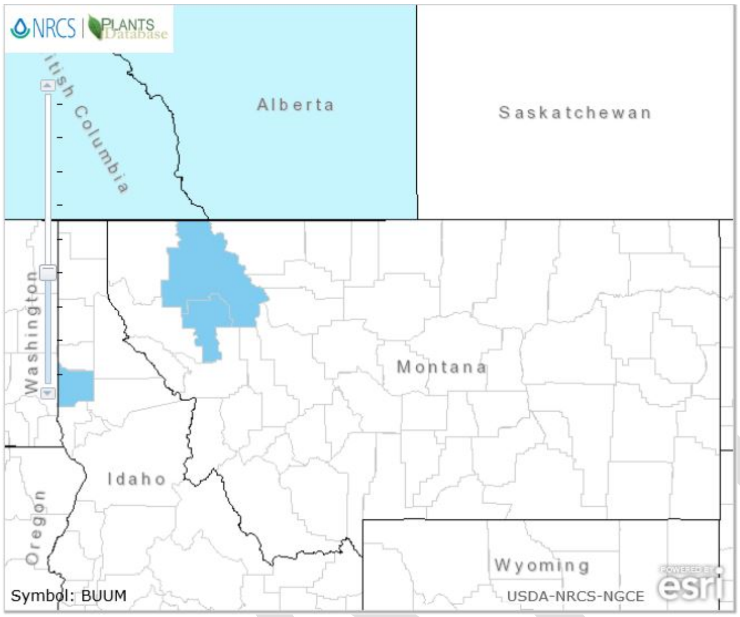

Figure 1-4. Locations of flowering rush (*Butomus umbellatus*) populations in western Montana. Flowering rush is currently found around the shores of Flathead Lake, portions of the Flathead River, Thompson Falls Reservoir, Noxon Reservoir, Cabinet Gorge and the Clark Fork River.

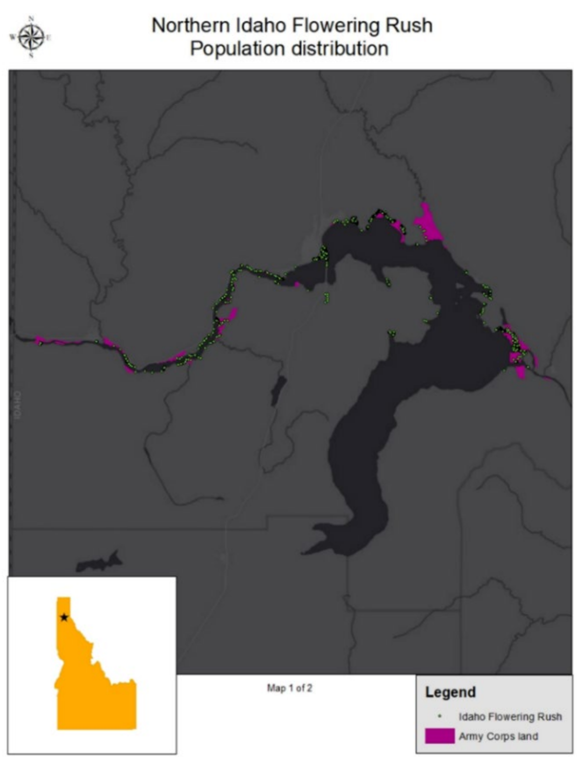

Figure 1-5. Flowering rush (*Butomus umbellatus*) populations in the Pend Oreille watershed in northern Idaho.

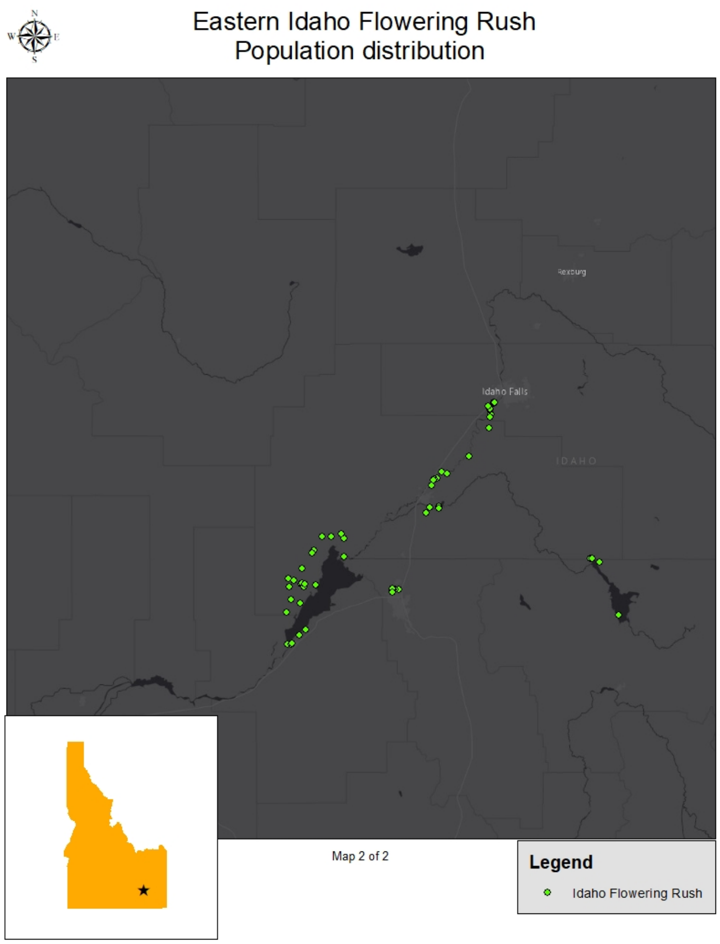

Figure 1-6. Locations of flowering rush (*Butomus umbellatus*) populations in the Snake and Blackfoot Rivers and canal systems in eastern Idaho.

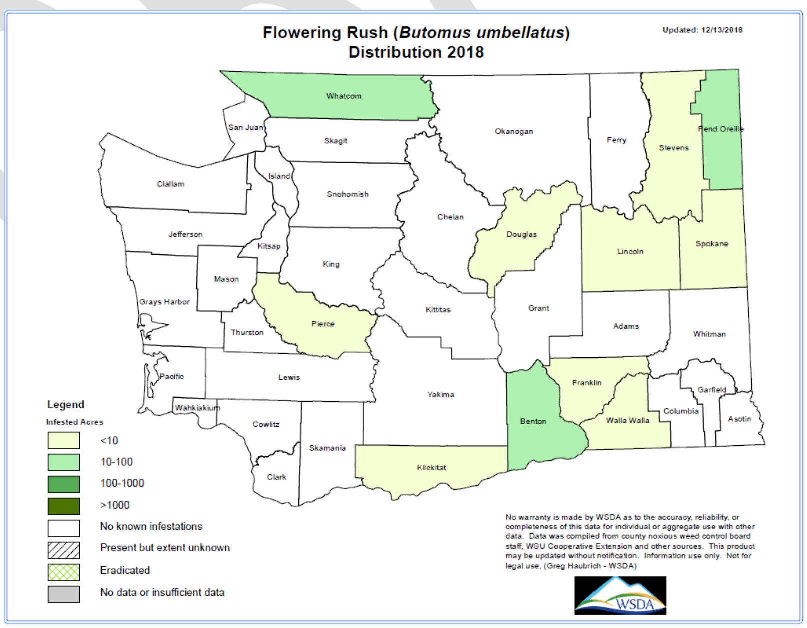

Figure 1-7: County-level distribution of flowering rush (*Butomus umbellatus*) in Washington.

Figure 1-8. Flowering rush (*Butomus umbellatus*) populations in the Columbia River Basin. The red lines indicate areas of known flowering rush invasion.

1.5 Background Information

Flowering rush is an aquatic perennial plant that can grow submersed in water up to six meters deep or as an emergent on damp shorelines. At intermediate depths up to three meters it will often grow to the surface with the leaf tip sticking above the water surface (Jacobs et al. 2011). Leaves are typically about 1 m long when flowering rush is growing fully emerged along shorelines, but can be up to 3 m long when growing fully submersed. Leaves of emergent plants tend to twist. Flowering rush grows from horizontal underground stems which put out lateral shoots (rhizomes) in the sediment and form an extensive mat that comprises most of the biomass of the plant (ODA 2014).

Flowering rush mainly disperses through buds, fragments of the plant's rhizome, and occasionally small bulblike structures in the flowers (Eckert et al. 2003 and Kliber and Eckert 2005). The rhizomes develop lateral buds that break off easily, and disperse the plant. The rhizomes also become brittle with age and develop structurally weak constrictions that spontaneously fragment or break readily following minor disturbances from waves, passing boats, waterfowl, people, etc. that also lead to dispersal of the plant (Hackett and Monfils 2014). Both rhizomes and rhizome buds float, which aids in rapid dispersal by water currents. Flowering rush has invaded irrigation canals where it blocks flow and requires expensive herbicide and mechanical treatments to maintain the water conveyance system (Perkowski 2014).

Flowering rush exhibits a seasonal growth pattern. It is dormant in winter, with the leaves dying back leaving only the rhizome. It starts growth in early spring; in Flathead Lake Montana it has been recorded to start growth between late February and mid-April. This is typically earlier in the spring than most native aquatic plants. Vegetative growth is continuous throughout the season and into fall. Plants flower from early summer to mid-fall. Fall frosts cause leaves to collapse as opposed to remaining upright through the winter like cattails. Leaf growth is rapid, peaking in mid-summer, then dying, usually in September to October (Jacobs et al. 2011).

Flowering rush is invasive and displaces native aquatic plants in a variety of habitats. Flowering rush is indigenous to Europe and Asia where the plant thrives in areas of slow-moving or relatively stagnant water (Core 1941). Flowering rush converts diverse native plant communities into monocultures that provide excellent habitat for nonnative, warm water fish (Perkowski 2014). A study in Montana showed flowering rush dominated areas near the lake shore are the preferred habitat for northern pike, an aggressive, nonnative juvenile salmonid predator (Muhlfeld et al. 2008). Flowering rush also interferes with boat propellers, swimming, and fishing thus reducing recreational opportunities along rivers and lake shores. Additionally, flowering rush supports habitat for the great pond snail (*Lymnaea stagnalis*) that hosts parasites that cause swimmers' itch (Jacobs et al. 2011).

Flowering rush control is likely to provide a benefit to aquatic species like juvenile anadromous salmonids by restoring native vegetation, maintaining suitable rearing habitat, and thereby restoring ecosystem and riparian function. In terms of ESA-listed salmon, steelhead, and chars, the restoration of riparian habitat incidental to the proposed action would benefit juveniles by improving shallow water, migration, and rearing habitat, and reducing piscivorous fish habitat. Adult bull trout may benefit from restored riparian habitats through increased prey species that would colonize the improved ecosystem. Consequently, most potential adverse effects are expected to be short-term and offset by benefits to riparian function that would improve the long-term viability of listed species. Positive changes to the riparian and benthic habitat caused by flowering rush control would benefit fish and habitats in the action area.

1.6 Authority

Section 104 of the River and Harbor Act (RHA) of 1958 (33 United States Code [U.S.C.] §610), as amended, authorizes the Corps to administer a comprehensive program to provide for the prevention, control, and progressive eradication of noxious aquatic plant growths and aquatic invasive species from the navigable waters, tributary streams, connecting channels, and other allied waters of the U.S. *See* 33 U.S.C. §610(a). This program is known as the Aquatic Plant Control (APC) Program and annually receives appropriations. Of amounts provided for the APC Program in Fiscal Year (FY) 2018 and FY 2019, specific allocations were provided for the control of flowering rush. The Consolidated Appropriations Act, 2018 (P.L. 115-141), and the Energy and Water, Legislative Branch, and Military Construction and Veterans Affairs Appropriations Act, 2019 (P.L. 115-244), each allocated $1,000,000 in funds “for activities for the control of the flowering rush.”

It is the policy of the Corps of Engineers that the APC Program shall be maintained to control specific types of aquatic plant infestations of major economic significance (such as the spread of flowering rush), or weed infestations that have potential for reaching such economic significance, in navigable waters, tributaries, streams, connecting channels and all allied waters. Specific guidance on the development of cost-sharing agreements, planning studies, and funding requests can be found in Chapter 14 of Engineer Pamphlet 1130-2-500.

On July 27, 2018, the Pacific States Marine Fisheries Commission (PSMFC) requested a cost share agreement with the Corps to control flowering rush in the States of Idaho, Montana, and Washington. Flowering rush has not yet been found outside of Federal waters in Oregon, but should it be discovered costs could be shared with Oregon through PSMFC under this authority and EA.

The PSMFC is acting on behalf of the States of Idaho, Montana, and Washington and the following related institutions:

- Idaho State Department of Agriculture
- Washington Department of Fish and Wildlife
- Washington Department of Ecology
- Washington Department of Agriculture
- Benton County, Washington
- Kalispel Tribe
- Chelan County Noxious Weed Board
- Pend Oreille Noxious Weed Board
- Whatcom County Noxious Weed Board
- Salish Kootenai College
- University of Montana
- Others may be included in the future.

The project would be implemented under the authority of Section 104 of the RHA of 1958, as amended.

1.7 Timeline

Flowering Rush control would commence shortly after the Corps signs the FONSI, if deemed appropriate. The Corps estimates that the first application period would begin in July 2019. Activities covered in this Environmental Assessment (EA) would be reviewed when necessary, but at least every five years, by the Corps Environmental Compliance Section to determine if the criteria in Section 1502.9 compel preparation of a supplemental EA, which is required when there has been a substantial change in a proposed action or if there are significant new circumstances or information relevant to environmental concerns. During that review, the Corps would also determine if compliance with other applicable environmental laws, regulations or executive orders are needed.

2 - Alternatives

Two alternatives are evaluated in this EA; Alternative 1 - the No Action Alternative and Alternative 2 - Flowering Rush Control (the Proposed Action Alternative). The statutory objectives/scheme supporting an action can serve as a guide to determine the reasonableness of objectives outlined in the EA – in this case the Consolidated Appropriations Act of 2018 and the Energy and Water, Legislative Branch, and Military Construction and Veterans Affairs Appropriations Act of 2019, each allocated $1,000,000 for flowering rush control cost shares under the Aquatic Plant Control Program, with additional allocations expected. Additionally, an agency's obligation to consider alternatives under an EA is a lesser one than under an Environmental Impact Statement. Consequently, only the No Action and Proposed Action Alternatives were analyzed further. The No Action Alternative does not satisfy the project's purpose and need, but NEPA requires analysis of the No Action Alternative to set the baseline from which to compare other alternatives. No Action does not mean there would be no environmental impacts from this alternative.

2.1 Alternative 1: No Action – No Change to Current Practice

Under the No Action Alternative the Corps would not share costs with the PSMFC to control flowering rush. State agencies, municipalities, and landowners currently control flowering rush under a variety of state and local programs, measures, and methods. Under the no action alternative, these various control operations would continue or cease based on state, local, and private needs and funding. In the event, some or all of these current operations cease or are cut back, flowering rush could grow prolifically in those areas and cause adverse effects, as detailed in Section 1.5.

2.2 Alternative 2: Cost Share Flowering Rush Control (Proposed Action)

The Corps proposes to share the costs with the Pacific States Marine Fisheries Commission (PSMFC) to treat flowering rush infestations on non-Federal lands. The goal of flowering rush control is to prevent and/or minimize the impacts of flowering rush invasion on habitat, irrigation, and recreation. The aim is to eradicate known and future flowering rush populations and provide continued subsequent control at a much-reduced effort. Using Corps funding, the PSMFC would assume the following obligations:

1. The PSMFC would perform control activities in cooperation with state, local, and tribal agencies in Washington, Idaho, Oregon, and Montana. Statements of Work (SOW) would be submitted annually by the acting agencies, through PSMFC. SOWs would detail treatment locations, timeline, and methodologies.

2. During the annual statement of work preparation, the PSMFC and the state/local/tribal agency aquatic invasive species coordinators and cooperators would

engage in an evaluation process to determine whether flowering rush control strategies (e.g. locations and methods) should be adjusted in 2019 and beyond.

3. Flowering rush control methods would fall within that which are outlined in this EA, including any listed impact minimization measures. Should there be a desire on the part of the states to use treatment protocols not detailed here, supplemental NEPA analysis would be required.

Initial SOWs for treatment in 2019 (with locations, times, and methodologies consistent with those outlined in this EA) have already been received by the Corps.

In general, treatment areas would not cover large tracts in a single season. The decision as to which treatment method to use would be according to the treatment area's patch density, land ownership, permit requirements, water level, water movement, and time of year. To facilitate the best results of the treatment method selected, all assigned treatment areas would have an onsite pre-treatment evaluation. This pre-treatment evaluation would occur two weeks to six months prior to application. This wide range is needed to capture and use the best information impacting the treatment area. Three categories of flowering rush control are proposed: manual, mechanical, and chemical. All treatments areas would additionally have a post-treatment survey conducted to evaluate the effectiveness of the applied control method.

2.2.1 Chemical Control

Aquatic herbicides are applied as concentrated liquids, granules, or pellets. Liquid treatments are mixed with water to facilitate application and to ensure even distribution. Aquatic herbicides are applied to the entire water column to control the submersed weeds. Aquatic herbicide applicators must measure the volume of the water to be treated before applying aquatic herbicides to ensure that the appropriate and effective amount of herbicide is used.

The aquatic-labeled herbicides evaluated in this EA are: ammonium salt of imazamox, diquat dibromide, endothall (salt of dipotassium), glyphosate, Imazapyr, colorants (dyes), and Agridex (a surfactant). Chemical specific application rates and chemical half-life in water are listed in Table 1. Proposed application rates for each chemical were taken from Gettys et al. 2009. Some adjuvant, dye, and surfactant data was lacking, but it is reasonable to assume that the proposed adjuvants, dyes, and surfactants would be used in chemical applications.

Submerged applications are typically up to five-acre treatment blocks for efficacy. Emergent treatments occur in patches or strips within a treatment area, specifically selecting the target species, and are typically up to two-acre treatments within a treatment area.

Table 2-1. Chemical specific application rates and chemical half-life in water.

Active Ingredient	Emergent Application Rate (pt/acre)	Submerged Application Rate (pt/acre foot of water)	Typical Period of Chemical Activity
Ammonium salt of imazamox	0.02 to 8 pints	1.0625 to 10.8125 pints	6.8 – 7 hours
Imazapyr	2 to 6 pints	Not for submerged	7 hours
Diquat dibromide	4 to 16 pints	2 to 4 pints	48 hours
Endothall	3.6 to 25.6 pints	3.6 to 25.6 pints	2.5-12 days
Glyphosate	1.5 to 7 pints	Not for submerged	1 – 1.5 days

2.2.2 Chemical Application Methods

The Corps proposes the following application methods for chemical control.

Hand/Select

Any of the following hand/select methods would be employed.

Wicking and Wiping. Involves using a sponge or wick on a long handle to wipe herbicide onto foliage and stems. Use of a wick eliminates the possibility of spray drift or droplets falling on non-target plants, although herbicide can drip or dribble from some wicks. An adjuvant or surfactant is often needed to enable the herbicide to penetrate the plant cuticle, a thick, waxy layer present on leaves and stems of most plants.

Stem Injection. Herbicides would be injected into herbaceous stems using a needle and syringe.

Spot

The most common chemical applications are spot treatments made by either ground-based sprayers [mounted to ATVs or trucks], a boat, or with backpack sprayers. Applicator type ranges from motorized vehicles with spray hoses, to backpack sprayers, to hand-pumped spray or squirt bottles. Hand-pumped spray and squirt bottles can target very small plants or parts of plants. Most spot applications treat areas that range in size from less than one-tenth acre to 1 ½ acres where herbicide is sprayed directly onto small patches or individual target plants.

Broadcast

Herbicides would be sprayed via ground vehicles with hose sprayers using an array of spray nozzles. This equipment is most commonly used for broadcast spraying of roads, but can also be used on all-terrain vehicles for broadcast or spot spray in remote areas.

Submerged flowering rush would be treated from a workboat using an injection system. Injection application consists of two large herbicide storage tanks, a GPS controlled herbicide flow system for precision application and from six to eight drop-hoses with variable depth herbicide discharge points. This allows for uniform placement of the targeted application rate throughout the horizontal and vertical profile.

Aerial

No aerial treatments are proposed.

Marker Dye

Marker dyes would be used to assure only target plants are sprayed.

Advantages of Chemical Control

- Aquatic herbicide application can be less expensive than other aquatic plant control methods.
- Aquatic herbicides are easily applied around underwater obstructions and structures, such as docks.
- Aquatic herbicides can be applied directly to problem areas of all size scales.
- Aquatic herbicides are deemed safe by EPA for intended use when used as directed.

Disadvantages of Chemical Control

- Some herbicides have swimming, drinking, and water use restrictions.
- Herbicide use may have unwanted impacts to people who use the water and to the environment.
- Non-targeted plants as well as nuisance plants may be adversely impacted by some herbicides.
- Depending on the herbicide used, it may take several days to weeks or several treatments during a growing season before the herbicide controls or kills treated plants.
- Rapid-acting herbicides may cause low oxygen conditions to develop as plants decompose.
- To be most effective, herbicides must be applied to specific stages of the plants, (i.e. young shoots, flowering stages).
- Some expertise in using herbicides is necessary in order to be successful and to avoid unwanted impacts. Therefore, permits are required for certain types of herbicides.
- Many people have strong feelings against using herbicides in water. Having the public involved and educated in the treatment process is beneficial.

Some local jurisdictions have policies forbidding or discouraging the use of aquatic herbicides. As policies change, updates/revisions would be made to this EA and flowering rush control practices would adjust.

2.2.3 Chemical Descriptions

There are five herbicides proposed for chemical control and evaluated in this EA. Descriptions of each herbicide are found below. The herbicides listed are either contact herbicides (which kill only the plant parts contacted by the chemical) or systemic herbicides (which are absorbed by the roots or foliage and then spread throughout the plant).

Ammonium salt of imazamox

Imazamox is available in both liquid and granular forms and is used to control submerged, emergent, and floating leaf plants. It is a selective, systemic herbicide that moves throughout plant tissue and prevents the plant from producing a necessary enzyme, known as acetolactate synthase (ALS) enzyme, which is not found in animals. Susceptible plants will stop growing soon after treatment, with plant death and decomposition occurring over several weeks.

