ENVIRONMENTAL ASSESSMENT

CHAMBERS LAKE WEIR REMOVAL
JOINT BASE LEWIS-MCCHORD, WASHINGTON

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REVIEWED BY:

Christopher J. Runner NEPA Program Manager	Date
Steven T. Perrenot, P.E. Director, Public Works	Date

APPROVED BY:

Nicole M. Lucas Colonel, US Army Commanding	Date

Chambers Lake Weir Removal
Environmental Assessment

As required by the National Environmental Policy Act (NEPA) and 32 Code of Federal Regulations (CFR) 651, this Environmental Assessment addresses the effects to the environment of the proposed Chambers Lake Weir removal and rehabilitation of the site.

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Acronyms and Abbreviations

Army	United States Army
BA	Biological Assessment
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ESA	Endangered Species Act
INRMP	Integrated Natural Resource Management Plan
JBLM	Joint Base Lewis-McChord
ka	*kilo-annum*, Thousand years ago
LWD	Large woody debris
MBTA	Migratory Bird Treaty Act
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service (NOAA Fisheries)
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service
OHW	Ordinary High Water
OLW	Ordinary Low Water
RM	River Mile
SHPO	State Historic Preservation Office/Officer
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service

USGS	United States Geological Survey
WDOE	Washington State Department of Ecology
WDFW	Washington State Department of Fish and Wildlife
Weir	In this document the term “weir” specifically refers to the water control structure on Muck Creek, which controls the water levels of Chambers Lake.

1 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

The United States (U.S.) Department of the Army has prepared this Environmental Assessment (EA) in accordance with the National Environmental Policy Act (NEPA) of 1969 (42 U.S. Code (USC) §4321-4370m), as implemented by the Council on Environmental Quality (CEQ) Regulations (40 Code of Federal Regulations (CFR) Parts 1500-1508; and Army regulations for implementing NEPA (32 CFR Part 651).

1.1 INTRODUCTION

1.1.1 BACKGROUND

Chambers Lake is a small lake (175 acres) in Pierce County, WA, located just within the boundary of Joint Base Lewis-McChord (JBLM), (Figure 1). While the lake is natural in origin, a small water control structure (weir) was constructed at the outlet on Muck Creek in 1967 to increase lake level and storage as a wildland firefighting water supply. The lake has not been used for this purpose for several years because there are more efficient means of filling fire trucks. Outflows from the lake are manually controlled by adding and removing boards at the outlet structure, impounding water during the wet season and releasing water to augment flows during the dry season. In the 1980s, the concrete dike was reconstructed to incorporate a fish passage structure. Despite this, the water control structure represents an impedance to fish migration that affects three species protected under the federal Endangered Species Act of 1973 (ESA), as well as non-listed species. As an environmental stewardship project and in order to improve habitat for ESA listed fisheries, JBLM proposes to remove the Chambers Lake weir.

Muck Creek is a tributary of the Nisqually River, which flows through JBLM, and feeds into Puget Sound in Western Washington. The creek provides habitat for Coastal Puget Sound Bull Trout, Puget Sound Chinook, and Puget Sound Steelhead, all of which are listed as a “threatened” species under the ESA. Muck Creek also provides Essential Fish Habitat (EFH) for both Coho and Chinook salmon, which are managed by the National Marine Fisheries Service (NMFS) under the Magnuson-Stevens Fishery Conservation and Management Act. Muck Creek is one of very few tributary sub-basins in the Nisqually River drainage that are supportive of salmonids. The flow of water in Muck Creek is affected by the weir located at the outlet of Chambers Lake. In September 2011, the headgate of the structure was adjusted downward, cutting the flow out of the lake. This adjustment contributed to a significant number of juvenile fish, including Coho salmon and Puget Sound Steelhead, being stranded and killed as areas of the creek further downstream dried out. In addition, the existence of the weir and the lake impoundment behind it negatively affect salmonids in several ways: by impairing upstream fish passage, by exposing fish to extreme high water temperatures during the summer, and by potential predation during juvenile fish out-migration.

1.1.2 LOCATION

Chambers Lake is located in the southeastern part of JBLM, near the City of Roy, Washington (Figure 2). The weir is at the southern end of Chambers Lake (SE ¼ Section 27, Township 18 North, Range 2 East; 47.013780º N latitude / -122.532284º W longitude).