Imazamox should be applied to plants that are actively growing when used as a post-emergence herbicide. It can also be used during drawdown as a pre-emergent herbicide to prevent plant regrowth.

Imazamox is only moderately persistent, and it degrades aerobically in the soil to a non-herbicidal metabolite which is immobile or moderately mobile. Imazamox also degrades in the water by aqueous photolysis. Hazard to non-target organisms is considered to be minimal. Imazamox is practically nontoxic to avian species, finfish, aquatic invertebrates, and honeybees (EPA 1997).

Liquid imazamox can be applied to the surface of the water using a sprayer or injected below the water surface. When treating emergent or floating plants, imazamox must be used with a spray adjuvant. Spray adjuvants generally consist of surfactants, oils, and fertilizers and enhance the effectiveness of herbicides. The Corps only authorizes use of aquatic registered adjuvants which are not petroleum-based, non-toxic, and do not contain metals.

Imazapyr

The active ingredient in Imazapyr is isopropylamine salt of imazapyr. Imazapyr is used for control of emergent vegetation. It is not recommended for control of submersed vegetation. Imazapyr is a systemic herbicide that moves throughout the plant tissue and prevents plants from producing a necessary enzyme, ALS, which is not found in animals. Susceptible plants would stop growing soon after treatment and become reddish at the tips of the plant. Plant death and decomposition would occur gradually over several weeks to months. Imazapyr should be applied to plants that are actively growing. If applied to mature plants, a higher concentration of herbicide and a longer contact time would be required.

Imazapyr is broken down in the water by light and has a half-life (the time it takes for half of the active ingredient to degrade) ranging from three to five days. Three degradation products are created as imazapyr breaks down. These are pyridine hydroxy-dicarboxylic acid, pyridine dicarboxylic acid (quinolinic acid), and nicotinic acid. These degradates persist in water for approximately the same amount of time as imazapyr. Imazapyr doesn't bind to sediments, so leaching through soil into groundwater is likely. Imazapyr is practically non-toxic (the U.S. Environmental Protection Agency's (EPA) lowest toxicity category) to fish, invertebrates, birds, and mammals and it does not bioaccumulate in animal tissues.

There are no restrictions on recreational use of treated water, including swimming and eating fish from treated water bodies. If application occurs within a ½ mile of a drinking water intake, then the intake must be shut off for 48 hours following treatment. There is a 120-day irrigation restriction for treated water, but irrigation can begin sooner if the concentration falls below one part per billion (WDNR 2012a).

Imazapyr could be applied using handguns at two to six pints per acre of herbicide, with one quart methylated seed oil, and an aquatic labeled colorant. All-terrain vehicles (ATV) applications could be made using the same herbicide rates with 100 gallon/acre water in open areas not restricted by docks, marinas, and boat ramps.

Diquat dibromide

Diquat is the common name for the chemical 6,7-dihyropyrido[1,2-a:2',1'-c] pyrazinediium. It is commonly formulated as a dibromide salt. Diquat inhibits photosynthesis and oxidizes cell membranes. It is rapidly absorbed by plants, and symptoms appear within hours (Senseman 2007). Diquat is a good choice for submersed weeds, but it is not especially effective on emergent weeds (Helfrich et al. 2009). Diquat is used to control submersed plants in small treatment areas or in areas where dilution may reduce the period of time that plants are exposed to the herbicide. Diquat is generally considered to be a "broad-spectrum" product that kills a wide range of plant species. However, the susceptibility of different submersed species can vary significantly.

Diquat is slow to degrade in the environment, but will rapidly be adsorbed by soil particles (Hofstra et al. 2001, Poovey and Getsinger 2002, and World Health Organization 2004). Diquat can be rapidly inactivated when treating "muddy" or turbid water and the speed of this inactivation can interfere with plant control. In pond studies, diquat was quickly eliminated from the water column and was present at very low levels within 14 days and undetectable after 38 days (Langeland and Warner 1986; Parsons et al. 2007; Robb et al. 2014).

High acute risk to birds is not expected from the use of diquat.

Diquat should be applied before plant growth becomes dense and when plants are actively growing. Application of this herbicide can be made by spraying it onto the water surface, by pouring into the water, or using an injection system.

Endothall

Endothall is the common name of the active ingredient endothal acid. Endothall is available in both liquid and granular forms. Two types of endothall are available, dipotassium salt and monoamine salts; the monoamine salt form of endothall is not covered for use of flowering rush treatment under this EA. Endothall is a contact herbicide that prevents certain plants from making the proteins they need. Factors such as density and size of the plants present, water movement, and water temperature determine how quickly endothall works. Under favorable conditions, plants begin to weaken and die within a few days after application. Endothall disperses with water movement and is broken down by microorganisms into carbon, hydrogen, and oxygen.

For effective control, endothall should be applied when plants are actively growing. Endothall is used primarily to control submersed plants. Most submersed weeds are susceptible to dipotassium salt formulations. The choice of liquid or granular formulations depends on the size of the area requiring treatment. Granular is more suited to small areas or spot treatments, while liquid is more suitable for large areas. If endothall is applied to a pond or enclosed bay with abundant vegetation, no more than 1/3 to 1/2 of the surface should be treated at one time because excessive decaying vegetation may deplete the oxygen content of the water and kill fish. Untreated areas should not be treated until the vegetation exposed to the initial application decomposes (WDNR 2012b).

Liquid endothall products can be sprayed on the water or injected below the water surface. It may be applied as a concentrate or diluted with water depending on the equipment used. Granular endothall products must be spread as evenly as possible in the area to be treated (State of Connecticut Department of Energy & Environmental Protection 2014).

Glyphosate

Glyphosate is a broad spectrum, systemic herbicide that moves throughout the plant tissue and works by inhibiting an important enzyme needed for multiple plant processes, including growth. Glyphosate is effective only on plants that grow above the water. It would not be effective on plants that are submerged or have most of their foliage under water, nor would it control regrowth from seed. Three salts of glyphosate are used as active ingredients in registered pesticide products and together, they are the most widely used pesticides by volume. Glyphosate should be applied to plants that are actively growing and after flowers have formed, usually around midsummer. Following treatment, plants will gradually wilt, appear yellow, and die in approximately two to seven days. Occasionally, effects are not seen on the plant the year it is applied, but the plants do not appear the next season.

In water, the concentration of glyphosate is reduced through dispersal by water movement, binding to sediments, and break-down by microorganisms. Glyphosate adsorbs strongly to soil and is readily degraded to carbon dioxide by soil microbes (Sprankle et al. 1975). Glyphosate does not degrade in distilled water, but is rapidly adsorbed by suspended sediment and subsequently degraded to Aminomethylphosphonic Acid (Zaranyika and Nyandoro 1993).

Glyphosate is no more than slightly toxic to birds and is practically non-toxic to fish, aquatic invertebrates and honeybees (Folmar et al. 1979, Howe et al. 2004, Mensah et al. 2015, and Takacs et al. 2002). Based on available data, the EPA has determined that the effects of glyphosate on birds, mammals, fish and invertebrates are minimal (EPA 1993).

Glyphosate may be applied as a broadcast spray. This application method is effective for most species in large stands. In very small stands, an alternative method of glyphosate application is to wipe the entire plant (wearing personal protective equipment) with a wet rag or using a wick type applicator. When using glyphosate, an appropriate surfactant must be mixed with the product before application to ensure that the glyphosate "sticks" to the plant surfaces, increasing the rate of absorption. Sometimes in very small stands, one can brush cut the plant down and use an eye dropper to place glyphosate into the interior of the cut stem. The herbicide will travel from the cut stem down into the roots and kill the remaining portion of the plant.

2.2.4 Manual and Mechanical Control

Physical removal is effective for small quantities of plants near shorelines. Techniques include hand pulling, diver assisted suction harvesting (DASH), benthic mats, and Vegetation Rakes. Vegetation Rakes can only be used on screened canals. Mechanical methods could treat up to five acres of submerged vegetation and two acres of emergent vegetation per day.

2.2.4.1 Hand-Pulling

Hand-pulling aquatic plants is similar to pulling weeds out of a garden. It involves removing entire plants (leaves, stems, and roots) from the area of concern and disposing of them in on land away from the shoreline. In water less than three feet deep, no specialized equipment would be required, although a spade, trowel, or long knife may be needed if the sediment is packed or heavy.

In deeper water, hand pulling would be best accomplished by divers. The divers would use mesh bags for the collection of plant fragments. Some sites may not be suitable for hand pulling such as areas where deep flocculent sediments may cause a person hand pulling to sink deeply into the sediment (WSDE 2003).

Hand pulling has the potential to increase turbidity in the area of removal (WSDE 2003). The removal of these plants could result in increased erosion along the shoreline since there would no longer be any roots holding the sediment in place. It is suggested that native species be replanted in place of the exotics which have been removed. This would not only act to stabilize the shoreline, but would also inhibit the regrowth of some exotic species (Corps 2013).

2.2.4.2 Diver Assisted Suction Harvesting (DASH)

Hand harvesting paired with a vacuum hose is a standard removal process for aquatic plants. The operation involves literally hand-pulling the weeds from the lake bed and feeding them to a suction hose. It requires water pumps to move a large volume of water to maintain adequate suction of materials that the divers are processing. The material placed by the divers into the suction hose along with the water is deposited into onion bags with water leaving through the holes in the bag mesh. The bags must have a large enough 'mesh' size so that silts, clay, leaves, and other plant material being collected do not immediately clog the bags and block water movement.

The basic removal technique is similar to hand-pulling, but DASH replaces collection bags with portable suction hoses. Hose nozzles often feature handles for divers to hold to ease underwater navigation. Once a hose is carefully navigated to a flowering rush patch, divers hold the nozzle steady and slowly input flowering rush plants and fragments into the suction hose. Divers shake root crowns away from the suction nozzle to minimize debris and sediments that may collect in above-water holding tanks (Lake Ellwood Association 2017). Divers must be sure locate and collect any fragments that may have resulted from hand-pulling and shaking. Hoses would be moved underwater from one spot to another with ease and diminish the likelihood of hose entanglement. The hose would also be utilized to suction debris that may be compromising visibility; however, drawing up large amounts of sediments such as small rocks or mud can clog filters and reduce suction capabilities.

Vacuums are typically around six inches in diameter and carry the flowering rush that is pulled underwater up to the surface, either to a stationary boat or a land mass where the plants are collected, sorted, and stored appropriately. The methods associated with filtering and separating plant material above the surface may vary greatly, along with individual DASH system set-ups. There is no uniform construction of DASH mechanisms, but systems generally share the basic components mentioned above.

Systems are costly to build and the manual labor, fuel, and upkeep costs prevent some organizations from employing this method of removal. DASH, along with hand-pulling, typically requires years of continued use to significantly diminish flowering rush infestations. Despite a few drawbacks, these devices improve visibility and transport plants quicker than hand-pulling and bagging.

Advantages of Manual Methods

- Manual methods are easy to use around docks and swimming areas.
- Hand pulling allows the flexibility to remove undesirable aquatic plants while leaving desirable plants.
- These methods are considered safe to the environment.

Disadvantages of Manual Methods

- Treatment may need to be repeated several times each summer as plants regrow or recolonize the cleared area from fragments.
- May not be practical for large areas or for thick weed beds because these methods are labor intensive.
- Difficult to collect all plant fragments even with the best containment efforts. Flowering rush can regrow from fragments.
- The massive rhizomes of flowering rush are difficult to remove by hand pulling.
- Pulling weeds and raking stirs up the sediment and makes it difficult to see remaining plants.
- Hand pulling and raking disturbs bottom-dwelling animals.

2.2.4.3 Vegetation Rakes – screened canals only

Mini excavators, excavators, and backhoe loaders can attach and operate vegetation rakes with several different sizes and functions (Figure 2-1). Vegetation rakes can either be operated from the land or water. The vegetation rake can remove nuisance vegetation and bottom debris from water depths ranging from 18 inches to 10 feet. Duration of treatment could take two to three years or longer for flowering rush due to the well-developed root systems.

Figure 2-1. Vegetation Rake at work in a canal.

During the removal process, the vegetation rake would extract the plant in its entirety, as well as its attached rhizome structure lain beneath the water's surface. Vegetation raking results in fragments of the plant, which, if not captured by the vegetation rake, must be hand collected to eliminate the possibility of spreading the plant to new areas (Corps 2013).

Vegetation rakes can cut and collect several acres per day depending on plant density and storage capacity of the equipment. Harvesting speeds for typical machines range from 0.5 to 1.5 acres per hour. The vegetation rake deposits each rake full (maximum

500 pounds) of material directly on-shore. Vegetation Rakes can provide sufficient plant reduction, especially when combined with herbicide management options.

It is important to make sure that the vegetation rake has been thoroughly cleaned and inspected before allowing it to be launched into a waterbody. This is extremely important if the vegetation rake has been working in waterbodies known to be infested with noxious species such as Eurasian watermilfoil (*Myriophyllum spicatum*), hydrilla (*Hydrilla spp.*), Brazilian elodea (*Egeria densa*), or with exotic animals such as the zebra mussel (*Dreissena polymorpha*).

Advantages:

- Removes plants and debris at the sediment-water interface.
- Results in immediate open areas of water.
- Removes plants and roots systems, as well as decaying organic matter, soft sediment, and debris.
- Provides anywhere from one to three years or longer of nuisance plant control through only one service, depending on conditions.
- Clears selective areas including beaches as well as boating and fishing lanes.
- Offers an environmentally friendly solution with no water use restrictions, since chemicals are not used.
- Helps preserve shoreline landscapes.
- Acts as a budget-friendly alternative to traditional dredging.

Disadvantages

- Similar to mowing a lawn; the plant grows back and may need to be harvested several times during the growing season.
- Off-loading sites and disposal areas for cut plants must be available. On heavily developed shorelines, suitable off-loading sites may be few and require long trips by the harvester.
- Small fish, invertebrates, and amphibians are often collected and killed by the harvester.
- Creates plant fragments, which may increase the spread of flowering rush throughout the waterbody.
- Although vegetation rakes collect plants as they are cut, not all plant fragments or plants may be picked up.
- Vegetation Rakes are expensive and require routine maintenance.

2.2.5 Benthic Barriers

Benthic barriers (bottom screen) installation would be subject to timing restrictions from State agencies, which would require installation in the winter.

Bottom barriers are semi-permanent materials laid over the top of flowering rush beds and are analogous to using landscape fabric to suppress the growth of weeds in yards.

A benthic barrier covers the sediment like a blanket, compressing aquatic plants while reducing, or blocking light. Materials such as burlap, plastics, perforated black Mylar, and woven synthetics can all be used as benthic barriers. Some people report success using pond liner materials. There is also a heavy, felt-like polyester fabric bottom screen commercial material, which is specifically designed for aquatic plant control.

An ideal bottom screen should be durable, heavier than water, reduce or block light, prevent plants from growing into and under the fabric, be easy to install and maintain, and should readily allow gases produced by rotting weeds to escape without "ballooning" the fabric upwards. It is very important to anchor the benthic barrier securely to the bottom, because even the most porous materials, such as window screen, will billow due to gas buildup. Unsecured screens could create navigation hazards and are dangerous to swimmers. Anchors must be effective in keeping the material down and must be regularly checked. Natural materials such as rocks or sandbags are preferred as anchors.

The duration of weed control depends on the rate that weeds can grow through or on top of the bottom screen, the rate that new sediment is deposited on the barrier, and the durability and longevity of the material. For example, burlap may rot within two years; plants can grow through window screening material, and can grow on top of felt-like fabric. Regular maintenance is essential and can extend the life of most bottom barriers.

In summer, cutting or hand pulling the plants first would facilitate bottom screen installation. The less plant material that is present before installing the screen, the more successful the screen would be in staying in place. Bottom screens may also be attached to frames rather than placed directly onto the sediment. The frames may then be moved for control of a larger area.

Advantages

- Installation of a benthic barrier creates an immediate open area of water.
- Benthic barriers are easily installed around docks and in swimming areas.
- Properly installed benthic barriers can control up to 100 percent of aquatic plants.
- Screen materials are readily available and can be installed by divers.

Disadvantages

- Benthic barriers are only suitable for localized control because they reduce habitat by covering the sediment.
- For safety and performance reasons, benthic barriers must be regularly inspected and maintained.
- Harvesters, fishing gear, propeller backwash, or boat anchors may damage or dislodge benthic barriers.
- Improperly anchored benthic barriers could create safety hazards for boaters and swimmers.

- Swimmers may be injured by poorly maintained anchors used to pin benthic barriers to the sediment.
- Some benthic barriers are difficult to anchor on deep muck sediments.
- Benthic barriers interfere with fish spawning and bottom-dwelling animals.
- Without regular maintenance, aquatic plants may quickly colonize the bottom screen.

2.2.6 Early Detection and Rapid Response (EDRR)

Rapid response and eradication primarily focuses on newly established invasive species. EDRR would primarily consist of active treatment for two to three years and then monitoring to ensure pest species have been eradicated. New detections in all areas would be subject to the EDRR process described in this section. EDRR treatments would be conducted using the same methods and tools described throughout the proposed action of this document.

EDRR refers to newly inventoried flowering rush infestations, including previously undiscovered flowering rush infestations over the life of this project. Ongoing inventory and monitoring occurring through annual applications would look for infestations of new invasive plant species or new locations of existing weeds. Newly discovered infestations or sites would receive a high priority for treatment to eradicate the invasive plants while the infestation is small and easily treatable (USDA 2010). The proposed action would allow treatment of new detections, as long as the treatment method is within the scope described in this document. Limitations associated with treatments would apply to new as well as existing sites.

3 - Affected Environment and Environmental Effects

This section describes the existing affected environment (existing condition of resources) and evaluates potential environmental effects on those resources for each alternative. Although only relevant resource areas are specifically evaluated for impacts, the Corps did consider all resources in the proposed project area and made a determination as to which ones to evaluate. The following resource areas were evaluated: Water Quality, Aquatic Resources, Vegetation, Wildlife, Threatened and Endangered Species, Historic and Cultural Resources, Recreation, and Cumulative Impacts. It was determined that it was not necessary to evaluate Aesthetics/Visual Quality, Noise, Geology and Soils, Air Quality, Climate Change, Socioeconomics, Environmental Justice, or Land Use as implementation of the proposed action would have No or Negligible Impacts to these resources.

The following descriptors are used in the body of this chapter for consistency in describing impact intensity in relation to significance:

• No or Negligible Impact: The action would result in no impact or the impact would not change the resource condition in a perceptible way. Negligible is defined as of such little consequences as to not require additional consideration or mitigation.

• Minor Impact: The effect to the resource would be perceptible; however, not major and unlikely to result in an overall change in resource character.

• Moderate Impact: The effect to the resource would be perceptible and may result in an overall change in resource character. Moderate impacts are not significant due to their limited context (the geographic, biophysical, and social context in which the effects would occur) or intensity (the severity of the impact, in whatever context it occurs).

3.1 Environmental Resources Considered, but Not Evaluated

Aesthetics/Visual Quality. Aesthetics or visual resources are the natural and cultural features of the landscape that can be seen and that contribute to people's appreciative enjoyment of the environment. The aesthetic quality of an area is a subjective measure of one's perception. Some might find the inflorescence of flowering rush aesthetically pleasing; however, despite the name, not all flowering rush plants flower regularly. Emergent flowering rush without flowers looks similar to the native rushes growing in the area that would not be treated or removed and therefore not changing the aesthetics of the area. Treated plants that are submerged would not be seen.

Flowering rush invasions and subsequent treatments occur in patches of habitat where flowering rush is introduced. Treatment locations would be primarily located at boat ramps, boat basins, marinas, and other similar access points. The majority of these locations would not be considered pristine natural areas, or areas that had not been modified for human use. Typically, these sites are a mix of natural elements (waterbodies, shoreline, riparian zones) and human elements (roads, parking lots, vehicles, boats, docks, etc.). Impacts to aesthetics or visual quality from either alternative would be negligible and are not analyzed in further detail in this EA because no large scale flowering rush invasions or removals in pristine areas are proposed.

Noise. The project areas would be located in areas frequently used for recreation such as lake shores, boat ramps, or fishing sites. Access to treatment sites would be infrequently made by foot, ATV, work truck, or boat. Methods of flowering rush treatment such as back pack sprayers, mounted sprayers, or hose sprayers would have a negligible impact on ambient noise.

Vegetation rakes would be operated by backhoes in screened irrigation canals near where tractors or farm equipment already operate. The added noise from vegetation rakes would be negligible. Impacts to noise from either alternative would be negligible and are not analyzed in further detail in this EA.

Geology and Soils. Aquatic herbicides would degenerate in sediments or bind to the sediments in an inert form. There is no alteration of the topography caused by the performance of either alternative. Impacts to geology and soils would be negligible and are not analyzed in further detail in this EA.

Air Quality. Herbicide treatment methods would employ conservation measures for pesticide applications to include the use of additives to reduce evaporation or volatilization as well as sizing of nozzles to produce larger droplets and orienting of nozzles to reduce or prevent spray drift of pesticides (Section 3.12). Herbicide application would not occur when wind speeds exceed 10 miles per hour and there would be no aerial spraying of herbicides. All vehicles used would add de minimus emissions to the air having a negligible impact on air quality.

Flowering rush control activities would not introduce any new stationary sources of air emissions to the region or contribute to a violation of any Federal, state, or local air regulations. Impacts to air quality from either alternative would be negligible and are not analyzed in further detail in this EA.

Climate Change. Climate change, including gradual changes to the climate and extreme climatic events, are already affecting natural resources, cultural identity, quality of life, infrastructure, and health of residents in the Pacific Northwest. Strong climate variability is likely to persist for the Northwest, owing in part to the year-to-year and decade-to-decade climate variability associated with the Pacific Ocean (USGCRP 2018).

Changes in snowpack and stream flows are already occurring in the Pacific Northwest and future climate change would likely continue to influence these changes. Although flowering rush growth varies due to changes in seasonal weather, the impacts from climate change would be negligible to the alternatives and are not analyzed in further detail in this EA.

The alternatives have no activities that produce significant emissions. Vehicular traffic used for the control of flowering rush would be similar to the vehicular traffic of surrounding lands for recreational, agricultural, rural, and commercial activities. Impacts to climate change would be negligible and are not analyzed in further detail in this EA.

3.2 Water Quality

The physical, chemical, or biological condition of water is referred to as water quality. Water quality affects whether water should be used by humans, aquatic organisms, or wildlife. The quality of water in the FSA is important for several reasons: fish and aquatic plants require relatively clean water to live; treatment costs for drinking and industrial supplies are higher if water is polluted; people want clean, attractive water for recreation; farmers need clean water to irrigate crops; and wildlife depend on rivers for clean, safe drinking water.

3.2.1 Affected Environment

CRB

Water quality in the CRB is generally good. The Columbia River carries a large volume of relatively unpolluted surface water. Compared to many other rivers in the United States, there are fewer sources of industrial and municipal wastes. Nevertheless, past studies by Federal and state agencies have shown increased levels of heavy metals such as arsenic, lead, cadmium, copper, mercury and zinc, and other contaminants like dioxins and furans in the rivers (EPA 2006). Several factors could be contributing to the water quality issues in the basin, including: (1) nonpoint source additions, (2) water withdrawal for irrigation, (3) impoundments, and (4) point source effluents.

Nonpoint source pollution comes from a wide variety of sources; including irrigation return flows, forestry practices, malfunctioning septic systems, urban runoff, and mining leaches. Irrigation is the dominant nonpoint source of pollutants in the CRB.

Impoundments (reservoirs) have interrupted the free-flowing river system and altered the seasonal variations in water discharge patterns. Some water quality conditions affected by reservoirs include water temperature, dissolved oxygen, nutrient availability, dispersion of hazardous chemicals, turbidity, and sanitary quality. Water temperatures can increase or decrease downstream of a dam. Compared to natural inflows, large reservoirs typically release cooler water in the spring and summer, and warmer water in the fall and winter.

Waste effluents from municipal and industrial plants can constitute a continuous source of water pollution. Municipal sewage treatment plant effluents primarily affect water bodies in urban areas, while mining wastes can seriously affect aquatic communities in rural areas.

Water temperatures in the Columbia and lower Snake Rivers sometimes approach the upper limits of tolerance for cold water fishes, including salmon and steelhead. These warmer temperatures are higher than temperature water quality standards established for the Columbia and lower Snake Rivers by Oregon, Washington, Idaho, and the Colville and Spokane Tribes. Because of these temperature standard exceedances, both rivers are included on the Clean Water Act §303(d) lists of impaired waters established by Oregon, Washington, and Idaho (EPA 2018a). The locations of these impaired waters are illustrated in Figure 3-1.

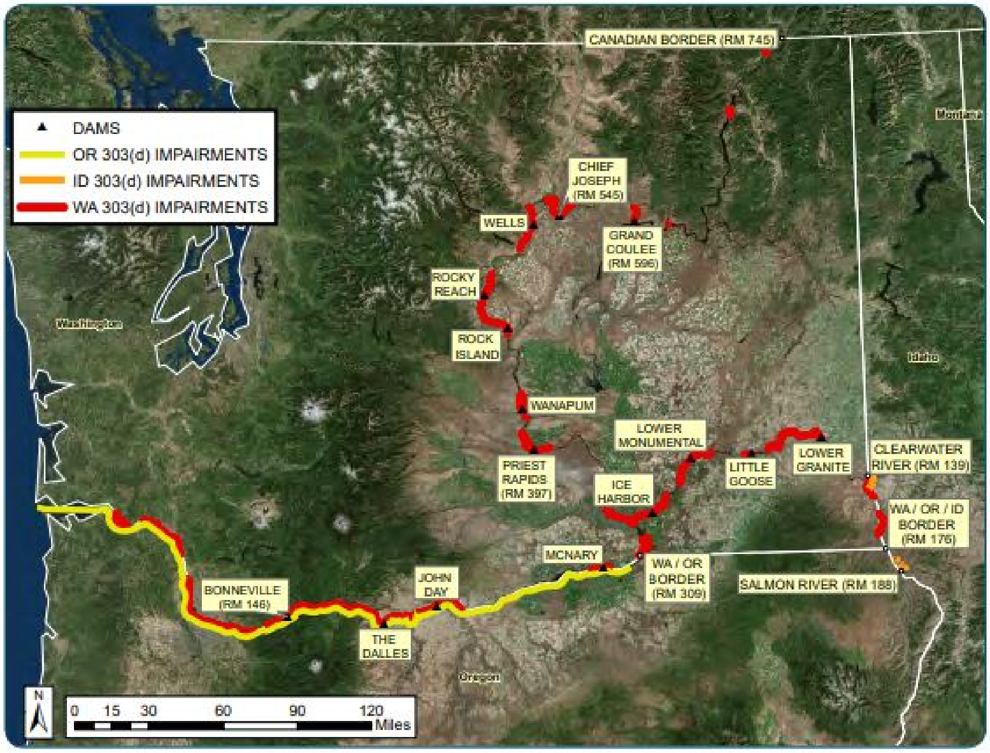

Figure 3-1. Temperature Impairments in the Columbia and Lower Snake Rivers. Source: EPA 2018.

MRB

Current water quality in the Missouri River is considered good. Prior to dam construction, the Missouri River was a dynamic, free-flowing river. As such, continuous bank erosion was common, and the Missouri River naturally tended to be a turbid river. Many of the native fish species in the Missouri River, such as the pallid sturgeon, are specially adapted for life in turbid waters like those that were present in the historic river. Currently, as a result of the upstream reservoirs being constructed in the mid-20th century, turbidity is lower than the natural condition. The suspended sediment load has decreased by 69 to 99 percent, depending on location and proximity to the main stem dams.

Water quality management for the Upper Missouri River in Montana is under the jurisdiction of the Montana Department of Environmental Quality (MDEQ). Montana DEQ develops water quality standards that designate the beneficial uses to be made of surface waters and the water quality criteria to protect the assigned uses. Inorganic nitrogen and total phosphorus levels within the Missouri River exceeded the recommended levels set by MDEQ. It is possible that high nutrient levels are the biggest threat that the Upper Missouri River is facing at present (Peterson et al. 2018). Primary sources of pollution in the Missouri River include runoff of fertilizer, pesticides, and herbicides from the predominantly agricultural watershed, as well as discharges from municipal wastewater treatment facilities and other urban industrial operations; however, reports do not suggest any major impairment to the river due to pollution.

PSB

Puget Sound, as in most large water bodies, has a great deal of variability with respect to water quality parameters across different parts of the water body. Additionally, water quality is influenced a great deal by natural variability, and discerning natural changes from anthropogenic changes is an ongoing challenge. The most recent monitoring data from the Puget Sound Partnership indicates that marine water quality as a whole continues to decrease relative to the baseline.

The most recent data show the top 50 meters water layer to be warmer than usual from about January to June and cooler than normal in the latter part of the calendar year. Surface temperatures (0-2 meters) in the Central Basin were at or slightly below the long-term average. Water bodies were measured to be slightly saltier than the previous 3 years, although these values did not approach the values observed in the mid-2000s. Salinities in the Central Basin specifically were typical compared to the long-term average except in May through July, when increased freshwater inputs from snowmelt decrease the overall salinity.

3.2.2 Environmental Consequences

3.2.2.1 Alternative 1: No Action Alternative

State agencies, municipalities, and landowners would continue their current program to control flowering rush invasion. The primary methods of treatment would remain chemical, manual, or mechanical methods.

Chemical Treatment Methods:

Pesticide applications have an inherent potential to affect water quality when in contact with the water table or surface water. Flowering rush control under the No Action Alternative must still follow all EPA label restrictions and therefore are assumed to be less than significant. However, accidental applications (overspray) and spray drift still have the potential to degrade water quality.

Adverse impacts to water quality would be minor to moderate in the short-term due to potential water quality degradation from the use of herbicides to control invasive species. Additionally, there would be beneficial, moderate impacts over the long-term as herbicides would control invasive plants and native species would reestablish.

The No Action Alternative does not employ the added conservation measures listed in Section 3.12 of this document to further reduce impacts of chemical treatment to water quality.

Manual and Mechanical Treatment Methods:

Application of manual/mechanical weed control methods could increase the potential for erosion and sedimentation into surface waters. However, generally large infestations would be treated with herbicides, while small infestations would be treated with manual/mechanical control, thus reducing the potential for erosion and sedimentation. The exception would be the use of vegetation rakes to remove large infestations of flowering rush in irrigation canals.

The vegetation rakes would create turbidity as the rake removes vegetation from beneath the water's surface. Removing the sediment structure provided by flowering rush rhizomes could increase erosion by creating instability in stream beds and stream banks. Erosion would further increase turbidity. Using vegetation rakes to remove infestations of flowering rush could have minor impacts in the short-term. Impacts would be limited to the immediate area where vegetation removal would occur. As dense monocultures of flowering rush prevent waterbodies from full ecological function, water quality would be only slightly impaired beyond its prior (infested) condition.

However, removing the flowering rush would allow for native plants to recolonize and stabilize the stream banks and stream beds. There may also be areas where flowering rush was removed that would remain as open flowing water improving habitat for native salmonids and removing habitat for predatory fish species. Ultimately, removal of flowering rush would have beneficial effects to water quality.

Impacts on water quality due to erosion from manual/mechanical treatments would range from negligible to minor depending on method used. Hand-pulling and DASH would have negligible adverse impacts to water quality in the short-term. Vegetation rakes could have minor adverse impacts on water quality in the short term. Long-term impacts are expected to be beneficial to the system for the reasons discussed above.

Benthic Barriers:

Installing benthic barriers would temporarily increase turbidity in the water. Benthic barriers would only be used in small localized areas and not disturb large areas of sediment. The turbidity increase caused by benthic barriers would have a minor impact to water quality in the short-term and negligible to no impact to water quality in the long-term.

3.2.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Flowering rush control cost shared with the PSMFC could treat up to double the acreages as under the No Action Alternative, if state and local agencies fully maximized their budgets. Differences in chemical use include fewer chemicals approved for use (Section 2.2.3) and more conservation measures (Section 3.12). Additionally, the Proposed Action Alternative restricts the use of vegetation rakes to screened irrigation canals. The impacts of chemical, manual, or mechanical flowering rush treatment are the same as discussed under Alternative 1 with the following exceptions:

Chemical Treatment Methods:

The Corps would only fund chemical flowering rush control using five aquatic herbicides known to have minor effects to water quality, although some of the approved herbicides have drinking and irrigation water use restrictions discussed below. The use of a limited number of herbicides reduces the intensity of chemical use and the potential of adversely impacting water quality. Additional control methods would reduce or eliminate chemical misapplications, spills, overspray, and spray drift (as discussed in the No Action Alternative).

The following restrictions apply to the approved herbicides:

Imazapyr cannot be applied within one-half mile upstream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within one-half mile of an active potable water intake in a standing body of water, such as a lake, pond, or reservoir. If application occurs within one-half mile of a drinking water intake, then the intake must be shut off for 48 hours following treatment. There is also a 120-day irrigation restriction for Imazapyr treated water, but irrigation can begin sooner if the concentration falls below one part per billion (ppb).

Diquat bromide treated water should not be used as drinking water for one to three days, depending on the concentration used in the treatment. Diquat bromide treated water cannot be used for pet or livestock drinking water for one day following treatment. The irrigation restriction for diquat bromide treated water on food crops is five days.

Endothall cannot be used within 600 feet of drinking water intakes.

Glyphosate treatment would require potable water intakes within one-half mile to be turned off for 48 hours after application.

Chemical flowering rush control under the Proposed Action Alternative would have a minor effect on water quality, but these effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative.

Manual and Mechanical Treatment Methods:

The Corps would only cost share the use of vegetation rakes in screened irrigation canals. Due to equipment size and operation costs, vegetation rakes would likely only be chosen for use in areas of extreme infestations where monocultures of flowering rush exist and irrigation canal function has been compromised. The use of vegetation rakes would increase turbidity and sedimentation in irrigation canals which could clog turnouts (point at which the control of the water changes from the irrigation district to the customer), reduce water and sediment conveyance capacity, raise water levels, and reduce discharge capacities (Lawrence and Atkinson 1998 and Depeweg and Mendez V 2002). Any additional sediment deposits in irrigation canals would need to be removed to maintain irrigation supplies.

Water conveyance and discharge capacities would improve in the irrigation canals once the flowering rush has been removed. With the flowering rush removed, irrigation canal turbidity would return to background levels and sediment would be transported downstream reducing accumulation.

This alternative would not allow the use of vegetation rakes in rivers, streams, lakes, or ponds limiting impacts to screened irrigation canals, thus limiting the context in which this method may be used and its impacts to natural environmental resources. Mechanical methods of flowering rush treatment under the Proposed Action Alternative would have a moderate effect to water quality, but these effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative.

Benthic Barriers:

Impacts would be the same as the No Action Alternative, but these effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative.

3.3 Wetlands and Aquatic Vegetation

3.3.1 Affected Environment

Wetlands improve water quality by filtering sediments and toxins; reducing flooding and erosion by acting like a sponge to absorb water during spring runoff and releasing it later in the year. Wetlands also provide critical habitat for fish and wildlife. In fact, more than one-third of the United States' threatened and endangered species live only in wetlands, and nearly half use wetlands at some point in their lives (EPA 2018b).

Wetlands are the transitional lands between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water. Wetlands must have one or more of the following three attributes: (1) at least periodically, the land must support predominantly hydrophytes (wetland plants); (2) the substrate is predominantly undrained hydric soil (i.e. adapted to a wet environment); and (3) rocky, gravelly, or sandy areas that are saturated with or covered by shallow water at some time during the growing season (Cowardin et al. 1979).

It is estimated that over 50% of the wetland areas in the U.S. have disappeared in the past 200 years and National Audubon Society estimates that over 100,000 acres of American wetlands continue to be destroyed annually (Montana Audubon 2019). Wetlands are threatened by both direct and indirect impacts related to land use.

Wetland loss by state is displayed in Table 3-1. The original wetland acreage was measured in the 1780's and the remaining wetland acreage was measured in the 1980's. Wetland losses during the 200 year period ranged from 27% in Montana to 56% in Idaho (Table 3-1). Today the most complete inventories show wetlands only make up 1 to 3 percent of the total land mass for each state in the FSA (Montana Natural Heritage Program 2015, Deinarowicz 2019, The Wetland Conservancy 2019, and WSDE 2019).

Table 3-1.Wetland Losses in the United States 1780's to 1980's (Dahl 1990).

State	Original Wetland Acreage	Remaining Wetland Acreage	Acreage Lost	Percent Lost
Washington	1,350,000	938,000	412,000	31%
Idaho	877,000	385,700	491,300	56%
Oregon	2,262,000	1,393,900	868,100	38%
Montana	1,147,000	840,3000	306,700	27%

Flowering rush invasions can have long-term detrimental impacts on wetland ecosystems. Weeds crowd out native plants and animals, interfere with or alter natural processes such as water flow and evapotranspiration and lead to loss of native plant biomass and biodiversity. Flowering rush does not tolerate salt water, so no coastal or estuary wetlands were analyzed in this document.

CRB

The majority of wetlands in the CRB are riverine wetlands. Riverine wetlands are associated with freshwater rivers and their tributaries. The Columbia and Snake River wetlands develop in the few areas where floodplains are wide enough for sediment to accumulate and support emergent vegetation. These wetlands are sustained by ground-water discharge and river flooding. Flowering rush invasion in riverine wetlands would most likely occur below the average water mark in the intermittently and permanently flooded zones where water is still or moderately flowing (Figure 3-2).

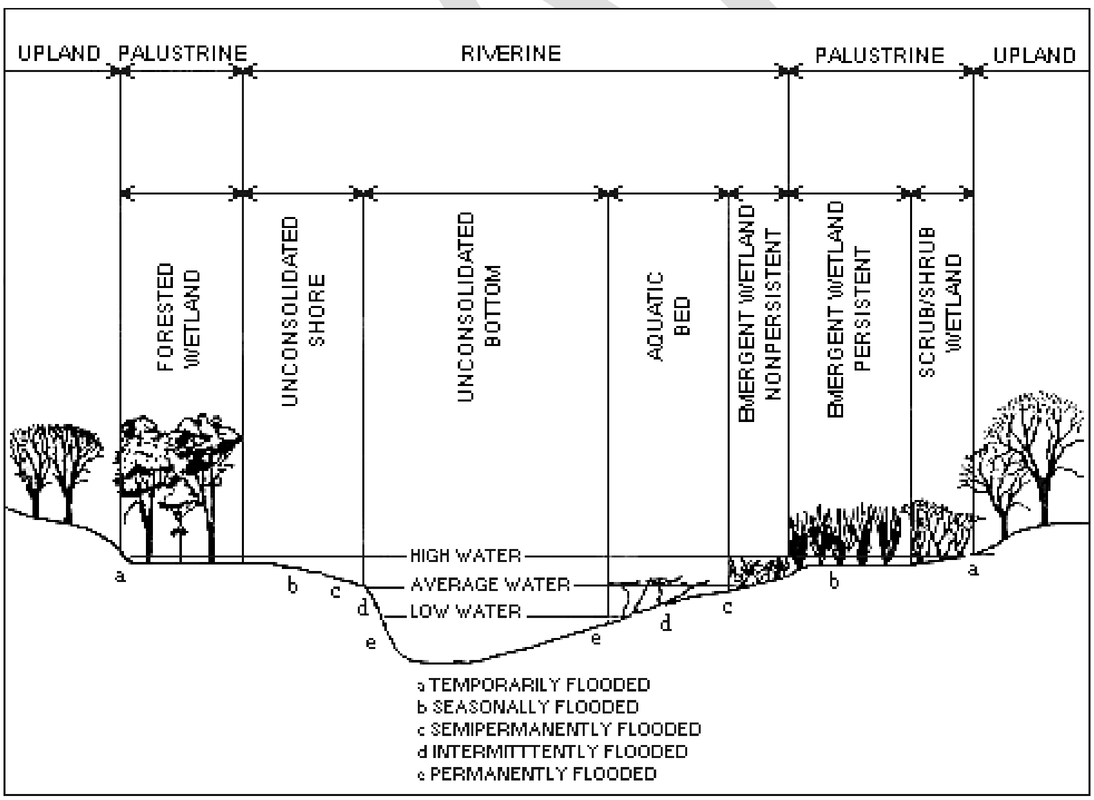

Figure 3-2. Riverine wetland complex (Coward et al 1979).

MRB

Historically the Missouri River represented one of North America's most diverse ecosystems with a dynamic complex of braided channels, riparian lands, chutes, sloughs, islands, sandbars, wetlands, and backwater areas. The river has been transformed from a free-flowing river into a system of main stem reservoirs and reaches influenced by self-channelization, bank stabilization and regulated flows. Much of the river's habitat diversity and balance has been lost, including wetlands.

PSB

Wetlands are present in the shallows of many landforms in Puget Sound including barrier estuaries, barrier lagoons, closed marshes and lagoons, and large river deltas. Many of these wetlands have severely declined or been lost due to anthropogenic stressors. Wetlands provide foraging and rearing habitat to a variety of organisms in Puget Sound. Three types of vegetated wetland classes are present: estuarine mixing, oligohaline transition, and tidal freshwater.

Freshwater tidal or surge plain wetlands were once common throughout the Puget Sound nearshore zone. Unique to the freshwater extent of river deltas, the water levels rise and fall with the tides but the water is fresh (less than 0.5 parts per trillion salt). Generally these are high-nutrient and high-energy systems (Kunze 1994). The analysis of changes in distributions of wetlands between the late 1800s and circa 2000 indicates that less than 10 percent of the historical area of tidal freshwater wetlands remains in Puget Sound (Simmental et al. 2009). The Washington Natural Heritage Program identifies freshwater tidal wetlands as highly vulnerable with a substantial decline. Loss of freshwater tidal wetlands can be attributed to sea dikes and levees, filling of estuaries for agriculture production, and commercial and residential development.

3.3.2 Environmental Consequences

3.3.2.1 Alternative 1: No Action Alternative

State agencies, municipalities, and landowners would continue their current program to control flowering rush invasion. Weed management in wetland habitats would result in the reduction of or prevention of expanding infestations and ultimately enhance native wetland plant communities. Enhancing native wetland vegetation would eventually provide higher quality habitat for wildlife and aquatic species and improve wetland function. The primary methods of treatment would remain chemical, manual, or mechanical methods.

Chemical Treatment Methods:

Management options for flowering rush are highly dependent upon the hydrology of the system. Winter drawdown allows for bareground herbicide treatment that can be effective if water levels are low enough to expose the whole plant, although repeated applications may be necessary and timing of treatments is critical. Treatment of emergent foliage of plants growing in water was most effective if at least 5-7 inches of leaves had emerged and plants were above the water line (Parkinson et al. 2010). Water column injection herbicide treatments may be more effective for killing rhizomes (Parkinson et al. 2010). Submersed plants are often treated with Diquat however, herbicide treatment of submersed plants in deep water is complicated by water movement and reduced contact times, although there are several aquatic labeled herbicides that have not been tried on flowering rush.

Herbicide application could have adverse impacts to wetland plant species diversity and total plant cover (native wetland plants and flowering rush). A reduction in total plant cover could increase sedimentation and change the hydrologic conditions necessary for floodwater storage. A reduction in total plant cover could also lead to an increase in water temperature and impair important wildlife habitat.

The risks of impacting non-target plant species and reducing total plant cover is higher with the non-selective herbicides. Non-selective herbicides would kill most plants in water. Misapplications and spills are the leading cause of impacts to non-target plant species. Accidental applications (overspray) and spray drift can degrade water quality in wetlands and damage non-target vegetation.

The No Action Alternative does not employ the added conservation measures listed in Section 3.12 of this document to further reduce impacts of chemical treatment to wetlands.

Minor to moderate adverse effects to wetlands could be observed in the short-term due to adverse effects to non-target plant species and water quality degradation from the use of herbicides, but the impacts would not last after the herbicide become inert. However, flowering rush control under the No Action Alternative must still follow all EPA label restrictions and therefore effects are assumed to be less than significant. Additionally, there would be beneficial, moderate impacts over the long-term as herbicides would control invasive plants and native species would reestablish.

Manual and Mechanical Treatment Methods:

Application of manual/mechanical methods could increase the potential for erosion and sedimentation into surface waters. Manual/mechanical methods could also create plant fragments, which may increase the spread of flowering rush throughout the wetland and temporarily increase turbidity.