1.2 PURPOSE AND NEE

1.3 THE PURPOSE OF THE PROPOSED WORK IS TO REMOVE THE CHAMBERS LAKE WEIR IN ORDER TO RESTORE THE NATURAL FLOW PATTERNS DOWNSTREAM AND ELIMINATE AN IMPEDANCE TO FISH MIGRATION. REMOVAL OF THE STRUCTURE WILL ALSO ELIMINATE THE NEED FOR PERSONNEL TO MONITOR AND MANUALLY ADJUST THE WATER CONTROL STRUCTURE, ELIMINATE THE POTENTIAL FOR BEING LIABLE UNDER ESA IF A CRITICAL ADJUSTMENT IS MISSED, AND RESTORE THE NATURAL FLUCTUATIONS OF THE WATER IN CHAMBERS LAKE D.

Figure 1. Vicinity map, Chambers Lake (red arrow) on JBLM

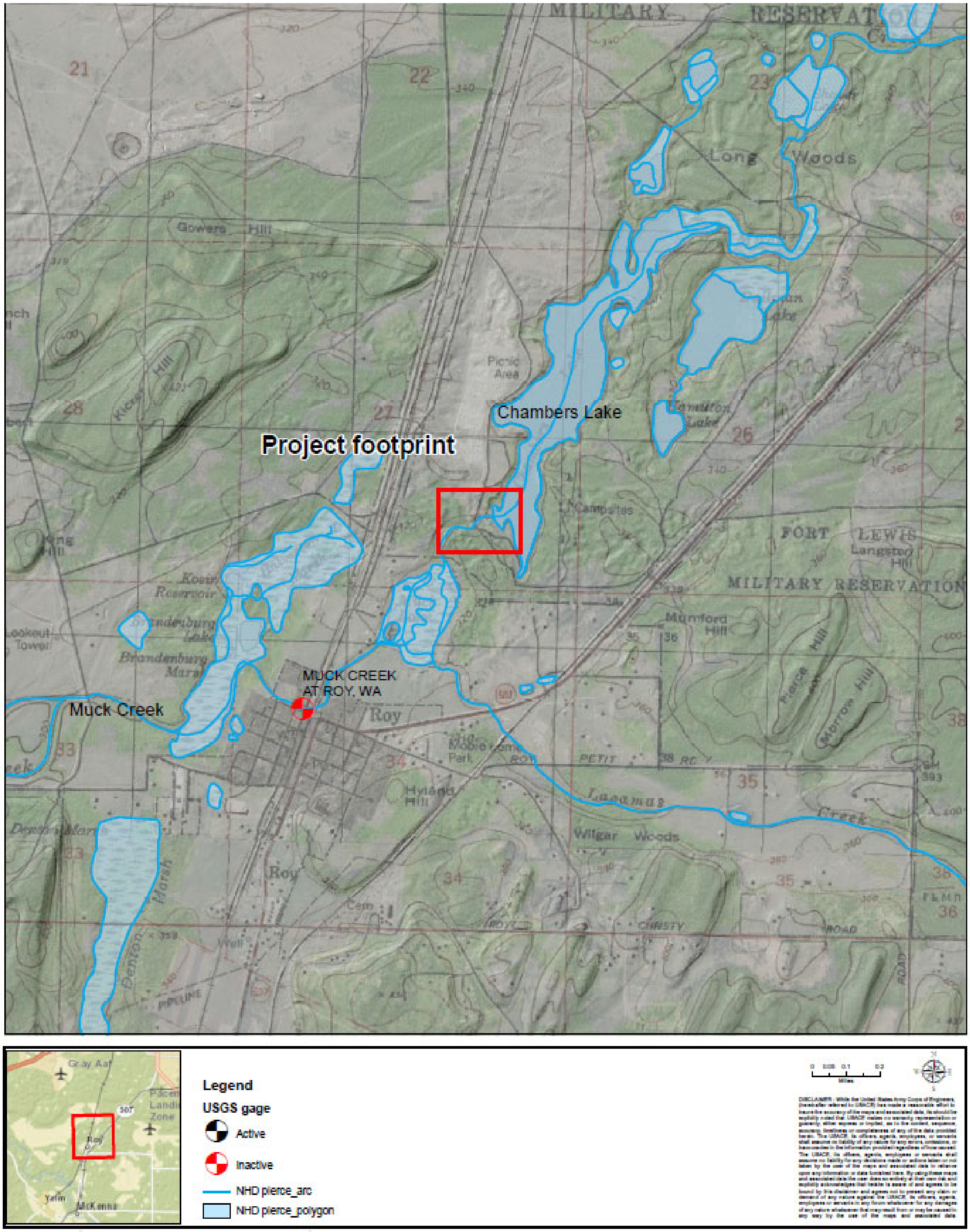

Figure 2. Project site at Chambers Lake

2 PROPOSED ACTION AND ALTERNATIVES

Alternatives considered under NEPA must include the proposed action (Preferred Alternative), and the No Action alternative. The No Action alternative is included as a means of comparison to the action alternative to help distinguish the relative merits and disadvantages between alternatives. In order for any alternative to be acceptable for consideration it must meet the purpose and need for action. Pursuant to Army Regulation 32 CFR 651, Environmental Analysis of Army Actions, the selected alternative must meet the project purpose and need and it should be environmentally acceptable, to the extent possible.

2.1 Proposed Action

The Department of the Army proposes to remove the Chambers Lake water control structure, restore the demolition area to natural habitat conditions, and restore the natural hydrology of Muck Creek at the site. The goal of the project is to restore the free-flowing creek, which will restore upstream fish passage, decrease the risk of exposure of fish to high water temperatures during summer months due low volume of stream flow, and decrease the risk of predation during juvenile fish outmigration due to low water levels that cause stranding.

In 2016, a Memorandum of Understanding (MOU) was reached with the National Marine Fisheries Service (NMFS) to

> *"…perform a habitat improvement project…which is intended to substantially reduce or eliminate the likelihood of a future dewatering event on Muck Creek, and also eliminate other negative impacts of the existing dam and lake on salmonids, by removing the existing dam on Muck Creek at Chambers Lake to restore a free-flowing creek…."*

As part of the MOU, the weir should be removed by 2020.

The Chambers Lake Weir consists of an 80-ft long, 40-ft wide, 6-ft tall reinforced concrete weir with a 4-ft wide fish ladder and a hand operated 3-ft diameter slide gate outlet supplied by a 5-ft wide channel (Figures 3 and 4). Muck Creek is lower at the inlet (lake side) of the structure than the outlet. Two 10-ft wide flat sloped concrete abutments are located on either side of the weir. A 40-ft long L-shaped concrete sharp crested weir spillway is overtopped and discharges into a 5-ft wide spillway channel when the fish ladder and low flow orifice discharge capacity is exceeded. Short concrete retaining and wing walls tie the structure back into the adjacent earthen embankment slopes at the approach and exit of the structure. Several concrete blocks have been placed in the channel downstream of the weir to dissipate energy. A chain-link security fence is on the outer edges of the weir for security.

Removal of the weir, with its associated structures and the restoration of the demolition site is expected to take approximately 6 months. In-water work would be completed during the 1 July to 15 September work window to minimize impacts to fisheries. In addition to the in-water work window, construction may occur when the project area within Muck Creek is typically dry due to the ephemeral nature of the stream (i.e., through October or early November).