DASH is an efficient manual/mechanical method, but may disturb native wetland organisms. Vacuum harvesting does not only collect plants that are directly placed into the hose, but it also collects anything that meets the nozzle including native plants. Impacts on water quality from manual/mechanical methods would be minor to moderate, because generally only small infestations would be treated with manual/mechanical control, thus reducing the potential for erosion.

Manual/mechanical control of weeds would range from minor to major adverse impacts to wetlands in the short term. Impacts would be limited to the immediate area where vegetation removal would occur. Regrowth of vegetation would occur within a few growing seasons. Long-term impacts would be beneficial as it is anticipated native wetland species would become reestablished in treated areas.

Benthic Barriers:

Benthic barriers reduce wetland habitat by covering the sediment. The growth of both flowering rush and non-target plants would be prohibited while the benthic barrier remains anchored and intact. Benthic barriers are only suitable for localized control. Adverse impacts to wetlands would be minor to moderate in the short-term due to potential negative affects to non-target plant species.

3.3.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Flowering rush control cost shared with the PSMFC could treat up to double the acreages as under the No Action Alternative, if state and local agencies fully maximized their budgets. The impacts of chemical, manual, or mechanical flowering rush treatment are the same as discussed under Alternative 1 with the following exceptions.

Chemical Treatment Methods:

The only non-selective herbicides that would be used for cost shared flowering rush would be Imazapyr, Diquat dibromide, and Glyphosate. The three listed non-selective herbicides do not persist long in the environment due to exposure to light (Imazapyr, half-life is 3-5 days) and rapid absorption by soils or break-down by microorganisms (Diquat and Glyphosate), thus limiting the exposure of non-target plants to these chemicals.

Conservation measures (Section 3.12) would be applied to reduce or eliminate chemical misapplications, spills, overspray, and spray drift (as discussed in the No Action Alternative). Minimizing application methods would reduce impacts to water quality in wetlands and limit the damage to non-target vegetation.

The impacts of chemical methods under the Proposed Action would be minor to moderate in the short-term because there is still the potential for water quality degradation and impact on non-target plants. These effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative. There would be beneficial, moderate impacts over the long-term as herbicides would control invasive plants and native species would reestablish.

Manual and Mechanical Treatment Methods:

Impacts from manual/mechanical methods would be similar to impacts under the No Action Alternative; with one major exception, vegetation rakes would not be used in wetlands. Manual/mechanical methods would have minor to moderate adverse impacts on wetlands in the short term and minor to moderate beneficial impacts in the long term. These effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative.

Benthic Barriers:

Impacts would be the same as the No Action Alternative. These effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative.

3.4 Aquatic Wildlife

3.4.1 Affected Environment

The biological aquatic resources include fish species, reptiles, amphibians, and mollusks that depend on the freshwater ecosystems within the project area for some or all of their life cycles. Fish are either resident fish that do not migrate out to the ocean or anadromous fish, born in fresh water, spend most of its life in the sea, then return to fresh water to spawn. Amphibians begin their life in freshwater with gills and tails and as they grow, they develop lungs and legs for their life on land. Freshwater mollusks are confined to permanent bodies of water, including creeks, rivers, ponds, and lakes. Aquatic insects are abundant in most freshwater habitats and often exhibit high diversity. In aquatic food webs, they serve as food items for nearly the full range of vertebrate and invertebrate predators, and many function as predators themselves.

CRB

The CRB provides habitat for hundreds of species of native and non-native aquatic organisms. The CRB has been significantly altered as a result of hydroelectric and agricultural development. Disturbance in the region is greater than a 15% equivalent clear-cut area within the Middle Columbia River watershed. Currently there is only a thin band of riparian vegetation along the Columbia River as the natural riparian and floodplain was inundated. Historically, the Columbia River may have had a larger riparian area and small floodplain.

While the Columbia River dams are run-of-river dams that generally pass the incoming river volume, the forebay pools act much like one large pool. The reservoirs are much deeper and wider than the pre-impoundment Columbia River. Furthermore, upstream dams alter the movement of sediment through the action area, resulting in few accumulations of suitable spawning gravels, most of the substrate consists entirely of sand. In many places no riparian trees are present at all along the Columbia River, often replaced by levees and riprap. Levees were constructed to confine the river and prevent the river from accessing the floodplain.

In the CRB, flowering rush has been found growing in a wide range of substrate types, from rock to sand to muck (Rice and Dupuis 2009 and Jacobs et al. 2011). It will also grow in still to moderately flowing water. Water level fluctuations can promote its growth, though it would also thrive where water levels are stable (Hroudova 1989 and Hroudova et al. 1996).

The most notable fish species migrating and spawning throughout the CRB are salmon and steelhead. The altered conditions of the Columbia River with sandy bottoms, rocky stream banks, and slow-moving fluctuating pools may facilitate flowering rush invasion reducing spawning habitat for salmonids and increasing habitat for predatory fish. Salmon are discussed in more detail because of their ecological, cultural, and economic importance in the CRB.

The most well-known anadromous fish in the CRB are salmonids (salmon, trout, and char). Several agencies monitor salmonid populations due to the ecological and economic importance and declining numbers (warranting the listing of several species on the Endangered Species List). Known as a keystone species (Willson and Halupka 1995), Pacific salmon are a food source for many marine, freshwater, and land animals and provide marine nutrients to freshwater environments post-spawning (Cederholm et al. 1999).

MRB

The Missouri River ecosystem experienced a marked ecological transformation during the twentieth century. At the beginning of the century, the Missouri River was notorious for large floods, for a sinuous and meandering river channel that moved freely across its floodplain, and for massive sediment transport. Seven large dams were constructed along the Missouri River during the twentieth century and floodplain areas along the upper Missouri were inundated by the reservoirs. Large areas of native vegetation communities in downstream floodplains were converted into farmland. Many native fish species experienced substantial reductions while nonnative fishes thrived is some areas (National Research Council 2002).

The clear water in the reservoirs provided an advantage to “sight feeding” native species, such as the walleye, which was a species in relatively low abundance whose numbers increased dramatically with habitat changes caused by the reservoirs. Just as these environmental changes made conditions better for some species, other species that were better adapted to pre-regulation conditions, such as the sauger (*Stizostedion canadense)*, experienced declines with the replacement of a free-flowing river by the system of reservoirs (National Research Council 2002).

PSB

Fifteen native species of anadromous fish use marine and freshwater of the Puget Sound area. These include all five species of Pacific salmon (Chinook (*Oncorhynchus tshawytcha*), pink (*O. gorbuscha*), Coho (*O. kisutch*), chum (*O. keta*), and sockeye (*0.Nerka*)), two species of native char (bull trout (*Salvelinus confluentus)* and Dolly Varden (*S. malma*), steelhead (*Oncorhynchus mykiss*) and coastal cutthroat trout (*O. clarki*), longfin smelt (*Spirinchus Thaleichthys*), eulachon (*Thaleichthys pacificus*), white sturgeon (*Acipenser transmontanus*), and green sturgeon (*A. medirostris*), and two species of lamprey.

Fish species

CRB: Chinook salmon, Sockeye salmon, Coho salmon, Chum salmon, pink salmon, rainbow trout (*O. mykiss*), Cutthroat trout, steelhead, bull trout, Dolly Varden, western brook lamprey (*Lampetra richardsoni*), mountain whitefish (*Prosopium williamsoni*), Pacific lamprey (*L. tridentata*), and white sturgeon, as well as a variety of minnow, suckers, catfish, and sport fish.

MRB: shovelnose sturgeon (*Scaphirhynchus platorynchus*), pallid sturgeon (S. albus), paddlefish (*Polyodon spathula*), burbot (*Lota lota*), sauger, walleye (*Sander vitreus*), northern pike (*Esox lucius*), a variety of minnows, suckers, catfish, and sport fish.

PSB: Chinook salmon, Sockeye salmon, Coho salmon, Chum salmon, pink salmon, steelhead, bull trout, Dolly Varden, longfin smelt, eulachon, western brook lamprey, Pacific lamprey, white sturgeon, and green sturgeon.

Reptile Species

CRB: painted turtle (*Chrysemys picta*)

MRB: western spiny softshell (*Trionyx spiniferus*) and painted turtle

PSB: western pond turtle (*Clemmys marmorata*) and painted turtle

Amphibian species

CRB: western toad (*Bufo boreas*), bullfrog (*Lithobates catesbeianus*), woodhouse toad (*Bufo woodhouseii*), Pacific tree frog (*Pseudacris regilla*), Columbia spotted frog (*Rana luteiventris*), Great Basin spadefoot (*Spea intermontana*), leopard frog (*Rana pipiens*), and long-toed salamander (*Ambystoma macrodactylum*).

MRB: tiger salamander (*A. tigrinum*), plains spadefoot (*Spea bombifrons*), Woodhouse's toad (*Bufo woodhousii*), Great Plains toad (*B. cognatus*), western chorus frog (*Pseudacris triseriata*), and northern leopard frog (*Rana pipens*).

PSB: Pacific giant salamander (*Dicamptodon tenebrosus*), Cope's giant salamander (*D. copei*), Olympic torrent salamander (*Rhyacotriton olympicus*), northwestern salamander (A. gracile), long-toed salamander (*A. macrodactylum*), rough-skinned newt (*Taricha granulosa*), Oregon ensatina (*Ensatina escholtzii*), western red-backed salamander (*Plethodon vehiculum*), tailed frog (*Ascophus truei*), western toad (*Bufo boreas*), Pacific tree frog, bullfrog, red-legged frog (*R. aurora*), Cascades frog (*R. cascadae*), and Oregon spotted frog (*R. pretisosa*).

Mollusk species

Snails, mussels, and clams. Examples include: Western ridged mussel (*Gonidea angulate*), fingernail clams and pea clams (Family *Sphaeriidae*), non-native Asian clams (*Corbicula fluminea*) and the great pond snail.

Common aquatic insects include: mayflies (*Ephemeroptera* spp.), caddisflies (*Trichoptera* spp.), dragonflies (*Odonata* spp.), and stoneflies (*Plecoptera* spp.).

3.4.2 Environmental Consequences

3.4.2.1 Alternative 1: No Action Alternative

State agencies, municipalities, and landowners would continue their current program to control flowering rush invasion. Weed management in freshwater habitats would result in the reduction of or prevention of expanding infestations and ultimately enhance freshwater habitats. Enhancing freshwater habitats would benefit aquatic species and improve ecological function. The primary methods of treatment would remain chemical, manual, or mechanical methods.

Without any treatment, flowering rush would have greater effects on fish habitat by forming dense stands in previously un-vegetated or sparsely-vegetated aquatic environments (Jacobs et al. 2011). Dense stands of flowering rush would be a disadvantage to native salmonid species that require open water to spawn, and actually be an advantage to introduced fish that prey upon native fish (Perkowski 2014). For example, largemouth bass (*Micropterus salmoides*), yellow perch (*Perca flavescens*), and northern pike (*Esox Lucius*) spawn in vegetated substrata. Largemouth bass and northern pike are ambush predators that hide in flowering rush vegetation. Introduced predatory fish species are depredating native fish populations and impairing the recovery of native salmonids in the Columbia River watershed (Tabor et al. 1993, Fritts and Pearsons 2004, and Bonar et al. 2005).

Chemical Treatment Methods:

Chemical toxicity from pesticide applications can directly impact aquatic wildlife. Aquatic species may encounter pesticides through direct application, drift, overspray, or consumption of insects that may accumulate pesticides through its diet. Additionally, rapid-acting herbicides may cause low oxygen conditions to develop as plants decompose which may result in fish kills in ponds or lakes. Herbicides can also kill salmonid species directly or through continued exposure (OPEN1999). Adverse effects to aquatic wildlife are dependent on a number of factors including the dosage, duration, or exposure, and particular species being exposed.

Site isolation would prevent effective concentrations of treatment chemicals from occurring outside intended treatment areas. Therefore, the effects of the proposed treatments are anticipated only for the specific, isolated treatment area, and are not applicable to the remainder of the waterbody or associated species populations.

Adverse effects to aquatic species could be seen in the short-term due to the potential negative effects discussed above and water quality degradation (Section 3.2) from the use of herbicides. However, flowering rush control under the No Action Alternative must still follow all EPA label restrictions and therefore are assumed to be less than significant. Additionally, there would be beneficial, moderate impacts over the long-term as herbicides would control invasive plants and improve aquatic habitat quality.

Manual and Mechanical Treatment Methods:

Nonchemical control can also be effective. Mechanical control using a vegetation rake has provided multiple years of control in Idaho irrigation canals. Raking creates abundant rhizome fragments, however, and may lead to colonization of downstream sites; for this reason raking should only be used on screened canals. Hand-pulling by divers and covering the treated area with bottom barriers have both been effective methods, but are only economically viable on small patches of plants. Vegetation rakes may collect small fish, amphibians, turtles, and aquatic insects in the bucket as plants are scooped and ripped from the sediment.

Vacuum harvesting may collect small aquatic organisms that meet the nozzle. Small organisms may be drawn into the hose and relocated from their natural habitat. Sound and vibration disruptions produced could also place stress on organisms above and below the surface.

Manual and mechanical methods under the No Action Alternative have the potential to adversely affect aquatic species through disturbance, increased turbidity, increased water temperature, and food resource impacts. Manual/mechanical control of weeds would range from minor (hand-pulling and DASH) to moderate (vegetation rakes) adverse impacts to aquatic species in the short term and beneficial impacts in the long term as it is anticipated aquatic species would become reestablished in treated areas.

Benthic Barriers:

Benthic barriers interfere with fish spawning and bottom-dwelling animals. Benthic barriers are only suitable for localized control so potential adverse impacts to aquatic species would be minor to moderate in the short-term due to the displacement of bottom-dwelling animals and the potential loss of small areas of spawning habitat. Short-term impacts would be minor.

3.4.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Flowering rush control cost shared with the PSMFC could treat up to double the acreages as under the No Action Alternative, if state and local agencies fully maximized their budgets. The beneficial effects of flowering rush control to aquatic resources would be greater than those seen in the No Action Alternative, if cost share partners are able to treat additional locations due to the additional funding. The adverse effects of chemical, manual, or mechanical flowering rush treatment are the same as discussed under Alternative 1 with the following exceptions.

Chemical Treatment Methods:

Conservation measures (Section 3.12) would be applied to reduce or eliminate chemical misapplications, spills, overspray, and spray drift. The minimizing application methods would reduce impacts to aquatic species. The following chemicals, discussed in Section 2.2.3 (Chemical Descriptions), are covered for use under this method.

Ammonium salt of imazamox is practically nontoxic to finfish and aquatic invertebrates. Acute fish toxicity occurs in rainbow trout (cold water species) at concentrations greater than 122 mg/L and in bluegill sunfish (warm water species) at concentrations greater than 119 mg/L. Aquatic invertebrate toxicity occurs at concentrations greater than 122 ppm (EPA 1997). Fish would not be exposed to concentrations equal to or greater than the amounts discussed above, therefore Ammonium salt of imazamox expected to pose only a minimal risk to aquatic organisms from exposure.

Imazapyr is practically non-toxic to freshwater fish (lethal concentration required to kill 50% of the population is greater than 100 mg/L), and to freshwater invertebrates (concentration with a response halfway between the baseline and maximum (EC50) is greater than 100 mg/L). No Observed Adverse Effect Concentration (NOAEC) for the early life-stage and full life cycle in fish range was between 118 and 120 mg/L. Chronic toxicity testing in freshwater invertebrates showed the NOAEC was 97.1 mg/L (EPA 2003). Imazapyr is therefore expected to pose only a minimal risk to aquatic organisms from exposure.

Diquat dibromide may pose acute or chronic risk to aquatic organisms, but the probability that exposure would occur is relatively low because diquat is rapidly absorbed by plants and soils. Diquat dibromide is therefore expected to pose only a minimal risk to aquatic organisms from exposure.

The presence of diquat products at concentrations effective against weeds in wetland environments may adversely affect these environments. Dilution should mitigate the effects of diquat so that it does not affect non-target animals. The presence of diquat in the lotic environment, due to outflow from a lake or pond, may kill aquatic plants favorable to sunfish, minnows, and bass. The subsequent habitat, with a low level of aquatic weed cover and a bottom consisting primarily of sand and gravel would be more appropriate to the production of salmonids (WSDE 2002).

Endothall dipotassium salt is applied directly to the aquatic environment. On an acute basis, the dipotassium salt is considered to be slightly toxic to practically non-toxic to freshwater fish and invertebrates (EPA 2005). At recommended rates, the dipotassium salts do not have any apparent short-term effects on the fish species that have been tested. In addition, numerous studies have shown the dipotassium salts induce no significant adverse effects in aquatic invertebrates (such as snails, aquatic insects, and crayfish) when used at label application rates (Table 2-1).

Glyphosate is practically nontoxic to fish and aquatic invertebrates (EPA 1993). Studies of the effects of glyphosate on salmonid species have found that when used at recommended rates it poses little or no risk of acute toxicity. The effects of glyphosate formulations on four species of frogs suggested that effects were largely due to the surfactant, citing no significant acute toxicity from glyphosate itself and the highest toxicity from the surfactant POEA, which is used in the common form of glyphosate known as Roundup (Howe et. al. 2004). Similarly, a study of the effects of Rodeo (glyphosate) found that moderate toxicity to larval frogs was from the surfactant R-11 and not Rodeo (Trumbo 2005). Glyphosate is therefore expected to pose only a minimal risk to aquatic organisms from exposure.

Impacts to aquatic species using chemical methods under the Proposed Action Alternative would be moderate to negligible in the short-term due to the restriction in chemicals, the conservation measures (Section 3.12), and the fact that applicators must follow all EPA label restrictions. No significant impacts to aquatic species are expected as a result of this action. Long-term impacts would be moderately beneficial.

Manual and Mechanical Treatment Methods:

Manual and mechanical methods would have similar effects to aquatic species as those described under the No Action Alternative, but these effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative. The difference is that vegetation rakes would be limited to screened irrigation canals to minimize impacts to fish. Limiting the use of vegetation rakes to screened irrigation canals would reduce the range of adverse impacts to aquatic organisms to minor or moderate in the short term.

Benthic Barriers:

Benthic barriers would have the same effects to aquatic species as those described under the No Action Alternative, but these effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative.

Long-term benefits of flowering rush treatment

Long-term benefits of flowering rush treatment include improved habitat, reduced predatory fish habitat, and increased ambient light. Promotion of native habitats would help reduce available spawning and rearing habitat for predatory fish, and improve access for foraging, rearing, refugia, and migration. Flowering rush stands can alter ambient light in treatment areas. Controlling infestations would help avoid and reduce the negative effects of altered ambient light regimes from pest species. Changes to the ambient light regime and riparian and benthic habitat resulting from flowering rush control would benefit fish behaviors and juvenile survivability. To the extent that a reduced financial burden would allow state and local agencies to more effectively combat flowering rush, the Proposed Action would have greater long-term benefits than the No Action Alternative.

3.5 Vegetation

3.5.1 Affected Environment

Riparian, lotic, and wetland plant communities within the FSA vary across the landscape based on the environmental factors such as elevation, climate, and physical and chemical characteristics present at each location.

Columbia and Missouri River Basins

High elevation sites within the watersheds are typically dominated by lodgepole pine (*Pinus contorta*), Drummond's willow (*Salix drummondiana*), Geyer's willow (*S. geyeriana*), Booth's willow (*S. boothii*), Sitka willow (*S. sitchensis*), green alder (*Alnus viridis*), subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), grey alder (*A. incana*), northern black currant (*Ribes hudsonianum*), twinberry honeysuckle (*Lonicera invulcrata*), thimbleberry (*Rubus parviflorus*), huckleberry (*Vaccinium membranaceum*), mountain rush (*Juncus balticus*), mountain boykinia (*Boykinia major*), Kentucky bluegrass (*Poa pratensis*), Nebraska sedge (*Carex nebrascensis*), Canby's licorice-root (*Ligusticum canbyi*), and fireweed (*Chamerion angustifolium*) (Hough-Snee et al. 2015).

Low elevation watersheds can be dominated by western red cedar (*Thuja plicata*), grand fir (*Abies grandis*), ponderosa pine (*Pinus ponderosa*), black cottonwood (*Populus* balsamifera *trichocarpa*), Rocky Mountain maple (*Acer glabrum*), black hawthorn (Crataegus douglasii), shinning willow (S*. lucida*), mock orange (*Philadelphus lewisii*), snowberry (*Symphoricarpos albus*), northern oak fern (*Gymnocarpium dryopteris*) and lady fern (*Athyrium filix-femina*), Canada thistle (*Cirsium arvense*), threeleaf foamflower (*Tiarella trifoliate*), Alpine enchanter's-nightshade (*Circaea alpine*), panicled bulrush (*Scirpus microcarpus*), and spike-rush (*Eleocharis palustris*) (Hough-Snee et al. 2015).

Heavily forested watersheds can be dominated by watermelon berry (*Streptopus amplexifolius*), prickly currant (*Ribes lacustre*), creeping dogwood (*Cornus canadensis*), and twinflower (*Linnaea borealis*) (Hough-Snee et al. 2015).

PSB

Riparian vegetation characteristic of Puget Sound lowlands includes coniferous trees such as western hemlock (*Tsuga heterophylla*), Douglas fir (*Pseudotsuga menziesii*), and western red cedar. Pacific madrone (*Arbutus menziesii*) occurs in drier areas. Native deciduous trees such as red alder (*A. rubra*), big leaf maple (*Acer macrophylla*), and vine maple (*Acer circinatum*) are present if there is disturbance, minimal soil development, and a local seed source to facilitate colonization. Shrubs and understory plants such as ocean spray (*Holodiscus discolor*), Oregon grape (*Mahonia spp.*), Indian plum (*Oemlaria cerasiformis*), and sword ferns (*Polystichum munitum*) are common in riparian areas (Brennan 2007).

In large river deltas, the majority of the forested wetlands and riparian zones are entirely devoid of trees or consist of sparse, narrow, and patchy strips of small-to medium-sized cottonwood, willow, and alder. River channelization and bank stabilization with levees have required vegetation removal, which results in the majority of the stabilized banks being covered with grasses and invasive species of low value to the native fish and wildlife. Invasive shrubby species such as Himalayan blackberry (*Rubus armenicus*), butterfly bush (*Buddleja davidii*), reed canary grass (*Phalaris arundinacea*), and Japanese knotweed (*Polygonum spp.*) commonly invade disturbed areas, often so aggressively that they inhibit establishment of native vegetation.

3.5.2 Environmental Consequences

3.5.2.1 Alternative 1: No Action Alternative

State agencies, municipalities, and landowners would continue their current program to control flowering rush invasion. Weed management in the FSA would result in the reduction of or prevention of expanding infestations and ultimately enhance native plant communities. Enhancing native vegetation would eventually provide higher quality habitat for wildlife and aquatic species and improve watershed function. The primary methods of treatment would remain chemical, manual, or mechanical methods.

Chemical Treatment Methods:

Chemical misapplications, spills on land, overspray, and spray drift would cause direct impacts to native or non-target terrestrial plants. Indirect impacts to terrestrial plants would occur if herbicides in the water were taken up by shoreline vegetation with roots extending into the water. Potential impacts to terrestrial plants include mortality, reduced productivity, and abnormal growth. Impacts would be minor to moderate depending on the sensitivity of the plant species to the specific herbicide and the dose to which the plant was subjected. Individual plants could perish entirely, but less than significant effects would be seen in vegetation communities overall. Impacts would be limited to the immediate area where vegetation removal would occur. Regrowth of vegetation would occur within a few growing seasons.

Manual and Mechanical Treatment Methods:

Vegetation rakes operated from the shorelines would have moderate adverse effects to shoreline vegetation due to crushing, breaking, or removal. The severity of the impact would depend on the amount of vegetation present. Impacts would be limited to the immediate area where vegetation removal would occur, and trampled vegetation would be expected to regrow within two seasons. However, it is not likely that vegetation rakes would be operated from the shoreline in heavily vegetated areas. Aquatic vegetation rakes (AVR) would be used instead. Aquatic vegetation rakes can best be described as a floating barge upon which a backhoe is mounted. The AVR can operate in water as shallow as 1.0 foot and can remove nuisance vegetation and bottom debris from water depths ranging from 18 inches to 10 feet. Because the AVR works from the water rather than land, plant species along the shoreline are not impacted. Raking creates abundant rhizome fragments, however, and may lead to colonization of downstream sites impacting native plant communities downstream. Impacts of vegetation rakes could range from negligible to moderate. Hand-pulling and DASH control methods would have negligible to no impacts on terrestrial plant species.

Benthic Barriers:

Benthic barriers would have no impacts to terrestrial vegetation.

3.5.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Flowering rush control cost shared with the PSMFC could treat up to double the acreages as under the No Action Alternative, if state and local agencies fully maximized their budgets. The impacts of chemical, manual, or mechanical flowering rush treatment are the same as discussed under Alternative 1 with the following exceptions:

Chemical Treatment Methods:

Chemical treatment methods under the Proposed Action Alternative would be similar in scope but fewer chemicals would be used than under the No Action Alternative. Conservation measures (Section 3.12) would also be applied to reduce or eliminate chemical misapplications, spills, overspray, and spray drift. Impacts would be minor to moderate due to the conservation measures, but these effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative.

Manual and Mechanical Treatment Methods:

Vegetation rakes would only be used in screened irrigation canals. The impacts of operating the vegetation rake from the shoreline would be minor to moderate due to the fact that treatment would take place in disturbed landscapes through which the irrigation canals run, but these effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative.

Benthic Barriers:

Benthic barriers would have no impacts to terrestrial vegetation.

3.6 Terrestrial Wildlife

3.6.1 Affected Environment

Riparian corridors (rivers, streams, and adjacent lands) are particularly valuable habitats for wildlife. This includes many of what are ordinarily thought of as "upland" species as well as wetland species. Many mammals, birds, and reptiles are dependent on undeveloped, vegetated riparian areas along rivers and streams for movement corridors, hiding cover, hunting, and drinking.

Mammal species dependent upon on the habitats provided by rivers, streams and associated ponds and wetlands include mink (*Neovison vison*), muskrat (*Ondatra zibethicus*), river otter (*Lontra canadensis*), American water shrew (*Sorex palustris*), American beaver (*Castor canadensis*), and moose (*Alces alces*). Many other species, however, spend much of their lives within the habitats immediately surrounding the waterways; they are dependent on mixed upland and lowland habitat. Species in this category include everything from raccoon (*Procyon lotor*) to deer, which often forage in the water. Bats often forage on insects above the water. All of these species, as well as many others, occasionally use river corridors as travel routes.

Riparian and wetland habitat provides essential habitat for migrating birds and waterfowl. Many other shorebird species occur along rivers where appropriate mud bars develop. Belted kingfishers (*Megaceryle alcyon*) patrol rivers from the headwaters to the sea in search of small fish. Osprey (*Pandion haliaetus*) flourish along rivers and many species of herons and bittern depend to a large extent on riparian corridors for food, roosting and nesting sites. Bald eagles (*Haliaeetus leucocephalus*) frequent riverine corridors in search of fish and roosting areas. Birds such as cormorants, night herons, and gulls follow river systems for many miles inland in search of good feeding areas. River corridors are also major migration routes for many species of songbirds such as vireos, flycatchers, thrushes, tanagers, and wood warblers.

Reptiles are far less mobile than birds and mammals. Many of the reptiles associated with riparian and wetland habitats in the United States (turtles, snakes, and a few lizards) are the opposites of amphibians in life history strategy. They differ by using riparian and wetland areas for food and cover, but move to the habitat edge or to drier land to deposit eggs (Clark 1979).

3.6.2 Environmental Consequences

3.6.2.1 Alternative 1: No Action Alternative

State agencies, municipalities, and landowners would continue their current program to control flowering rush invasion. The effects of flowering rush control on wildlife would likely include displacement of mammals, birds, and reptiles as a result of staging and operation of equipment. Application could also cause direct and indirect injuries to wildlife.

Any loss of shoreline vegetation as discussed in Section 3.5 would affect wildlife habitat by reducing cover, perching, foraging, and nesting opportunities. Impacts of flowering rush treatment on terrestrial wildlife would range from minor to moderate depending on the size of the treatment site, the time of year treatment took place, the amount of wildlife present, duration of treatment, and scarcity of similar habitat for displaced wildlife. Long-term impacts of flowering rush treatment would benefit terrestrial wildlife due to increased water quality, return of native vegetation, and improved ecological function.

Chemical Treatment Methods:

Herbicides have been designed to target biochemical processes, such as photosynthesis, that are unique to plants and are not typically acutely toxic to animals (Tatum 2004). Most health problems in animals result from exposure to excessive quantities of herbicides because of improper or careless use or disposal of containers. When herbicides are used properly, poisoning problems in are rare. Vegetation treated with herbicides at proper rates would not be hazardous to animals; particularly after the herbicides have dried on the vegetation (Gupta 2019).

However some herbicides can have subtle physiological, developmental, and behavioral effects on animals if they come in contact. There are four pathways through which wildlife can be impacted by herbicides: Acute poisoning, chronic poisoning, secondary poisoning, and indirect effects.

Acute toxicity may kill or sicken wildlife. Acute toxicity is rare and would only occur if an animals gained direct access to the product (Gupta 2019). Acute poisoning to wildlife takes place over a relatively short time, impacts a very localized geographical area, and is linked to a single pesticide.

Chronic poisoning happens after exposure to pesticides over an extended period of time. The most well-known example of a chronic effect in wildlife is that of the organochlorine insecticide DDT (via the metabolite DDE) on reproduction in certain birds of prey.

Secondary poisoning occurs when an animal consumes food that contains pesticide residues. Examples of secondary poisoning are (1) birds of prey becoming sick after feeding on an animal that is dead or dying from acute exposure to a pesticide, and (2) the accumulation and movement of persistent chemicals in wildlife food chains.

Indirect impacts occur when pesticides modify part of an animal's habitat or food supply. For example, herbicides may reduce food, cover, and nesting sites needed by insect, bird, and mammal populations.

Wildlife and non-target plant species may be unintentionally impacted during normal application of an aquatic herbicide as a result of direct spray, contact with leaves after herbicide application, or consumption of food items sprayed during application. These exposures may occur within the application area (direct spray) or outside of the application area (consumption of terrestrial food items sprayed by aquatic herbicide) (BLM 2005).

Accidental spills, overspray, and spray drift can damage non-target vegetation and directly impact wildlife species; however, the more common routes of exposure for terrestrial wildlife to aquatic applications of herbicides are indirect such as: drinking water treated with herbicides, eating aquatic plants or plants along a shoreline that have been treated accidentally by overspray, or by eating fish or other aquatic organisms from the treatment site (WSDE 2002).

Some species could experience adverse impacts through direct or indirect exposure to pesticides while other species would encounter beneficial impacts through improved habitat. Due to the unknown application procedures of herbicides under the No Action Alternative, impacts to terrestrial wildlife could range from minor to moderate in the short-term for the reasons discussed above.

Manual and Mechanical Treatment Methods:

Vacuum harvesting may collect small reptiles in the water which meet the nozzle. Vegetation rakes may collect small reptiles in the bucket as plants are scooped and ripped from the sediment. Additionally, sound and vibration disruptions produced by the staging and operation of equipment could also place stress on organisms above and below the surface. Impacts to terrestrial wildlife could range from minor (Hand-pulling and DASH) to Moderate (vegetation rakes) in the short-term.

Benthic Barriers:

Benthic barriers would have negligible impacts to terrestrial wildlife.

3.6.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Flowering rush control cost shared with the PSMFC could treat up to double the acreages as under the No Action Alternative, if state and local agencies fully maximized their budgets. The impacts of chemical, manual, or mechanical flowering rush treatment are the same as discussed under Alternative 1 with the following exceptions:

Migratory bird nesting season and flowering rush control would overlap in areas of the FSA. Flowering rush control would take place during flowering rush growing season which begins in February and ends with the fall frost. Migratory birds nesting season begins April 1 and ends August 15. It has been shown that impacts to birds from herbicide spraying have largely been tied to changes in vegetation composition and not direct impacts to birds themselves (Solberg and Higgins 1993). Any direct damage to terrestrial vegetation, and thus indirect impact to birds, would be from the misapplication of the aquatic herbicides and be localized to the area of the spill or overspray.

If a Corps funded flowering rush treatment is expected to impact any migratory bird species, coordination with the U.S. Fish and Wildlife Service (USFWS) would be initiated in order to minimize any impacts to these species. Minimization measures provided by the Services after consultation would help ensure the effect of flowering rush treatment on migratory birds would be minor.

Chemical Treatment Methods:

Impacts to terrestrial wildlife due to chemical applications are expected to be less than the impacts described under the No Action Alternative. The lesser impacts are due to fewer chemicals used than under the No Action Alternative and conservation measures (Section 3.12) to reduce or eliminate chemical misapplications, spills, overspray, and spray drift; however, wildlife could still be indirectly exposed to aquatic herbicides as discussed under the No Action Alternative. Impacts of each chemical are discussed below. Most data are on mammals and birds with little information regarding the toxicity of herbicides to reptiles; however, no significant exposures are anticipated to any terrestrial wildlife.

Imazamox has been subject to a standard and relatively extensive series of acute, subacute, and chronic studies in mammals. There is little doubt that imazamox is practically nontoxic to mammals. Data on the toxicity of imazamox to birds are less extensive but include both acute toxicity and reproduction studies that fail to identify any potential hazards to birds. For other groups of animals the toxicity data are very limited, but fail to suggest any hazards (Durkin 2010).There would be no significant exposures are anticipated to any terrestrial wildlife.

Similarly, imazapyr is believed to be virtually non-toxic to mammals with no significant bioaccumulation reported (WSDA 2009). Acute, subchronic, and chronic toxicity studies on imazapyr do not demonstrate adverse effects that are unequivocally attributable to exposure. This uncertainty or a lack of knowledge has a relatively minor impact on this risk assessment, because the available toxicity studies are relatively complete—chronic studies in three mammalian species (dogs, rats, and mice) and several reproduction studies in two mammalian species (rats and rabbits)—indicate that imazapyr is not likely to be associated with adverse effects at relatively high-dose Levels. The available avian studies on imazapyr do not report any signs of toxicity (Durkin 2011). There would be no significant exposures are anticipated to any terrestrial wildlife.

Diquat dibromide is moderately toxic to mammals and ranges from moderately toxic to practically nontoxic to birds, depending on the species (EPA 1986). Diquat is poorly absorbed from the gastrointestinal tract of rats, cows, and goats and mainly eliminated via the feces during the first 24 hours, the small part that is absorbed would be eliminated via the urine (FAO/WHO 1994). Diquat could have minor impacts to terrestrial wildlife.

Excessive exposures to endothall are most likely to be associated with portal of entry effects—i.e., Oral exposure could damage to the gastrointestinal tract, dermal exposure could lead to skin irritation, inhalation exposure could lead to respiratory tract irritation. Because endothall is used only as an aquatic herbicide in Corps funded applications, any exposures are likely to involve the consumption of contaminated water. The most plausible effects of exposure are likely to involve irritation of the gastrointestinal tract. Birds appear to be less sensitive than mammals to potential effects of endothall exposure (Durkin 2009). There could be minor impacts to terrestrial wildlife.

The application of glyphosate-based herbicides in forest vegetation management is not considered to pose a significant risk of direct toxicity to small mammals or birds. Indirect effects resulting from alteration of vegetative habitat or food availability do occur, however these are transient effects and depend on individual species preferences (Durkin 2011). There would be no significant exposures to any terrestrial wildlife.

Manual and Mechanical Treatment Methods:

Impacts to terrestrial wildlife would be the same as under the No Action Alternative, but may occur at a greater number of treatment locations.

Benthic Barriers:

Benthic barriers would have negligible impacts to terrestrial wildlife.

3.7 Threatened and Endangered Species

3.7.1 Affected Environment

CRB

The Corps reviewed the lists of threatened and endangered species from the states of Washington (1EWFW00-2019-SLI-0789), Oregon (01EOFW00-2019-SLI-0323), Idaho (1EIFW00-2019-SLI-0932), and Montana (06E11000-2019-SLI-0325) that pertain to the CRB area under the jurisdiction of the USFWS (Appendix A Threatened and Endangered Species Lists). Threatened and Endangered species lists were also gathered for species under National Marine Fisheries Service (NMFS) jurisdiction and compiled into the analysis below. The analysis only discusses species that occur in or around the lakes, streams, rivers, and wetlands of the CRB; upland, coastal, and saltwater species are not included.

Terrestrial

Threatened and endangered mammal species in the CRB are the Canada lynx (*Lynx canadensis*), gray wolf (*Canis lupus*), grizzly bear (*Ursus arctos horribilis*), North American wolverine (*Gulo gulo luscus*), woodland caribou (*Rangifer tarandus caribou*), Columbia white-tailed deer (*Odocoileus virginianus leucurus*), and fisher (*Pekania pennant*).

Threatened and endangered birds in the CRB are the Northern streaked horned lark (*Eremophila alpestris strigata*), Northern spotted owl (*Strix occidentalis caurina*), yellow-billed cuckoo (*Coccyzus americanus*), piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and whooping crane (*Grus americana*).

The only endangered insect is the Fender's blue butterfly (*Icaricia icarioides fender*).

Aquatic

Threatened and endangered fish species under USFWS jurisdiction are Columbia River bull trout (*Salvelinus confluentus*), Coastal-Puget Sound bull trout, dolly varden (*S. malma*), and Lahontan cutthroat trout (*O. clarkii henshawi*).

Threatened and endangered fish species under NMFS jurisdiction are Upper Columbia spring run Chinook salmon (*Oncorhynchus tshawytscha*), Snake River spring/summer Chinook salmon, Snake River fall Chinook salmon, Upper Columbia River distinct population segment (DPS) steelhead (*O. mykiss*), Middle Columbia River DPS steelhead, Snake River DPS steelhead, Snake River Evolutionary Significant Unit (ESU) Sockeye salmon (*O. nerka*), and white sturgeon (*Acipenser transmontanus*).

The only threatened amphibian species in the CRB is the Oregon spotted frog (*Rana pretiosa*). There are two proposed threatened insects, meltwater lednian stonefly

(*Lednia tumana*) and Western glacier stonefly (*Zapada glacier*). There are three endangered snails in the CRB, Banbury Springs limpet (*Limpet lanx sp.*), Bruneau hot spring physa (*Pyrgulopsis bruneauensis*), Snake River physa snail (*Physa natricina*), and one threatened snail, Bliss Rapids snail (*Taylorconcha serpenticola*).

Vegetation

Threatened and endangered flowering plant species in the CRB are the Ute ladies'-tresses (*Spiranthes diluvialis*), water howellia (*Howellia aquatilis*), Willamette daisy (*Erigeron decumbens*), Bradshaw's desert parsley (*Lomatium bradshawii*), Howell's spectacular thelypody (*Thelypodium howellia ssp. Spectabilis*), and Wenatchee Mountains Checkermallow (*Sidalcea oregana var. clava*).

MRB

The Corps reviewed the lists of threatened and endangered species from the state of Montana (06E11000-2019-SLI-0326) that pertain to the MRB area under the jurisdiction of the USFWS (Appendix A Threatened and Endangered Species Lists). The analysis only discusses species that occur in or around the lakes, streams, rivers, and wetlands of the MRB; upland species are not included.

Terrestrial

Threatened and endangered mammal species in the MRB are the Canada lynx, gray wolf, grizzly bear, and North American wolverine. Threatened and endangered birds in the MRB are the least tern (*Sterna antillarum*), piping plover, red knot, and whooping crane.

Aquatic

Threatened and endangered fish species under USFWS jurisdiction are bull trout and pallid sturgeon (*Scaphirhynchus albus*).

Vegetation

Ute ladies'-tresses is the only threatened flowering plant species.

PSB

The Corps reviewed the lists of threatened and endangered species from the state of Washington (01EWFW00-2019-SLI-0788) that pertains to the PSB area under the jurisdiction of the USFWS (Appendix A Threatened and Endangered Species Lists). Threatened and Endangered species were also gathered for species under NMFS jurisdiction and compiled into the analysis below. The analysis only discusses species that occur in or around the lakes, streams, rivers, and wetlands of the PSB; upland, coastal, and saltwater species are not included.

Terrestrial

Threatened and endangered mammal species in the CRB are the Canada lynx, gray wolf, grizzly bear, North American wolverine, fisher, Olympia pocket gopher (*Thomomys mazama pugetensis*), Roy Prairie pocket gopher (*T. mazama glacialis*), Tenino pocket gopher (*T. mazama tumuli*), and Yelm pocket gopher (*T. mazama yelmensis*).

Threatened and endangered birds in the PSB are streaked horned lark, Northern spotted owl, yellow-billed cuckoo, and marbled murrelet (*Brachyramphus marmoratus*).

There are two endangered insect species, the island marble butterfly (*Euchloe ausonides insulamus*) and Taylor's checkerspot (*Euphydryas editha taylori*).

Aquatic

Threatened and endangered fish species under USFWS jurisdiction are the Coastal-Puget Sound bull trout and Dolly Varden.

Threatened and endangered fish species under NMFS jurisdiction are the Puget Sound Chinook ESU, Puget Sound steelhead DPS, eulachon (*Thaleichthys pacificus*), and North American green sturgeon (*Acipenser medirostris*).

The only threated amphibian in the PSB is the Oregon spotted frog.

Vegetation

Water howellia and Nelson's checker-mallow (*Sidalcea nelsoniana*) are threatened plant species in the PSB and marsh sandwort (*Arenaria paludicola*) is the only endangered flowering plant species.

3.7.2 Environmental Consequences

3.7.2.1 Alternative 1: No Action Alternative

State agencies, municipalities, and landowners would continue their current program to control flowering rush invasion. Weed management in the FSA would result in the reduction of or prevention of expanding infestations and ultimately enhance native plant communities. Enhancing native vegetation would eventually provide higher quality habitat for wildlife and aquatic species and improve watershed function. The primary methods of treatment would remain chemical, manual, or mechanical.

Chemical Treatment Methods:

Aquatic Threatened or Endangered Species

Application of chemicals to or near surface water has the potential to expose threatened or endangered aquatic species to herbicides, resulting in potential chemical toxicity that may impact the animal or their habitat. Effects from toxicity are a function of exposure to the toxic substance (herbicide), at a concentration, and for duration of exposure, sufficient to cause an effect. This is also dependent upon the composition and mode of action of the toxicant. The exposure depends on the application method, and the route of exposure (e.g. direct application, drift, or misapplication). Negative impacts of chemical treatments on threatened or endangered aquatic species would depend on the concentration, duration of exposure, species present, life stage of the listed species, and toxicity of the herbicide and associated compounds, but would range from minor to moderate.

Sub-lethal effects to aquatic threatened or endangered species include changes in behavior that render them susceptible to predation, compromised immune system, and effects to organs. Sub-lethal effects can also include changes in behaviors or body functions that are not directly lethal to the aquatic species, but could impact reproductive success or juvenile to adult survival. Effects of sub-lethal exposure to threatened or endangered aquatic species are expected to be minor.

Threatened or endangered aquatic species may be indirectly affected if their food source is impacted. Most herbicides have no effect on wildlife, but some may be irritants as described in Sections 3.4 (Aquatic Wildlife) and Section 3.5 (Terrestrial Wildlife). Pesticide treatments can be toxic to terrestrial and aquatic insects that are a source of food for listed aquatic species. The magnitude and duration of the potential stressor on riparian insects is related to the sensitivity of the invertebrate to the herbicide, the time the herbicide is in the environment, the extent of the area treated, the toxicity of the herbicide, and the life stages of the invertebrates affected by the herbicide.

Aquatic plants are a significant producer of macroinvertebrates, but treatments would not target native plant species or remove a proportion of vegetation great enough to adversely affect the overall habitat value. While aquatic plants are producers of macroinvertebrates, it is unlikely that the loss of flowering rush would result in a reduction in available food resources. Additionally, invasive plants host substantially less diverse invertebrate communities than native vegetation and provide impoverished food resources in comparison to native aquatic plants (Kovalenko et al. 2010; Phillips 2008; Wigginton et al. 2014). Native vegetation is typically able to reestablish quickly in the absence of invasive vegetation and abundance and diversity of macroinvertebrates can rapidly return to pre-invasion patterns (Beltman 1987; Kovalenko and Dibble 2011; Poovey et al. 2013; Roerslett and Johansen 1996).