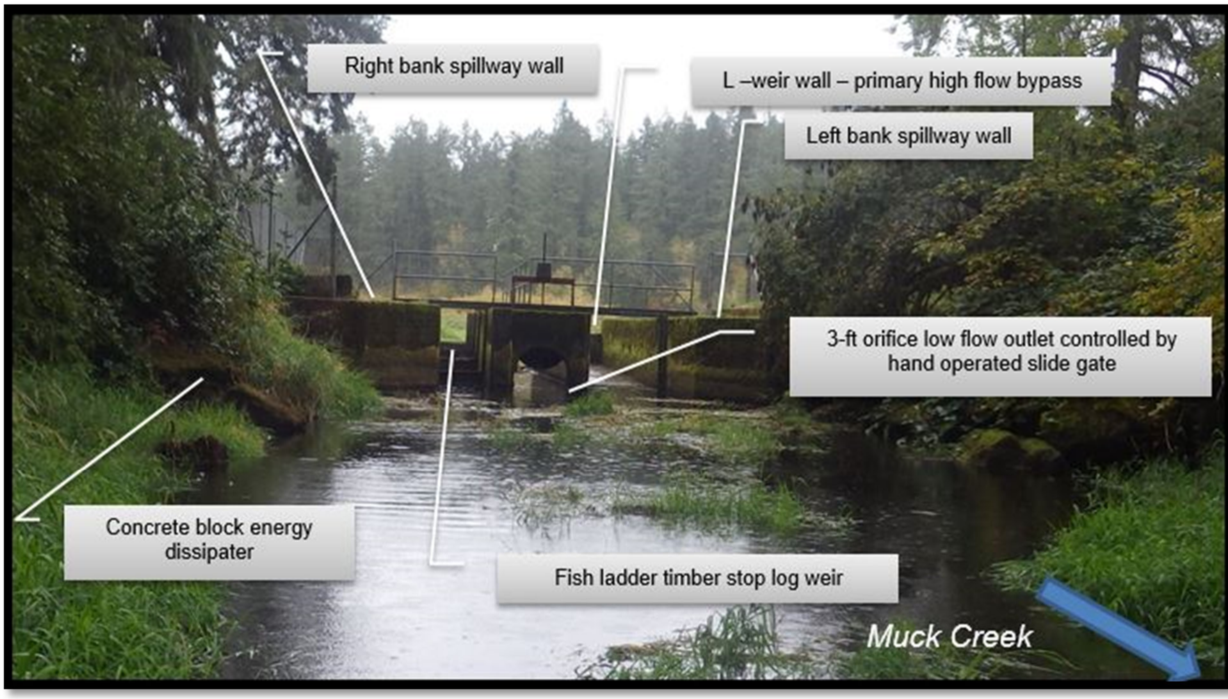

Figure 3. Chambers Lake Weir, looking upstream from the outlet.

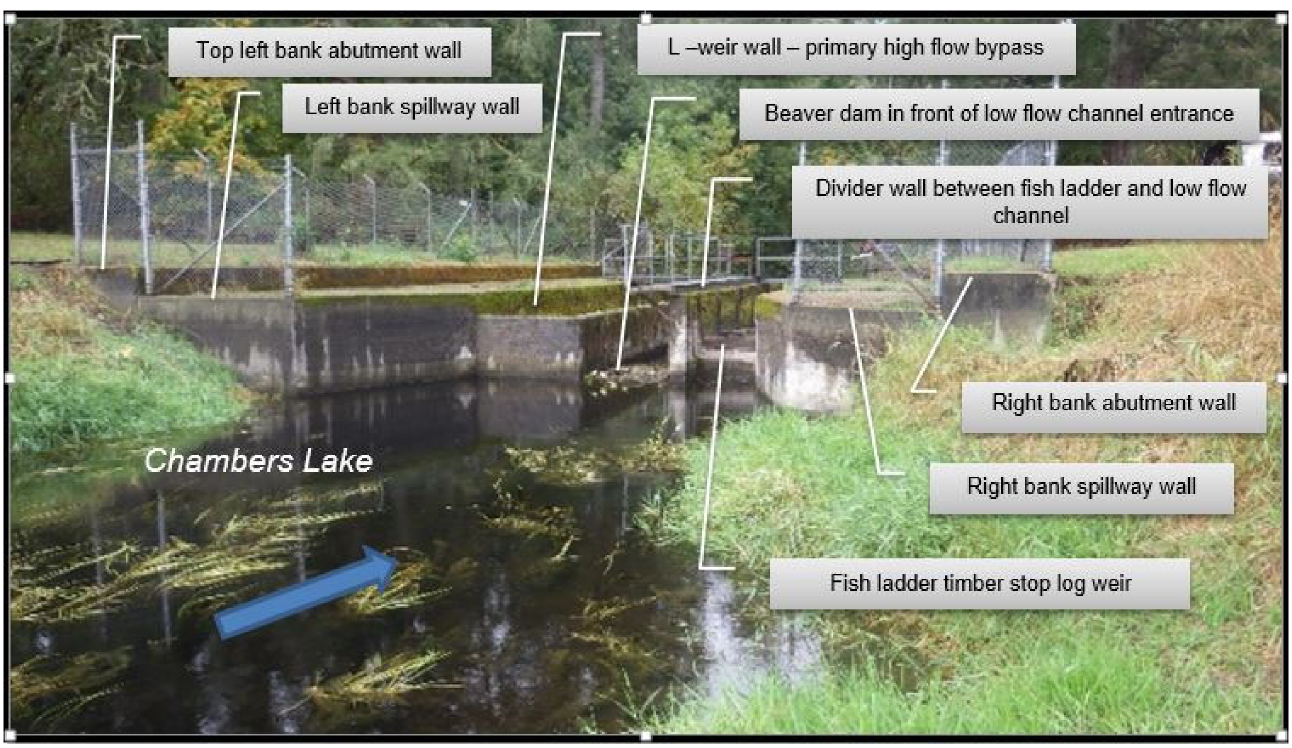

Figure 4. Chambers Lake Weir, looking downstream at inlet.