Given the relatively small areas of food resources impacted during any one treatment cycle, food resource impacts would not reach a magnitude to cause responses in threatened or endangered aquatic species that may be present in the treatment area. Impacts to aquatic food sources would range from minor to moderate.

Use of chemicals may result in avoidance of treatment areas, or impacted olfactory function, resulting in delayed or affected migration of individuals in the immediate vicinity of treatment locations. However, given the size of the treatment areas in proportion to the lake or river, individuals would have opportunities to escape these areas, and use other, unaffected, portions for migration. Such disturbances could result in delayed migration for up to a few hours, but exposure to these disturbances are not likely to reduce individual performance. Impacts of chemical treatment on threatened or endangered fish migration would be minor.

Flowering rush treatment activities have the potential to decrease dissolved oxygen (DO) in the vicinity of the treatment area, which may affect threatened or endangered aquatic species. Aquatic plants generate DO and any large-scale loss of plants can reduce the amount of DO available. Die-off and decomposition of submerged plants can also contributes to low DO. This can be a problem with larger-scale treatments in treatment areas with slow moving water, such as in enclosed bays and more problematic during warmer summer months when DO is already lower due to warmer temperatures. However, given the minimal amount of DO that could be lost as a result of the proposed action, the impact of chemical treatments on DO would be moderate. Due to the exchange of water in all currently proposed treatment sites (Section 1.4) and likely areas of future occurrences in lake fringes, canals, or slow-moving river pools, exposure to the stressors produced is not likely to cause responses in listed aquatic species sufficient to reduce their individual performance. Therefore, response to this stressor would likely be minor.

Terrestrial Threatened or Endangered Species

Noise and human presence associated with flowering rush control could disturb threatened or endangered terrestrial species and cause them to evacuate the treatment site. Flowering rush treatments could also both directly and indirectly affect threatened or endangered terrestrial species through drinking water treated with products containing herbicides, eating aquatic plants or plants along a shoreline that have been accidentally treated by overspray, and by eating fish or other aquatic organisms from the treatment site (WSDE 2002). Impacts to terrestrial threatened or endangered species would be minor in the short-term for the reasons discussed above.

Threatened or Endangered vegetation

Effects to threatened or endangered vegetation would be the same or similar as the effects discussed in Section 3.5 (Vegetation). Impacts could be minor to moderate depending on the sensitivity of the plant species to the specific herbicide and the dose to which the plant was subjected. It is unlikely that state agencies would apply herbicides in the vicinity of threatened or endangered plants.

Manual and Mechanical Treatment Methods:

Manual and mechanical treatment activities occurring adjacent to or in occupied river or stream channels have the potential to disturb threatened or endangered aquatic species. This disturbance would be caused by the physical presence of people traveling immediately adjacent to or in streams or rivers to complete treatments. Impacts of manual and mechanical flowering rush treatment are further discussed in Section 3.4 (Aquatic Wildlife).

Threatened or Endangered Aquatic Species

Mechanical treatment activities such as DASH or vegetation rakes have the potential to injure or kill threatened or endangered aquatic species that may be present in treatment areas during treatments. These activities are associated with use of equipment that could strike the fish, or inadvertently capture fish. Exposure to these activities is inherently limited, because most aquatic species would move out of the area due to the disturbance associated with these activities, snails or larval insects as possible exceptions. Injury or death caused by mechanical treatment of flowering rush is moderate due to the low likelihood death or injury and the low number of individuals likely to be injured or killed.

Manual and mechanical treatment activities occurring adjacent to or in occupied river or stream channels have the potential to interfere with the migration of juvenile and adult fish. Interference may result in delayed migration or avoidance of the treatment area, resulting in altered migration patterns in localized areas. This would primarily occur when larger equipment is employed such as vegetation rakes or DASH. However, other treatments resulting in disturbance have the potential to result in interference in migration, albeit on a much smaller scale. The magnitude of this effect is related to the intensity and extent of flowering rush treatment. Mechanical treatments could have up to moderate effects on aquatic threatened or endangered species while manual treatments are likely to have minor impacts.

Threatened or Endangered Terrestrial Species

Noise and human presence associated with manual or mechanical flowering rush control could disturb or displace threatened or endangered terrestrial species. Manual or mechanical treatments could also directly affect prey species through trampling if treatments are conducted from the shoreline or displace prey species if they use emergent flowering rush as habitat. These effects would likely be insignificant as terrestrial threatened or endangered species generally have large foraging ranges and flowering rush treatments would be small in scale and occur only in localized patches along the riparian zone. It is unlikely there would be a noticeable change in an overall prey availability. Effects from reduced food sources from manual or mechanical treatment would be minor.

Threatened or Endangered Vegetation

Effects to threatened or endangered vegetation would be the same or similar as the effects discussed in Section 3.5 (Vegetation). Impacts of vegetation rakes could range from negligible to moderate. Hand-pulling and DASH control methods would have negligible to no impacts on terrestrial plant species. It is extremely unlikely that state agencies would deploy vegetation rakes in the vicinity of endangered or threaten plants.

Benthic Barriers:

Threatened or Endangered Aquatic Species

Benthic barriers interfere with fish spawning and bottom-dwelling animals. Benthic barriers are only suitable for localized control so potential adverse impacts to aquatic species would be minor to moderate in the short-term due to the displacement of bottom-dwelling animals and the potential loss of small areas of spawning habitat. Long-term impacts would be beneficial due to improved spawning habitat and reduced predator habitat from the removal of flowering rush.

Threatened or Endangered Terrestrial Wildlife and Vegetation

Benthic barriers would have negligible impacts to terrestrial wildlife and vegetation.

3.7.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Life history, biological requirements, distribution, critical habitat, common threats, and species specific effect determinations can be found in the individual Biological Assessments (Corps 2019a and Corps 2019b). Effects analysis for the other listed species listed above would be conducted in future biological analysis based on submitted scopes of work. The Corps would engage with the Services when new treatment areas are proposed to 1) confirm no effects to species and 2) receive new terms and conditions that would be adhered to.

Flowering rush control cost shared with the PSMFC could treat up to double the acreages as under the No Action Alternative, if state and local agencies fully maximized their budgets. Any additional proposed treatment areas would be evaluated for effects to threatened and endangered species and consulted on with the Services if necessary.

The following stipulations are restrictions and conservation measures to avoid take of threatened or endangered species under the Proposed Action Alternative.

Ute Ladies'-tresses Avoidance

- Prior to engaging in cost-shared flowering rush treatments in the Snake River watershed upstream of American Falls Reservoir, a survey for Ute ladies'-tresses shall be conducted at the prospective treatment site by a qualified botanist.
- All flowering rush control activities will be conducted a minimum of 15 feet from known populations of Ute ladies'-tresses.
- Spot chemical treatment of flowering rush would be conducted a minimum of 100 feet from known populations of Ute ladies'-tresses.
- Broadcast chemical treatment of flowering rush would be conducted a minimum of 300 feet from known populations of Ute ladies'-tresses.

Yellow-billed Cuckoo Nesting Season Avoidance

- No treatments shall be conducted under the proposed cost share at the proposed action areas on or near the Snake and Blackfoot Rivers during the May 1 to August 31 nesting season.

Watershed Broadcast Treatment Temperature Restriction

- Broadcast application of herbicides in the Lake Pend Oreille or the Pend Oreille River shall be conducted only when water temperature at the treatment location is greater than 65 degrees Fahrenheit / 18.5 degrees Celsius.

Chemical Treatment Methods:

The impacts of chemical treatment on threatened or endangered species are the same as the impacts discussed under the No Action Alternative with the following exceptions:

Ammonium salt of imazamox

Threatened or Endangered Aquatic Species

Application rates (Table 2-1) of ammonium salt of imazamox would be well below that which would cause adverse effects to threatened or endangered fish. Spot treatments with imazamox would be primarily foliar, with the majority of the herbicide remaining on the emergent vegetation and not entering the water column. Larger treatments with imazamox would likely be conducted during drawn down periods on exposed substrates, with little potential for herbicide to enter the water.

In the case of broadcast application over emergent flowering rush, even when assuming that 100 percent of the herbicide would enter the water, application at 8 pints/acre would result in a concentration of 3.1 ppm once the chemical has diffused through the top one foot of the water column. Application rates for submerged flowering rush result in a concentration of 4.2 ppm. Aquatic invertebrate toxicity occurs at concentrations greater than 122 ppm (EPA 1997). Negative impacts on threatened and endangered aquatic wildlife from flowering rush treatment using imazamox would be minor.

Threatened or Endangered Terrestrial Species

A wildlife risk assessment conducted by US EPA for imazamox to estimate the dietary exposure values from possible ingestion of imazamox or residues from vegetation or prey items found no adverse effects at the highest concentrations and concluded that there were no adverse effects to birds from the labeled use of imazamox (EPA 2008). As stated in Section 3.6 (terrestrial Wildlife) there is little doubt that imazamox is practically nontoxic to mammals. Negative impacts on threatened and endangered terrestrial wildlife from flowering rush treatment using imazamox would be negligible.

Threatened or Endangered Vegetation

Chemical treatment methods under the Proposed Action Alternative would be similar in scope but fewer chemicals would be used than under the No Action Alternative. Conservation measures (Section 3.12) would also be applied to reduce or eliminate chemical misapplications, spills, overspray, and spray drift. Negative impacts to threatened or endangered plants would be negligible.

Imazapyr

Threatened or Endangered Aquatic Species

Considering the established application rates for imazapyr (Table 2-1), the toxicological data (discussed in Section 3.4 Aquatic Wildlife), the scale of proposed actions, and the beneficial impact of removing invasive aquatic vegetation to enhance native species, application of imazapyr is expected to pose only a minimal risk to threatened or endangered aquatic organisms from exposure. Negative impacts to threatened or endangered aquatic species would be minor.

Threatened or Endangered Terrestrial Species

Imazapyr is not likely to be associated with adverse effects to threatened or endangered mammals at relatively high-dose Levels and the available avian studies on imazapyr do not report any signs of toxicity (as shown in Section 3.6 Terrestrial Wildlife). Negative impacts to threatened or endangered terrestrial species would be negligible.

Threatened or Endangered Vegetation

Chemical treatment methods under the Proposed Action Alternative would be similar in scope but fewer chemicals would be used than under the No Action Alternative. Conservation measures (Section 3.12) would also be applied to reduce or eliminate chemical misapplications, spills, overspray, and spray drift. Negative impacts to threatened or endangered plants would be negligible.

Diquat dibromide

Threatened or Endangered Aquatic Species

Application rates (Table 2-1) of diquat dibromide would be well below that which would cause adverse effects to threatened or endangered fishes. Spot treatments with diquat would be primarily foliar, with the majority of the herbicide remaining on the emergent vegetation and not entering the water column. Larger treatments with diquat would likely be conducted during drawn down periods on exposed substrates, with little potential for herbicide to enter the water.

In the case of broadcast application over emergent flowering rush, even when assuming that 100 percent of the herbicide would enter the water, application at 16 pints/acre would result in a concentration of 6.1 ppm once the chemical has diffused through the top one foot of the water column. Application rates for submerged flowering rush result in a concentration of 1.5 ppm. This is safely below concentrations demonstrated to be safe for fish. Diquat dibromide is also expected to pose only a minimal risk to aquatic organisms from exposure (as discussed in Section 3.4 Aquatic Wildlife). Negative impacts to threatened or endangered aquatic species would be minor.

Threatened or Endangered Terrestrial Species

Diquat is therefore expected to pose only a minimal risk to threatened or endangered fishes from exposure. Diquat dibromide may pose acute or chronic risk to aquatic organisms, but the probability that exposure would occur is relatively low because diquat is rapidly absorbed by plants and soils. Diquat is poorly absorbed from the gastrointestinal tract of terrestrial wildlife (as discussed in Section 3.6 Terrestrial Wildlife). Negative impacts to threatened or endangered terrestrial species would be negligible.

Threatened or Endangered Vegetation

Chemical treatment methods under the Proposed Action Alternative would be similar in scope but fewer chemicals would be used than under the No Action Alternative. Conservation measures (Section 3.12) would also be applied to reduce or eliminate chemical misapplications, spills, overspray, and spray drift. Negative impacts to threatened or endangered plants would be negligible.

Endothall

Threatened or Endangered Aquatic Species

Endothall dipotassium salt is considered to be slightly toxic to practically non-toxic to freshwater fish and invertebrates on an acute basis as discussed in Section 3.4 (Aquatic Wildlife). Negative impacts of endothall dipotassium salt on aquatic threatened or endangered species would be minor.

Threatened or Endangered Terrestrial Species

In its dipotassium salt form, endothall is practically non-toxic to birds. Dietary LD50 values for quail and mallards are greater than 1,475 ppm (SERA 2009). Endothall is not used to treat emergent flowering rush, so the only route of exposure for terrestrial species would be direct ingestion of treated water or consumption of prey from treated areas. Label application rates are far below levels of concern for adverse effects to avian species (SERA 2009). Negative impacts to terrestrial threatened or endangered species would be negligible.

Threatened or Endangered Vegetation

Chemical treatment methods under the Proposed Action Alternative would be similar in scope but fewer chemicals would be used than under the No Action Alternative. Conservation measures (Section 3.12) would also be applied to reduce or eliminate chemical misapplications, spills, overspray, and spray drift. Negative impacts to threatened or endangered plants would be negligible.

Glyphosate

Threatened or Endangered Aquatic Species

Glyphosate is practically nontoxic to fish and aquatic invertebrates as discussed in Section 3.4 (Aquatic Wildlife). Glyphosate is therefore expected to pose only a minimal risk to aquatic organisms from exposure.

Impacts to aquatic species using chemical methods under the Proposed Action Alternative would be moderate to negligible in the short-term due to the restriction in chemicals, the conservation measures (Section 3.12), and the fact that applicators must follow all EPA label restrictions. Negative impacts to threatened or endangered aquatic species would be minor.

Threatened or Endangered Terrestrial Species

Glyphosate is no more than slightly toxic to birds. Oral LD50 values for quail and mallards are greater than 4,460 ppm (Tomlin, 2009). There is no published information regarding dermal glyphosate exposure thresholds in birds, but glyphosate is nonirritating in dermal applications to rabbits (Beste 1983). The US EPA notes in the draft reregistration review of glyphosate that label applications of glyphosate are well below the levels where adverse effects to avian species would be seen (Blankinship and Hetrick 2015). No studies report an adverse effect on birds, with most indicating an increase in avian abundance due to greater open water habitat (Linz et al. 1997, 1996, 1994; Linz and Blixt 1997; Solberg and Higgins 1993). Negative impacts to threatened or endangered terrestrial species would be negligible.

Threatened or Endangered Vegetation

Chemical treatment methods under the Proposed Action Alternative would be similar in scope but fewer chemicals would be used than under the No Action Alternative. Conservation measures (Section 3.12) would also be applied to reduce or eliminate chemical misapplications, spills, overspray, and spray drift. Negative impacts to threatened or endangered plants would be negligible.

Manual and Mechanical Treatment Methods:

The impacts of manual and mechanical treatment on threatened or endangered species are the same as the impacts discussed under the No Action Alternative with the following exceptions:

Threatened or Endangered Aquatic Species

Stressors would be produced by this activity, but the Corps has determined that ESA-listed fish species are not certain to be exposed to or respond to those stressors due to the scale and timing of the activity, and avoidance of flowering rush habitat by ESA-listed fishes (Hillman et al. 1987; Tiffan et al. 2006).

Because of the low potential for ESA-listed fishes to be in the treatment area, the minimal acreage treated at one location, and the long-term benefit to critical habitat from the removal of invasive plants, the Corps has determined that potential adverse effects would range from minor to moderate in the short-term. Impacts to other threatened or endangered aquatic species Manual and mechanical methods would have the same or similar effects to aquatic species as those described in Section 3.4 (Aquatic Wildlife).

Threatened or Endangered Terrestrial Species

Effects to terrestrial species from manual or mechanical methods would be the same or similar as the No Action Alternative.

Threatened or Endangered Vegetation

Vegetation rakes would only be used in screened irrigation canals. The impacts of operating the vegetation rake from the shoreline would be minor to moderate due to the fact that treatment would take place in disturbed landscapes through which the irrigation canals run.

Benthic Barriers:

Impacts of benthic barriers to threatened and endangered species under the Proposed Action Alternative would be the same as the impacts under the No Action Alternative.

3.8 Historic/Cultural Resources

3.8.1 Affected Environment

CRB

Prehistoric riverine cultures were located along the rivers and tributaries in the CRB up until the middle and late 19th century when they were relocated to reservations (Walker Jr. 1998). During their extensive occupation along the rivers and tributaries of the Columbia River, Native Americans subsisted on the abundant salmon and aquatic resources available. Traditional Cultural Properties (TCPs) and Historical Properties of Religious and Cultural Significance to Indian Tribes (HPRCSITs) reflect important fishing locations and fishing villages native peoples occupied for collecting such resources.

When the first European settlers arrived, the CRB was reformed to support agricultural practices. This, in return, brought more and more settlers to the region and continued to transform the region into the agricultural and industrial superpower it is today. This transformation was aided through the impoundment of water by creating reservoirs within the major rivers of the CRB. This was done so through the construction of dams, locks and other facilities throughout the CRB. The benefits of water impoundment include water storage for irrigation and flood protection, raising water levels to promote barge navigation, hydroelectric power production, along with many others.

The construction of these structures began as far back as the late 19th century and continued into the mid-20th century, as dams were desired to control the rivers. Many of these dams are complex units with intakes, fish passages, locking mechanisms, and countless other components; all of which can be considered in evaluating their eligibility for the National Register of Historic Places.

MRB

Over the course of thousands of years of occupation, Indigenous Peoples have established and maintained cultures and traditions that revolve around the natural resources of, and wildlife attracted by, the Missouri River ecosystem. This ecosystem and its well-being continue to be crucial to the worship practices and life ways of contemporary Indigenous Peoples. There is a direct relationship between the environment, traditional worship practices, and the continued survival of diverse indigenous groups. Animals such as the buffalo, eagle, wolf, turtle, migratory and non-migratory birds, a variety of fish and aquatic plants and animals, as well as several species of trees, shrubs, and plants are central to traditional worship beliefs and practices. Within the Missouri River corridor, important natural springs exist which are sacred to Indigenous Peoples and have been considered so for thousands of years.

Known cultural and historic sites in the Missouri River Basin located in Montana consist of lithic scatters, bison kill sites and corrals, tipi rings, stone effigies, campsites, Lewis and Clark campsites, trails, early homesteaders' cabins, hunting cabins, stage routes, railroads, shanty towns from the dam construction era, and other construction camp era buildings. These sites are associated with the Gros Ventre, the Assiniboine bands of Canoe Paddler and Red Bottom, the Sioux divisions of Sisseton/Wahpetons, the Yantonais, and the Heton Hunkpapa, the Blackfoot, early Euro-American explorers, homesteaders, the antebellum Civil war period, and industrial development; river transportation; and dam building and river control.

PSB

Puget Sound has played a vital role in the development and growth of Native American settlement within the Northwest Coast region. Native American tribes relied heavily upon Puget Sound and its vast marine and lacustrine resources as an integral part of their culture by contributing heavily to subsistence strategies as well as transportation and trading routes. Hundreds of prehistoric and historic archaeological sites have been found on the historical shorelines of Puget Sound, providing insight about these coastal-based cultures. Distinguishing characteristics of prehistoric groups include a heavy reliance on abundant marine organisms and anadromous fish, highly skilled woodworking and fishing technology, and complex social organization.

Between 14,000 and 15,000 years ago, the glaciers surrounding the Northwest Coast began to recede, allowing the settlement of the region by migrating people from the north and the south. However, while much of the region was ice free, little, if any, cultural material dates from within this period. Early sites throughout the region are composed primarily of lithic assemblages that become increasingly complex through time. Due to a lack of faunal material at these sites, it is believed that subsistence strategies during this period focused primarily on terrestrial mammals, with increased reliance on marine food sources over time.

The first large shell midden sites date from the period between 5,500 and 3,500 years before present, accompanying an increase in population, a diversification of artifact types, specialized technological adaptations for fishing and marine mammal hunting, woodworking, artwork, and wealth and status objects. This pattern of increased specialization in technology and site composition continued until approximately 1,500 years before present, when artifact diversity began to decline, while Coast Salish structures and cultural practices began to emerge.

Euro-Americans started venturing into the Puget Sound region in increased numbers during the 1850s. The draw for most was the region's vast forests of giant fir, spruce, cedar, and hardwoods, building materials that were in high demand down the Pacific Coast at the burgeoning California city of San Francisco. In 1852, the fledgling settlement that became Seattle took root at the Sound's premier inlet, Elliot Bay. A lumber mill was in operation at Seattle within a year, and logging camps and mills soon dotted the landscape throughout the region.

The timber industry significantly aided early agricultural activities as loggers cleared fertile bottomlands of trees. Many loggers and mill workers turned to subsistence farming as means to feed their family. By the mid-1860s, only a few settlers had looked to the low-lying river deltas, estuaries, and sloughs along the coast as potential farmland. Preparing those otherwise swampy tidal lands for agricultural uses required the construction of ditches and earthen dikes to drain and hold back rising tides and the seasonal floodwater of rivers.

3.8.2 Environmental Consequences

3.8.2.1 Alternative 1: No Action Alternative

Chemical Treatment Methods:

Chemicals would have no impact on historic or cultural resources.

Manual and Mechanical Treatment Methods:

The use of a vegetation rake from the stream bank could unintentionally impact cultural resources due to digging out the flowering rush rhizomes and any subsequent erosion due to the temporary loss of soil structure. Additionally, vacuum harvesting may collect small cultural artifacts if they are near the surface of the sediment. Flowering rush treatment under the No Action Alternative would still be subject to State Historic Preservation Officer (SHPO), and possibly tribal, consultation. The impacts to cultural resources range from no effect to moderate depending on location and method.

Benthic Barriers:

Benthic Barriers would have no impact on historic or cultural resources.

3.8.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Chemical Treatment Methods:

Chemicals would have no impact on historic or cultural resources.

However, the Corps would conduct standard Section 106 consultation with the relevant tribes (listed in Section 5) and state SHPO for each submitted flowering rush treatment scope of work (SOW). If possible detrimental effects are identified, supplemental/tiered NEPA analysis would be required, or projects would be modified.