2.2 Alternatives Considered

The no action and three removal alternatives were conceptually considered, and all were evaluated with hydraulic modeling for wetted acreage changes in the peak of the wet season (winter) and through the dry season (late summer).

2.2.1 No Action Alternative

Under the No Action Alternative, the Chambers Lake structure would be left in place, and existing conditions are expected to continue. The No Action Alternative is not recommended as it does not meet the project purpose; however, it is carried forward for further evaluation to serve as a base condition for evaluation of other alternatives.

2.2.2 Alternative 1 – Weir removal to pre-weir hydrology

Alternative 1 would remove the entire weir and foundation material (including all concrete rubble in the channel), import suitable streambed material that would be compacted and shaped to restore pre-weir channel topography, add streambank stabilization measures (rounded rock, large wood, soil lifts), and revegetate disturbed areas with native plants. It is assumed that native material is likely three feet below the bottom of the existing weir (boring or ground penetrating radar survey is needed to verify). The design cross section for the restoration is based on the channel dimensions of the natural channel 150 feet downstream of the weir. The finished width of the restored area ranges from 70 feet to 100 feet at its maximum. The channel has 6-ft wide, 5-ft high, bankfull flow benches on both banks to establish vegetation at elevations that create ample shade near the channel. The constructed bankfull width between the benches is 50 feet, with a bottom width of about 30 feet. The channel length to be restored is about 150 feet, including transitions into the upstream and downstream undisturbed channel banks. The objective of this alternative is to restore the pre-weir hydrology, channel conditions, and associated biota to the extent practicable.

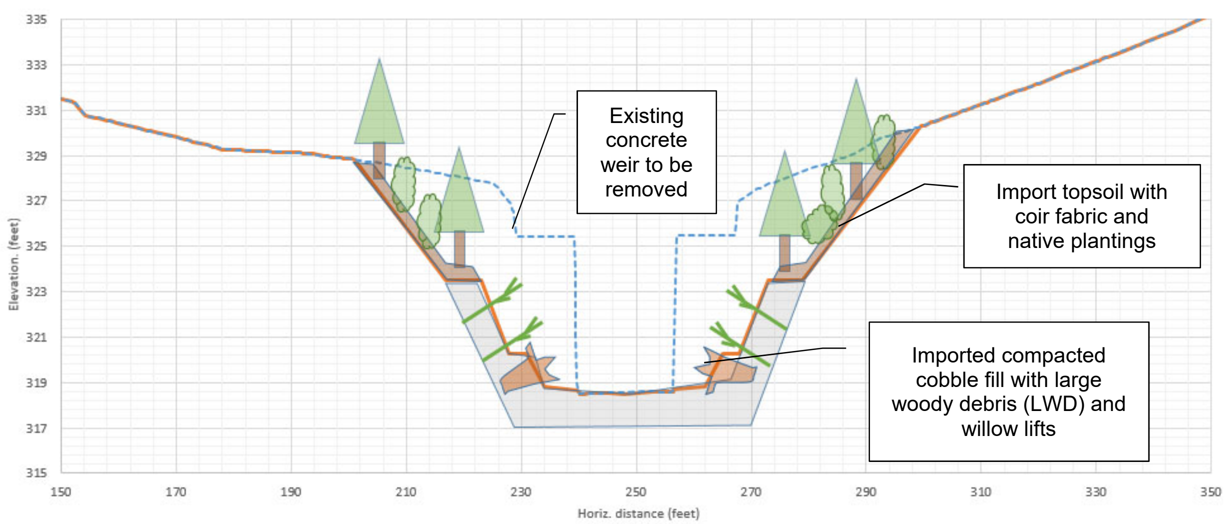

Figure 3. Restoration Alternatives 1 and 3 for removal of Chambers Lake Weir - typical cross section (not to scale).

2.2.3 Alternative 2 – Weir removal with higher streambed

Alternative 2 would remove the entire weir, restore the lake outlet channel, add streambank stabilization measures, and revegetate disturbed areas with native plants. The restored outlet channel will consist of a two percent gradient engineered fish passable riffle and have an upstream sill elevation of 323 feet. The restored outlet channel will have a 5-foot higher bed elevation than existing conditions between Chambers Lake and paved downstream low water crossing (ford) to maximize lake elevations and reduction in wetland acreage post-restoration. Alternative 2 would likely cause an increase in flooding upstream of the restored channel by a foot or more under very large floods (50 year or greater). Because of the higher wintertime flood levels, and higher summer time normal water level, the amount of seasonal wetland area would decrease and convert to open water.