Manual and Mechanical Treatment Methods:

The effects of mechanical methods would be similar to the No Action Alternative, but could potentially occur at a greater number of locations. The Corps would conduct standard Section 106 consultation with the relevant tribes and state SHPO for each submitted flowering rush treatment SOW. If possible detrimental effects are identified, supplemental/tiered NEPA analysis would be required, or projects would be modified to avoid effects.

Benthic Barriers:

Benthic Barriers would have no impact on historic or cultural resources.

3.9 Socioeconomics and Environmental Justice

3.9.1 Affected Environment

The population of the FSA has grown continually over the last 20 years with a trend of migration from rural areas into urban centers. While population densities are relatively low, the FSA has experienced rapid growth since 1980, paced by Idaho, the fastest growing state in the United States from July 1, 2016 to July 1, 2017 (Figure 3-3). The FSA is generally rural in nature with generally low population densities. The main population centers in the FSA are Boise, Idaho; Portland, Eugene, and Salem, Oregon; Seattle, Tacoma, and Spokane, Washington; and Billings and Missoula, Montana.

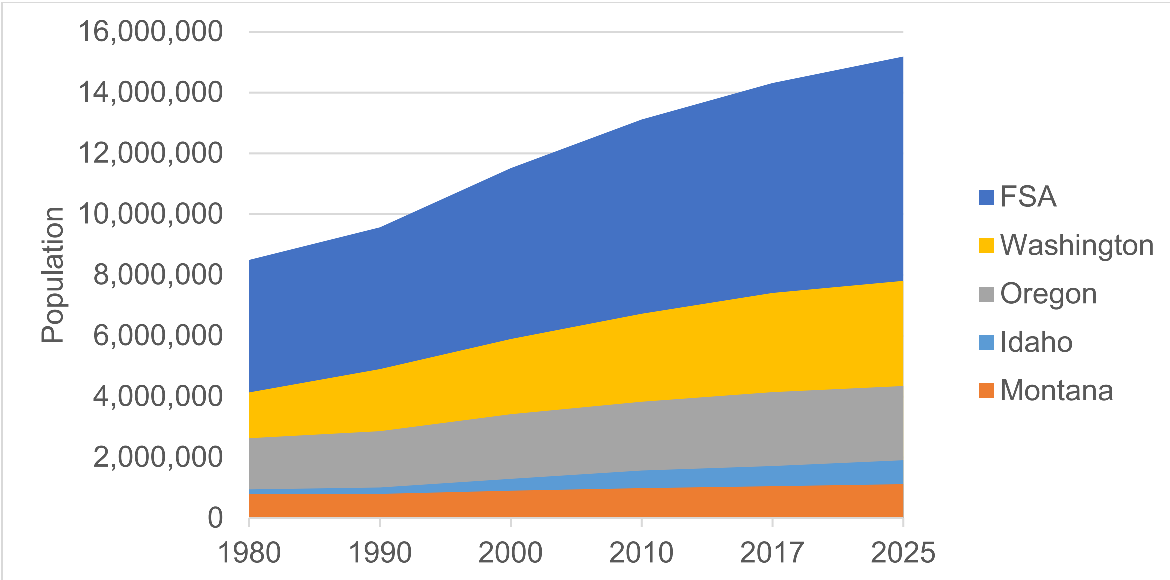

Figure 3-3. Population trends in the four-state area, 1980 - 2025.

Population and Demographics

The population of the FSA is less racially diverse than the national average, but similar to national averages in most other demographic measures (Table 3-3). Area employment has largely recovered from the national recession in 2008-2010, and incomes have continued to increase throughout the region. Washington is currently the only state in the FSA with a median household income above the national and FSA averages. Racial diversity, household income, and higher education were all greater in the coastal states (Oregon and Washington) than the two interior states.

Table 3-2. Education and Income in the Four-State Area compared (U.S. Census Bureau 2016)

	Idaho	Montana	Oregon	Washington	FSA
Population	1,716,943	1,050,493	4,142,776	7,405,743	14,315,955
Persons under 18	25.8%	21.8%	21.1%	22.2%	22.3%
Persons Over 65	15.4%	18.1%	17.1%	15.1%	15.9%
Percent Minority	18.0%	13.8%	24.2%	31.3%	26.4%
High School Graduates	90.0%	92.9%	90.0%	90.6%	90.5%
Bachelors Degree or Higher	26.2%	29.9%	31.4%	33.6%	31.8%
Percent In Labor Force	62.3%	63.2%	61.9%	63.3%	62.8%
Median Household Income	$49,174	$48,380	$53,270	$62,848	$57,375
Persons in Poverty	14.4%	13.3%	13.3%	22.2%	18.0%

Environmental Justice

As outlined in Executive Order 12898, Federal agencies must evaluate environmental justice issues related to any project proposed for implementation. This evaluation includes identification of minority and low-income populations, identification of any negative project impacts that would disproportionately affect these low-income or minority groups, and proposed mitigation to offset the projected negative impacts. The evaluation of environmental justice issues includes an identification of high minority and low-income populations in the watershed study area.

While less racially diverse than other areas of the country, the FSA is home to people of a broad variety of races. The majority of the population in the four-state area is white. The second highest racial identity is Hispanic or Latino in all states except Montana. The second highest racial identity in Montana is American Indian (Table 3-4).

Table 3-3. Racial Identification in the FSA. Note that percentages do not add to 100, as categories are not mutually exclusive (U.S. Census Bureau 2016).

State	Idaho	Montana	Oregon	Washington
White	91.30%	89.10%	85.10%	77.30%
Black or African American	0.60%	0.40%	1.90%	3.60%
American Indian and Alaskan Native	1.30%	6.60%	1.10%	1.30%
Asian	1.30%	0.70%	4.00%	7.80%
Native Hawaiian and Other Pacific Islander	0.10%	0.10%	0.40%	0.60%
Hispanic or Latino	12.00%	3.40%	12.40%	12.10%

All four states have similar poverty levels for children and working age groups (Ages 0-64), while Idaho and Montana have higher poverty levels for seniors over 65. Oregon has the highest overall percentage of people living in poverty in the FSA (Table 3-5).

Table 3-4. State Population Poverty Percent by Age Group (U.S. Census Bureau 2016).

Age Group	Idaho	Montana	Oregon	Washington
0-17	15%	14.4%	15.9%	13.7%
18-64	13%	13%	13.4%	10.5%
65+	10%	10%	7.5%	7.6%
All Ages	12.8%	12.8%	13.2%	11.2%

3.9.2 Environmental Consequences

3.9.2.1 Alternative 1: No Action Alternative

Under the No Action Alternative there would be no additional funds available for flowering rush control. The No Action Alternative would not alter new wages, alter the characteristics of the population in the project areas, or impact the local economy.

Flowering rush control activities are tied to industry standard health and safety protocols that minimize hazardous exposure to applicators and nearby populations, so there would be no adverse effect on human health or safety and no disproportionate adverse impacts on minority and low-income populations. Socioeconomic and environmental justice impacts would be negligible.

3.9.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Flowering rush control cost shared with the PSMFC could treat up to double the acreages as under the No Action Alternative, if state and local agencies fully maximized their budgets. Opposite of the No Action Alternative, the Proposed Action Alternative could create additional jobs, alter new wages, or positively impact the local economy.

Further, herbicide application conservation measures (Section 3.12) would further reduce potential hazardous exposure to applicators and nearby populations. Adverse impacts to socioeconomics and environmental justice under the Proposed Action Alternative would be negligible, but there is the potential for minor beneficial impacts to the economy.

3.10 Recreation

3.10.1 Affected Environment

The FSA provides a variety of opportunities for outdoor recreation, which in turn provides intrinsic value to residents as well as economic opportunities through tourism. Estimates of the economic value of outdoor recreation reports that outdoor recreation generates 522,000 jobs, $57.5 billion in consumer spending, $17.2 billion in wages, and $3.3 billion in state and local tax revenue in the four-state area. In addition to generating tourism and economic benefits, approximately 75% of FSA residents participate in outdoor recreational activities (OIA 2017).

Recreation facilities and land available for recreation in the FSA are managed and operated by the Corps, USFWS, local and state recreation agencies, and public port authorities. Recreation sites in the FSA include parks, rivers, trails, forests, lakes/reservoirs, marinas, boat ramps, and wildlife areas. The Corps owns most of the water-based recreation areas and facilities located along reservoirs and manages many of them. Some Corps-owned facilities are managed under lease agreements by other agencies or organizations.

Research on recreational usage shows that swimming, fishing, and boating occur primarily spring through fall, with prime recreational season from Memorial Day to Labor Day. Flowering rush treatment would largely overlap with water related recreation. Other recreational opportunities that take place around water resources include picnicking, sightseeing, camping, hiking, wildlife viewing, and hunting.

3.10.2 Environmental Consequences

3.10.2.1 Alternative 1: No Action Alternative

Although recreational opportunities may be temporarily inconvenienced during herbicide application or mechanical operations, flowering rush control would not adversely affect long-term public access. Adverse impacts on recreation due to flowering rush control would be minor to moderate depending on location and number of people present.

Flowering rush also interferes with boat propellers, swimming, and fishing thus reducing recreational opportunities along rivers and lake shores. Removing flowering rush from state waterways would provide moderate long-term benefits to recreation.

State agencies, municipalities, and landowners would continue their current program to control flowering rush invasion. Flowering rush control could restrict access to or temporarily close recreational sites used for fishing, swimming, or boating. Potential impacts by treatment method are discussed below.

Chemical Treatment Methods:

Most of these herbicides can be used with relatively little risk (as long as label directions are followed), some are extremely toxic and require special precautions. Aquatic herbicide use could result in chemical exposure through contact, ingestion, or inhalation during activities such as boating, fishing, or swimming.

Contact exposure results in absorption immediately after a pesticide contacts skin or eyes. Absorption will continue as long as the pesticide remains in contact with the skin. The rate at which dermal absorption occurs is different for each part of the body.

Ingestion may result in serious illness, severe injury, or even death, if an herbicide is swallowed.

Inhalation is particularly hazardous because herbicide particles can be rapidly absorbed by the lungs into the bloodstream. Herbicides can cause serious damage to nose, throat, and lung tissue if inhaled in sufficient amounts. Vapors and very small particles pose the most serious risks. The hazard from inhaling pesticide spray droplets is fairly low when dilute sprays are applied with low pressure application equipment. This is because most droplets are too large to remain airborne long enough to be inhaled.

Determining the toxicity of herbicides to humans is not easy. An herbicide that is poisonous to lab rats, is not necessarily poisonous to people; toxicity studies are only guidelines. Some pesticides are dangerous after one large dose (exposure). Others can be dangerous after small, repeated doses.

All pesticides in a given chemical group generally affect the human body in the same way; however, severity of the effects vary depending on the formulation, concentration, toxicity and route of exposure of the pesticide.

The effects of chronic toxicity, as with acute toxicity, are dose-related. In other words, low-level exposure to chemicals that have potential to cause long-term effects may not cause immediate injury, but repeated exposures through careless handling or misuse can greatly increase the risk of chronic adverse effects.

Some aquatic herbicides restrict swimming or fish consumption for a certain time period after application for the reasons described above. Flowering rush control under the No Action Alternative must still follow all EPA label restrictions and therefore impacts of chemical treatment on recreation are assumed to be less than significant.

Manual and Mechanical Treatment Methods:

The presence of personnel and machinery performing flowering rush control could detract from the recreational experience through temporary visual and auditory intrusions.

Benthic Barriers:

The installation of benthic barriers could temporarily restrict recreation opportunities in the area of application. Flowering rush treatment using benthic barriers would have a minor short-term impact on recreation.

3.10.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Flowering rush control cost shared with the PSMFC could treat up to double the acreages as under the No Action Alternative, if state and local agencies fully maximized their budgets. The impacts of chemical, manual, or mechanical flowering rush treatment are the same as discussed under Alternative 1 with the following exceptions:

Chemical Treatment Methods:

Proper signage and notices would be posted in treatment areas to warn swimmers, boaters, and fishers about potential chemical exposure. There are no fishing restrictions for any of the five chemicals approved for use by this document. The use of Endothall would restrict swimming in the treatment area for 24 hours. The use of chemicals for flowering rush treatment under the Proposed Action Alternative would have minor to moderate effects to recreation, but these effects could potentially occur at a greater number of treatment locations.

Manual and Mechanical Treatment Methods:

Vegetation rakes would only be used in screened irrigation canals and not around recreational sites. This would reduce visual and auditory intrusions for recreational users. Manual and Mechanical methods of flowering rush treatment under the Proposed Action Alternative would have a minor impact on recreation, but these effects could potentially occur at a greater number of treatment locations.

Benthic Barriers:

The impacts of benthic barriers would be the same as under the No Action Alternative, but these effects could potentially occur at a greater number of treatment locations.

3.11 Cumulative Impacts

The NEPA and CEQ regulations implementing the Act require Federal agencies to consider the cumulative impacts of their actions. Cumulative effects are defined as, “the impact on the environment which results from the incremental impact of an action when added to other past, present and reasonable foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions” (40 CFR § 1508.7). Cumulative impacts can result from individually small, but collectively significant actions taking place over a period of time.

The primary goal of a cumulative effects analysis is to determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative effects of other past, present, and reasonably foreseeable future actions. The Corps used the technical analysis conducted in this EA to identify and focus on cumulative effects that are “truly meaningful” in terms of local and regional importance. While the EA addresses the effects of alternatives on the range of resources representative of the human and natural environment, not all of those resources need to be included in the cumulative effects analysis – just those that are relevant to the decision to be made on the proposed action. This section evaluates the cumulative effects of actions that could potentially affect the same environmental resources as those discussed earlier in this EA.

The Corps has identified the following resources that are notable for their importance to the area and potential for cumulative effects. Those resources are:

- Water Quality
- Wetlands and Aquatic Vegetation
- Aquatic Resources – Aquatic Wildlife and Threatened and Endangered Aquatic Species

3.11.1 Geographic and Temporal Scope of Cumulative Effects Analysis

Resources are discussed in terms of their cumulative effect boundary (spatial and temporal). The timeframe of 55 years was identified based on the first discovered invasion of flowering rush in the FSA in 1964. A timeframe of five years into the future has been considered. Only actions that are reasonably foreseeable are included. To be reasonably foreseeable, there must be a strong indication that an action/event will occur or be conducted.

Table 3-5. Summary of geographic and temporal boundaries used in this cumulative effects analysis

Geographic Boundary	Temporal Boundary
Columbia River, Missouri River, and Puget Sound Basins	55 years

3.11.2 Affected Environment

Past actions that have affected natural resources in the FSA include building numerous dams throughout the watershed and the subsequent formation of their reservoirs, conversion of landscapes for agricultural uses, and extensive timber harvest. While the vast majority of human alterations has occurred outside the temporal boundaries of this analysis, development in the past ten years has contributed to vegetation loss due to increased timber harvest, agriculture, and urbanization. As development increases the amount of human-caused impacts on the rivers and associated resources are also expected to increase.

3.11.3 Environmental Consequences

Cumulative Effects to Water Quality

While water quality in the FSA is generally considered excellent, cumulative human-caused disturbances can affect water quality. Urban, industrial, and agricultural development have in the past and would continue to create sediment, nutrient, and chemical loading in waters of the FSA.

For example, timber harvests in riparian forest led to large-scale habitat loss and degradation affecting both terrestrial and aquatic species. Timber harvest has resulted in altered water flow, sediment load, and higher water temperatures.

A variety of contaminants enter rivers from point and non-point sources such as industrial discharges and runoff from urban, agricultural, and de-forested areas. Runoff of irrigation water polluted with pesticides and fertilizers can contribute excessive nutrients, elevated levels of chemicals, and substantial amounts of sediment to natural waterways further degrading the water quality of the system.

Recreational activities like boating can also contribute pollutants and increase sediments in surface waters. Watercraft using docks or boat ramps could adversely affect water quality along the shoreline and many watercraft leak small amounts of fuel and oil. Engines and hydraulic components also leak petroleum products into the bilge water, which is ultimately pumped into the water.

Flowering rush control methods discussed in this document would have a cumulative impact on water quality. Applied indiscriminately, these effects could be more than moderately adverse, especially if treatments are repeated in a given location over several years, but the conservation measures discussed below in Section 3.12 would reduce these effects. Given the vastness of the action area, the generally excellent water quality conditions in the basins, and the expected impacts of flowering rush treatment discussed above, cumulative impacts on water quality are expected to be minor to moderate in the short-term. Flowering rush treatment would have a positive cumulative benefit to water quality in the long-term by allowing native plant communities or natural habitats to reestablish in areas previously infested.

Cumulative Effects to Wetlands and Aquatic Vegetation

Wetlands are not isolated from each other, but rather interact with each other by way of the waters and organisms that connect them. While cumulative impacts can occur within individual wetlands (e.g., repetitive spraying of a pesticide within a wetland, multiple nonpoint-source pollution inputs to a wetland), the concept of cumulative impacts is generally used when there are many impacts to multiple wetlands (Johnston 1994).

The loss of wetland areas as a result of human activities is a general indicator that cumulative impacts are occurring. The wetland losses in the FSA over time (discussed in Section 3.3) are one measure of cumulative impacts to wetlands. In addition to the direct losses of wetlands, alterations have occurred from human activities such as diking, draining, and agricultural practices (Washington State Department of Natural Resources 1998). These changes, even if small on an individual basis, can have cumulative impacts on wetland function. Wetland impacts that seem minor on an individual basis may become major when considered collectively over time and space (Johnston 1994).

Flowering rush treatment in wetlands would have minor to moderate adverse cumulative impacts to wetlands in the short-term. Conservation measures (Section 3.12) would be applied to reduce or eliminate chemical misapplications, spills, overspray, and spray drift. Minimizing application methods would reduce impacts to wetlands and limit the damage to non-target vegetation. The removal of flowering rush infestations would have a long-term beneficial cumulative impacts to wetlands by removing invasive species and allowing native plant communities to re-establish.

Cumulative Effects to Aquatic Resources

Aquatic species, and especially migratory fish, including ESA listed salmon and steelhead, are exposed to a host of biological and physical stressors that reduce their survival and fitness (Johnson et al. 2012). Aquatic species within impounded or altered rivers are affected by an array of environmental conditions and changes such as increasing water temperature, changes to water quality parameters, changes to water velocity, habitat degradation, changing turbidity, shifting seasonal patterns, changing volumes of river flow, passage effects at dams, changes in predators and predation rates, and overfishing.

Aquatic resources have also been affected in the FSA by urbanization, industrialization, croplands, irrigation, overgrazing, and the creation of impervious surfaces. All of which can create point and nonpoint source water pollution. These actions have been ongoing for at least the last 55 years and are reasonably certain to continue.

The proposed action, while a fraction of the volume of cumulative chemical and nutrient inputs to aquatic systems in the FSA, still has the potential to act in concert with existing and future pollution sources to adversely affect aquatic resources. Mixtures of pesticides and other aquatic pollutants often act in concert to have deleterious effects not seen in laboratory-based assessments of individual chemicals or pollutants (Laetz et al. 2009). Cumulative effects from multiple treatments would be species- and watershed-specific, but treatments would have to occur simultaneously or consecutively within the same subbasin sufficient to damage a large enough proportion of habitat that restoration would be unable to recover the damages within an appropriate amount of time.

Additionally, a number of accidentally and intentionally released aquatic species can be found in the basins. These aquatic invasive species can impact the health of the water systems and the native aquatic species that live there. Populations of exotic, temperate mesotherms (intermediate between warm-blooded and cold-blooded) and eurytherms (species that can tolerate a wide range of temperatures) seem to thrive in reservoirs once established and can have a detrimental impact on native fish populations. For example, non-indigenous predatory fish such as smallmouth bass and walleye could have a large impact on native salmonid populations through increased predation on out-migrating juveniles (Draheim et al. 2007).

The magnitude of cumulative effects from river modifications, pollutants, and invasive species impart a profound impact on aquatic resources. The cumulative effects of flowering rush treatment could have adverse impacts to aquatic species, especially if treatments are repeated in a given location over several years. However, conservation measures discussed in Section 3.12 would be employed to reduce the cumulative impacts of flowering rush treatment.

Given the vastness of the action area and the expected impacts of flowering rush treatment on aquatic resources and Threatened and Endangered species discussed above (Sections 3.4 and 3.7), cumulative impacts on aquatic resources and threatened and endangered species are expected to be minor to moderate in the short-term. Flowering rush treatment would have a positive cumulative benefit to aquatic resources and threatened and endangered species in the long-term by allowing native plant communities or natural habitats to reestablish in areas previously infested.

3.12 Conservation Measures

The Corps proposes the following conservation measures as part of the proposed action in order to reduce potential adverse effects related to implementation of the proposed action. These conservation measures are not meant to be mitigation for the proposed action, but are integral to the reduction of impacts (potential adverse effects) that may be incidental to the proposed action, and must be considered when analyzing the potential effects of the proposed action.

In terms of intentional and purposeful development of measures designed to minimize impacts to ESA-listed species and designated critical habitats from potential stressors of the proposed action, the Corps has considered a comprehensive list of impact minimization measures [best management practices (BMPs)], that have been integrated into the proposed action as conservation measures. These measures all effectively and drastically reduce the exposure profile of all listed species, as well as the designated critical habitats in the action area.

The following impact minimization measures would be required by the Corps as part of the proposed action.

1. *General Practices:*
    a. *Licensing/Certification:* All applicators shall be state licensed or certified, or under the direct visual supervision of a state licensed or certified applicator.
    b. All applicators shall comply with all applicable Federal, state, and herbicide manufacturer's directions and requirements for handling pesticides, including storage, transportation, application, container disposal, and spill cleanup.
    c. Herbicide application shall be according to the chemical manufacturer's label recommendations for best results. Applicators shall use caution to minimize the application of herbicides to non-target species and structures within the application areas.
    d. Clean and inspect all mechanical equipment after using in a waterbody. This is extremely important if the vegetation rake has been working in waterbodies known to be infested with noxious species such as Eurasian watermilfoil (*Myriophyllum spicatum*), hydrilla (*Hydrilla spp*.), Brazilian elodea (*Egeria densa*), or with exotic animals such as the zebra mussel (*Dreissena polymorpha*).
    e. Post proper signage and notices in treatment and adjacent areas warning of potential chemical exposure through contact, ingestion, or inhalation during activities such as boating, fishing, or swimming.

2. *Calibration/Maintenance:*
    a. All application equipment (e.g. booms, back packs, etc.) shall be properly calibrated according to the chemical manufacturer's suggested application rates printed on the chemical label prior to use. Equipment and settings shall be properly maintained for the duration of the contract performance period.
    b. Dyes shall be used to reduce the potential for over-application.
    c. Appropriate sized nozzles shall be used to minimize the potential for drift.
    d. Application equipment would be maintained to ensure proper application rates, minimize leakage, reduce drift, and ensure applicator safety. Equipment would be maintained, and visually inspected prior to each application.

3. *Spill Management:*
    a. All applicators shall carry a Spill Prevention and Control Plan. The Plan shall provide detailed descriptions on how to prevent a spill or ensure effective and timely containment of any chemical spill. The Spill Prevention and Control Plan shall include spill control, containment, clean up, and reporting procedures.
    b. A spill kit must be available to all applicators and shall be within 150 feet of the application site.
    c. Equipment refueling will not occur within 100 feet of open water. This includes ATVs, trucks, and tractors.

d. All concentrated or mixed solution pesticides shall be placed in locked storage in closed containers with watertight lids, and placed in secondary containment vessels of 100% plus freeboard (worst annual rain event, which for this area is one inch over a square yard, which equals 2.385 gallons). A good rule of thumb is 110% of capacity.
e. All mixing for spray bottles, and backpack sprayers shall be done within secondary containment of 110% capacity of the liquid.

4. *Disposal:*
   a. Disposal of waste materials shall occur in accordance with the label and in accordance with all applicable Federal, state, and county laws regulations, as well as label restrictions and instructions.

5. *Water Quality:*
   Only aquatic approved herbicides and surfactants would be authorized for use within 15 feet of "live" waters or areas with shallow water tables.

4 – Compliance with Applicable Environmental Laws and Regulations

4.1 Treaties and Native American Tribes

Treaties are legally binding contracts between sovereign nations that establish those nations' political and property relations. Treaties between Native American tribes and the United States confirm each nation's rights and privileges. In most of these treaties, the tribes ceded title to vast amounts of land to the United States, but reserved certain lands (reservations) and rights for themselves and their future generations. Like other treaty obligations of the United States, Indian treaties are considered to be "the supreme law of the land," and they are the foundation upon which Federal Indian law and the Federal Indian trust relationship is based.

There are many treaties with Native American Tribes which may be applicable to flowering rush control in the FSA. These include treaties with 35 Tribes in the FSA (listed in Section 5). These Tribes explicitly reserved certain rights, including the exclusive right to take fish in streams running through or bordering reservations, the right to take fish at all usual and accustomed (U&A) places in common with citizens of the territory, and the right of erecting temporary buildings for curing, together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed lands. The treaty rights and resources potentially affected by the proposed action primarily relate to fishing and aquatic plant gathering.

The proposed action could have short-term impacts on treaty rights or temporarily diminish treaty resources. Flowering rush treatment could result in temporary restricted access to U&A fishing locations during flowering rush treatment. There would be no fishing restrictions once flowering rush treatment is complete. Flowering rush treatment also has the potential to impact non-target aquatic plant species that may be harvested as food. These impacts would be limited to the treatment area and the impacts to non-target aquatic plant species would be reduced through conservation measures. The long-term effects of the Proposed Action would support treaty rights through the enhancement of aquatic habitats and the preservation of native fish and plant species.

4.2 Federal Laws

4.2.1 National Environmental Policy Act

This Environmental Assessment (EA) was prepared pursuant to regulations implementing NEPA (42 U.S.C. §4321 et seq.). NEPA provides a commitment that Federal agencies will consider the environmental effects of their proposed actions prior to implementing those actions. Completion of this EA and signing of a Finding of No Significant Impact (FONSI), if applicable, fulfills the requirements of NEPA. This EA and a draft FONSI will be sent out for a 30-day comment period beginning on or about June 24, 2019 and concluding on or about July 24, 2019. If a FONSI is signed, it will be posted to the Corps website and available to the public.

Conservation measures, stipulations, best management practices, or environmental commitments identified in this document ensure compliance with the laws, regulations, and Executive Orders (EOs) reviewed.

4.2.2 Endangered Species Act

The Endangered Species Act (ESA) established a national program for the conservation of threatened and endangered fish, wildlife and plants and the habitat upon which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the USFWS and NMFS, as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their critical habitats. Section 7(c) of the ESA and the Federal regulations on endangered species coordination (50 CFR §402.12) require that Federal agencies prepare biological assessments of the potential effects of major actions on listed species and critical habitat.

The Corps has determined that impacts to threatened and endangered species from the proposed flowering rush treatment methods, as described above, would range from no effect to may affect, but not likely to adversely affect depending on species present and treatment methods. Initial scopes of work discussed in Section 1.4 (project location) have been consulted on with the USFWS and NMFS in 2019 and the methods described in this document were determined to "not likely to adversely affect threatened or endangered species." Initial consultation will be considered complete upon reception of Letters of Concurrence from the Services.

The Corps would conduct standard Section 7 consultation with the relevant Services (USFWS or NMFS, listed in Section 5) for each submitted flowering rush treatment Scope of Work. If possible adverse effects are identified, the Corps would first attempt to modify any project potentially affecting threatened or endangered species to avoid or minimize any potential impacts.

The USFWS was consulted through their Information for Planning and Consultation (IPaC) website to coordinate the identification of potential listed and protected resources in the FSA.

4.2.3 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act prohibits the taking or possession of and commerce in bald and golden eagles, with limited exceptions, primarily for Native American Tribes. Take under this Act includes both direct taking of individuals and take due to disturbance.

Bald and golden eagles are common throughout much of the action area. Nesting, roosting, or foraging eagles may be present near a treatment site during Plan implementation. In some locations, eagles that may occupy treatment sites frequently are likely accustomed to the daily human activities and related noise levels such as vehicles, equipment, and boat and foot traffic, while in other areas, eagles may rarely have human interaction.

In the case of a treatment site occurring where eagles have relatively little human interaction, eagles are likely to avoid the immediate treatment site. In addition, suitable roosting and foraging habitat is expected to be available adjacent to the treatment site outside of a range of disturbance. The Plan would be implemented with BMPs to avoid nests in accordance with the USFWS Bald Eagle Management Guidelines and Conservation for the Pacific Region (USFWS 2015b). Therefore, the Corps has determined there would be no disturbance or take of eagles as a result of the Proposed Action.

4.2.4 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) (16 U.S.C. §§ 703-712, as amended) prohibits the taking of and commerce in migratory birds (live or dead), any parts of migratory birds, their feathers, or nests. Take is defined in the MBTA to include by any means or in any manner, any attempt at hunting, pursuing, wounding, killing, possessing or transporting any migratory bird, nest, egg, or part thereof.

Migratory bird nesting season and flowering rush control would overlap in areas of the FSA. Flowering rush treatment would occur during the growing season (February through the first fall frost). Migratory birds nesting season begins April 1 and ends August 15. Corps funded flowering rush treatment is not expected to impact (directly or indirectly) any migratory bird species, but if such take becomes anticipated for any treatment/management action coordination with the USFWS would be initiated in an effort to avoid such impacts.

4.2.5 Fish and Wildlife Coordination Act of 1958

The Fish and Wildlife Coordination Act (FWCA) of 1934, as amended (16 USC 661 et seq.) requires consultation with USFWS when any water body is impounded, diverted, controlled, or modified for any purpose. The USFWS and state agencies charged with administering wildlife resources are to conduct surveys and investigations to determine the potential damage to wildlife and the mitigation measures that should be taken. The USFWS incorporates the concerns and findings of the state agencies and other Federal agencies, including NMFS, into a report that addresses fish and wildlife factors and provides recommendations for mitigating or enhancing impacts to fish and wildlife affected by a Federal project.

The proposed action would not impound, divert, control or modify any body of water and would not involve activities subject to the Fish and Wildlife Coordination Act.

4.2.6 National Historic Preservation Act

The National Historic Preservation Act (NHPA) of 1966 as amended directs Federal agencies to assume responsibility for all cultural resources under their jurisdiction. Section 106 of NHPA requires agencies to consider the potential effect of their actions on properties that are listed, or are eligible for listing, on the National Register of Historic Places (NRHP). The NHPA implementing regulations, 36 Code of Federal Regulations (CFR) Part 800, requires that the Federal agency consult with the State Historic Preservation Officer (SHPO), Tribes and interested parties to ensure that all historic properties are adequately identified, evaluated and considered in planning for proposed undertakings.

The Corps has determined that the proposed flowering rush treatment methods, as described above, would have no to moderate impacts to cultural and historic resources based on location and method. The Corps would conduct standard Section 106 consultation with the relevant tribes (listed in Section 5) and state SHPO for each submitted flowering rush treatment Scope of Work. If possible detrimental effects are identified, the Corps would first attempt to modify any project potentially affecting historic/cultural properties to avoid or minimize any potential impacts. If adverse effects are identified, the Corps would identify appropriate mitigation and enter into an appropriate MOA with the SHPO or ACHP.

Initial Scopes of Work submitted by PSMFC for cost sharing in 2019 were evaluated by Corps archeologists. Actions requested for cost sharing by the State of Washington did not have potential to affect historic or cultural resources. The Corps determined that some activities in the SOW submitted by the state of Montana may have a potential to effect historic or cultural resources. The Corps initiated consultation with the Confederated Salish and Kootenai Tribes Historic Preservation Officer in June of 2019. NHPA compliance for the 2019 SOWs will be considered complete upon the successful completion of consolation. No funds would be shared with Montana until that time.

4.2.7 Clean Water Act

The Federal Water Pollution Control Act on 1972 (33 U.S.C. §1251 et seq., as amended) is more commonly referred to as the Clean Water Act. The Clean Water Act establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters.

Section 401 of the Federal Clean Water Act requires that any Federal activity that may result in a discharge of a pollutant or dredged or fill material to waters of the United States must first receive a water quality certification from the state in which the activity would occur. If a permit under either Section 402 or 404 is needed for an action, Section 401 Water Quality Certification is also needed. In this case, application of chemical treatments would be covered by existing programmatic general permits, not new permits and Section 401 Certification would not be required.

Section 402 of the Act, the National Pollutant Discharge Elimination System (NPDES) program, pertains to discharge of pollutants. Aquatic pesticide application would require approval for use under a NPDES permit, either the EPA's 2016 Pesticide General Permit (PGP) for treatments in Idaho, Washington, or on Tribal Reservations; the Montana Pollutant Discharge Elimination System Permit (MTG870000) in Montana, or the Oregon Department of Environmental Quality Pesticide General Permit (2300A).

4.2.8 Wild and Scenic Rivers Act of 1974

The National Wild and Scenic Rivers System was created by Congress (Public Law 90-542; 16 U.S.C. 1271 et seq.) to preserve rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. Designation as a wild and scenic river is not the same designation as a National Park, and does not generally confer the same level of protection as a Wilderness Area designation. Instead of enacting strict and mandatory conservation measures, the goal is often to preserve the character of a river.

Of 12,754 miles of designated rivers in the United States, 3,394 are in the proposed action area. In Idaho, designated rivers include Battle Creek, Big Jacks Creek, the Bruneau River, the West Fork Bruneau River, the Middle Fork Clearwater River, Cottonwood Creek, Deep Creek, Dickshooter Creek, Duncan Creek, the Jarbridge River, Little Jacks Creek, the Owyhee River, the North Fork Owyhee River, the South Fork Owyhee River, the Rapid River, the St, Joe River, the Middle Fork Salmon River, Sheep Creek, the Snake River, and Wickahoney Creek for a total of 891 miles.

In Oregon, designated rivers include Big Marsh Creek, the Chetco River, the Clackamas River, the South Fork Clackamas River, the Collawash River, Crescent Creek, the Crooked River, the North Fork Crooked River, the Deschutes River, Donner and Blitzen River, Eagle Creek (Mt. Hood National Forest), Eagle Creek (Wallowa-Whitman National Forest), the Elk River, Elkhorn Creek, Fifteenmile Creek, Fish Creek, the Grande Ronde River, the East Fork Hood River, the Middle Fork Hood River, the Illinois River, the Imnaha River, the John Day River, the North Fork John Day River, the South Fork John Day River, Joseph Creek, the Klamath River, the Little Deschutes River, the Lostine River, the Malheur River, the North Fork Malheur River, the McKenzie River, the Metolius River, the Minam River, the North Powder River, the North Umpqua River, the Owyhee River, the North Fork Owyhee River, the Powder River, Quartzville Creek, the River Styx, the Roaring River, the South Fork Roaring River, the Rogue River, the Upper Rogue River, the Salmon River, the Sandy River, the North Fork Smith River, the Snake River, the Sprague River, Squaw Creek, the Sycan River, the Wallowa River, the Wenaha River, the West Little Owyhee River, Whychus Creek, the White River, Wildhorse & Kiger Creeks, the North Middle Fork Willamette River, and the Zigzag River, for a total of 1,918 miles.

In Montana designated rivers include east Rosebud Creek, the Flathead River, and the Missouri River for a total of 388 miles; and in Washington, designated rivers include Illabot Creek, the Klickitat River, the Pratt River, the Skagit River, the Middle Fork Snoqualmie River, and the White Salmon River, for a total of 197 miles.

Flowering rush is likely to colonize Wild and Scenic Rivers. However, due to fewer boat access points than the more heavily trafficked rivers in the FSA, such as the Columbia and mainstem Snake Rivers, it is less likely treatment actions would occur on these systems. Should such a treatment occur, the Corps would consult with the Bureau of Land Management, National Park Service, USFWS, or U.S. Forest Service, depending on jurisdiction, to ensure water quality is not degraded and to determine mitigation as necessary.

4.2.9 Safe Drinking Water Act

The Safe Drinking Water Act (SDWA), along with the Reduction of Lead in Drinking Water Act and 40 CFR Part 141 - National Primary Drinking Water Regulations, are the Federal laws that protect public drinking water supplies throughout the nation. SDWA authorizes the US EPA to set national health-based standards for drinking water to protect against both naturally-occurring and man-made contaminants that may be found in drinking water.

The Proposed Action would not involve public drinking water systems or groundwater injection and is therefore not subject to the Acts.

4.2.10 Rivers and Harbors Act of 1899

Section 10 of the Rivers and Harbors Act requires that regulated activities conducted below the Ordinary High Water Mark elevation of navigable waters of the U.S. be approved/permitted by the Corps of Engineers Regulatory Division. Regulated activities include the placement/removal of structures, work involving dredging, disposal of dredged material, filling, excavation, or any other disturbance of soils/sediments or modification of a navigable waterway.

The Proposed Action would be covered by existing programmatic general permits, not new permits and Section 401 Certification would not be required.

4.3 Executive Orders

4.3.1 Executive Order 11988, Floodplain Management

This Executive Order outlines the responsibilities of Federal agencies in the role of floodplain management. Each agency must evaluate the potential effects of actions on floodplains and avoid undertaking actions that directly or indirectly induce development in the floodplain or adversely affect natural floodplain values.

Conservation measures have been carefully considered and listed in Section 3.12 to ensure the proposed action would result in only minor to moderate impacts to floodplains.

4.3.2 Executive Order 11990, Protection of Wetlands

This order directs Federal agencies to take actions to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands when undertaking Federal activities and programs. It has been the goal of the Corps to avoid or minimize wetland impacts associated with their planned actions.

Conservation measures have been carefully considered and listed in Section 3.12 to ensure the proposed action would result in only minor to moderate impacts to wetlands.

4.3.3 Executive Order 12898, Environmental Justice

This order requires Federal agencies to consider and address environmental justice by identifying and assessing whether agency actions may have disproportionately high and adverse human health or environmental effects on minority or low-income populations. Disproportionately high and adverse effects are those effects that are predominantly borne by minority or low-income populations and are appreciably more severe or greater in magnitude than the effects on nonminority or non-low income populations.

This EA considers activities related to the treatment of flowering rush in the FSA. The proposed action is not expected to disproportionately affect any particular demographic group.

4.3.4 Executive Order 13751, Safeguarding the Nation from the Impacts of Invasive Species

This EO states that it is the policy of the United States to prevent the introduction, establishment, and spread of invasive species, as well as to eradicate and control populations of invasive species that are established. The order directs Federal agencies to refrain from authorizing, funding, or implementing actions that are likely to cause or promote the introduction, establishment, or spread of invasive species in the United States unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions. Conservation measures (Section 3.12) would be implemented to ensure that the Proposed Action would comply with EO 13751.

Section 5 – Consultation, Coordination and Public Involvement

The scoping period for the Proposed Action was from February 28, 2019 to March 30, 2019. Due to the large potential action area, scoping letters were sent to congressional delegates, Federal and state agencies, Tribes, and stakeholders. The Corps received three comments during the scoping period. The Washington State Department of

Ecology and a private citizen from Portland State University each commented that the No Action Alternative should address the potential economic damages associated with flowering rush treatment and the environmental effects of flowering rush infestation on native species. The third comment is from an archaeologist with Confederated Tribes of the Umatilla concerned about impacts associated with treatment of flowering rush on treaty protected rights and resources and how the project would impact cultural resources protected under both NEPA and the NHPA. All comments have been addressed in this EA.

The draft Finding of No Significant Impact (FONSI) and this EA are being distributed to Federal, state, and local agencies, Tribes, and the public for a 30-day review and comment period beginning on or about June 24, 2019 and concluding on or about July 24, 2019. It is available on the Walla Walla District Corps of Engineers website at www.nww.usace.army.mil/Missions/Environmental-Compliance. The distribution list includes the following:

Federal Agencies:

National Marine Fisheries Service
U.S. Bureau of Indian Affairs
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service Region 1
U.S. Forest Service Region 6
U.S. Bureau of Land Management Idaho State Office
U.S. Bureau of Land Management Oregon/Washington State Office
U.S. Bureau of Land Management Montana/Dakotas State Office
U.S. Bureau of Reclamation Great Plains Region
U.S. Bureau of Reclamation Pacific Northwest Region
Natural Resources Conservation Service Washington Office
Natural Resources Conservation Service Oregon Office
Natural Resources Conservation Service Idaho Office
Natural Resources Conservation Service Montana Office
National Park Service

State Agencies:

Idaho Department of Commerce
Idaho Department of Environmental Quality
Idaho Department of Water Resources
Idaho Governor's Office
Idaho Office of Species Conservation
Idaho Parks and Recreation
Idaho Soil and Water Conservation Commission
Idaho State Historic Preservation Officer
Montana Department of Environmental Quality
Montana Department of Natural Resources and Conservation
Montana Fish, Wildlife, and Parks
Montana Office of the Governor
Montana State Historic Preservation Officer
Oregon Department of Agriculture
Oregon Department of Energy
Oregon Department of Environmental Quality
Oregon Governor's Office

Oregon Parks and Recreation Department
Oregon State Police
Oregon State Historic Preservation Officer
Washington Department of Agriculture
Washington Department of Natural Resources
Washington Department of Ecology
Washington State Historic Preservation Officer
Washington Office of the Governor

Tribes:

Confederated Colville Tribes
Confederated Salish Kootenai Tribe
Confederated Tribes and Bands of the Yakama Nation
Confederated Tribes of the Umatilla Indian Reservation
Confederated Tribes of the Warm Springs Indian Reservation
Cowlitz Tribe
Grand Ronde Tribe
Kalispel Tribe
Kootenai Tribe
Nez Perce Tribe
Shoshone Paiute Tribe
Shoshone-Bannock Tribes
Spokane Tribe
Upper Snake River Tribes
Lummi Nation
Nooksack Indian Tribe
Upper Skagit Swinomish Indian Tribe
Stillaguamish Tribe of Indians
Sauk-Suiattle Tribe
Tulalip Tribes
Port Gamble S'Klallam Tribe
Muckleshoot Tribe
Nisqually Tribe
Chehalis Confederated Tribes
Squaxin Island Tribes
Skokomish Tribe
Quinault Indian Tribe
Jamestown S'Klallam Tribe
Lower Elwha Klallam Tribe
Blackfeet Nation
Crow Nation
Fort Peck Assiniboine and Sioux Tribes
Fort Belknap Assiniboine and Gros Ventre Tribes
Chippewa Cree Tribe
Northern Cheyenne Tribe

Other:

American Association of Port Authorities
Association of Pacific Ports
Audubon Society of Portland
Beyond Toxics
Bitterroot River Protection Association
Blue Mountains Land Trust
Columbia River Inter-Tribal Fish Commission
Columbia River Steamship Operators' Association
Columbia Riverkeeper
Conservation Northwest
CREATE, a Columbia Riverkeeper Affiliate
Eastside Audubon Society
Friends of the Clearwater
Golden Eagle Audubon Society
Idaho Conservation League
Idaho Foundation for Parks and Lands
Idaho Native Plant Society
Idaho Rivers United
Idaho Wildlife Federation
Inland Northwest Land Conservancy
Institute for Applied Ecology
Lower Columbia Basin Audubon Society
Lower Columbia Fish Recovery Board
Merchant's Exchange of Portland
Northwest Center for Alternatives to Pesticides
Northwest Indians Fisheries Commission
Northwest Marine Terminal Association
Northwest Power and Conservation Council

Northwest Steelheaders
Oregon Cultural Trust
Oregon Invasive Species Council
Oregon Watershed Enhancement Board
Pacific Northwest Waterways Association
Palouse Audubon Society
Palouse-Clearwater Environmental Institute
Save Our Wild Salmon
Sierra Club Idaho
Sierra Club Oregon
Sierra Club Washington
Snake River Waterkeeper
Spokane Riverkeeper
The Freshwater Trust
The Nature Conservancy
Toxic-Free Future
Tri-State Steelheaders
Upper Columbia Salmon Recovery Board
Upper Missouri Waterkeeper
Washington Native Plant Society
Washington Public Ports Association
Washington Recreation and Conservation Office
Washington Wild
WaterWatch of Oregon
Willamette Riverkeeper
Wood River Land Trust

In accordance with the Corps supplemental NEPA regulations (33 CFR §230.11), the Corps will provide Notice of Availability of the EA and the FONSI (if/when signed) to concerned agencies, organizations, and the interested public through a news release issued to all area newspapers. The EA and signed FONSI would also be posted to the Corps website at http://www.nww.usace.army.mil/Missions/Environmental-Compliance/.

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