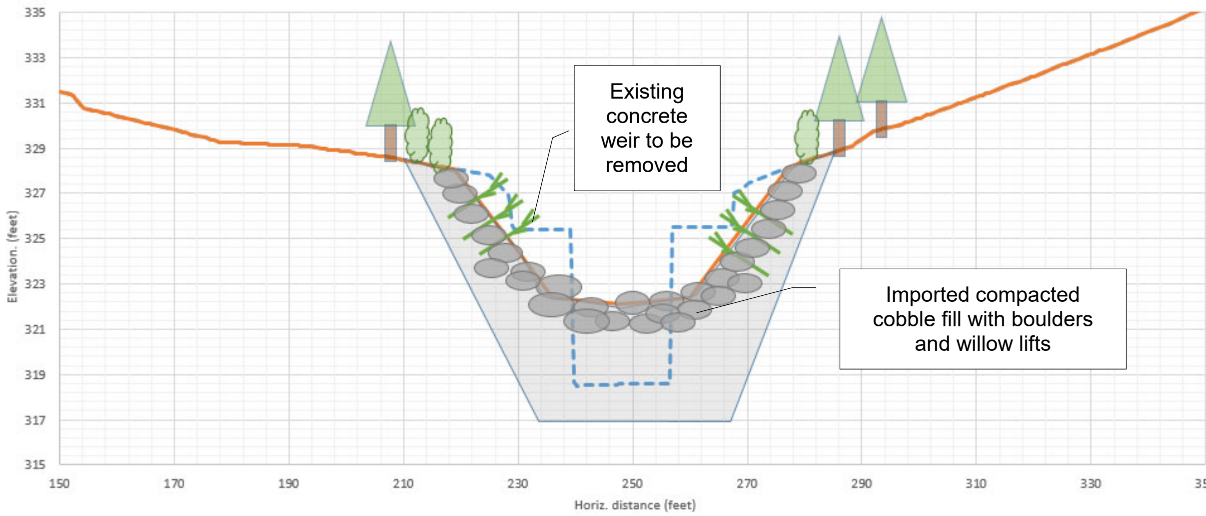

Figure 4. Restoration Alternative 2 for removal of Chambers Lake Weir - typical cross section (not to scale).

2.2.4 Alternative 3 – Weir removal with lower streambed

Alternative 3 would remove the entire weir, restore the Lake outlet channel, add streambank stabilization measures, and revegetate disturbed areas with native plants. The restored outlet channel will be the same as Alternative 1; however two isolated, relatively small (1 to 2-ft high), flow-obstructing vegetated gravel bars downstream of the weir will be graded to match adjacent channel elevations between the lake and ford, in order to maximize Muck Creek base streamflows out of the Lake post-restoration in an attempt to increase the duration of active streamflow. Initial modeling anticipates that wetlands conditions from this alternative would become significantly dryer in the summer, and during peak wintertime flooding the maximum inundated acreage could be reduced.

2.2.5 Initial Analysis of the Three Weir Removal Alternatives

Alternative 1 would most closely resemble pre-weir channel and lake conditions and does not significantly alter summertime lake levels, when water availability is at a minimum and wetland plant stress is at a maximum. It likely represents the most defensible post-removal condition from a holistic ecosystem restoration standpoint. The primary effects are expected to be restoration of seasonal inundation patterns that existed prior to the weir. The lake would rise and fall annually but the lake would take longer to fill to its maximum level, and would fall back to minimum levels more quickly. The rapid rise in lake levels that currently occurs in November due to the weir would no longer occur and the maximum stage will be about two to three feet lower (Figure 7). No change in peak flood levels downstream of the lake is expected. The average lake water level in the lake will decrease by about one-two feet, and a concordant reduction in the duration of inundation between the average and maximum water elevation.

Alternative 1 and 3 decrease flood levels by about three feet during the one-year event, about one foot during the 100-year event and about 0-feet during the 500-year event, with Alternative 3 resulting in about a half foot of additional reduction in lake stage due to removal of the obstructions in the downstream channel (Figure 7). By reducing lake elevations the velocities and shear stresses in Muck Creek in the former Lake

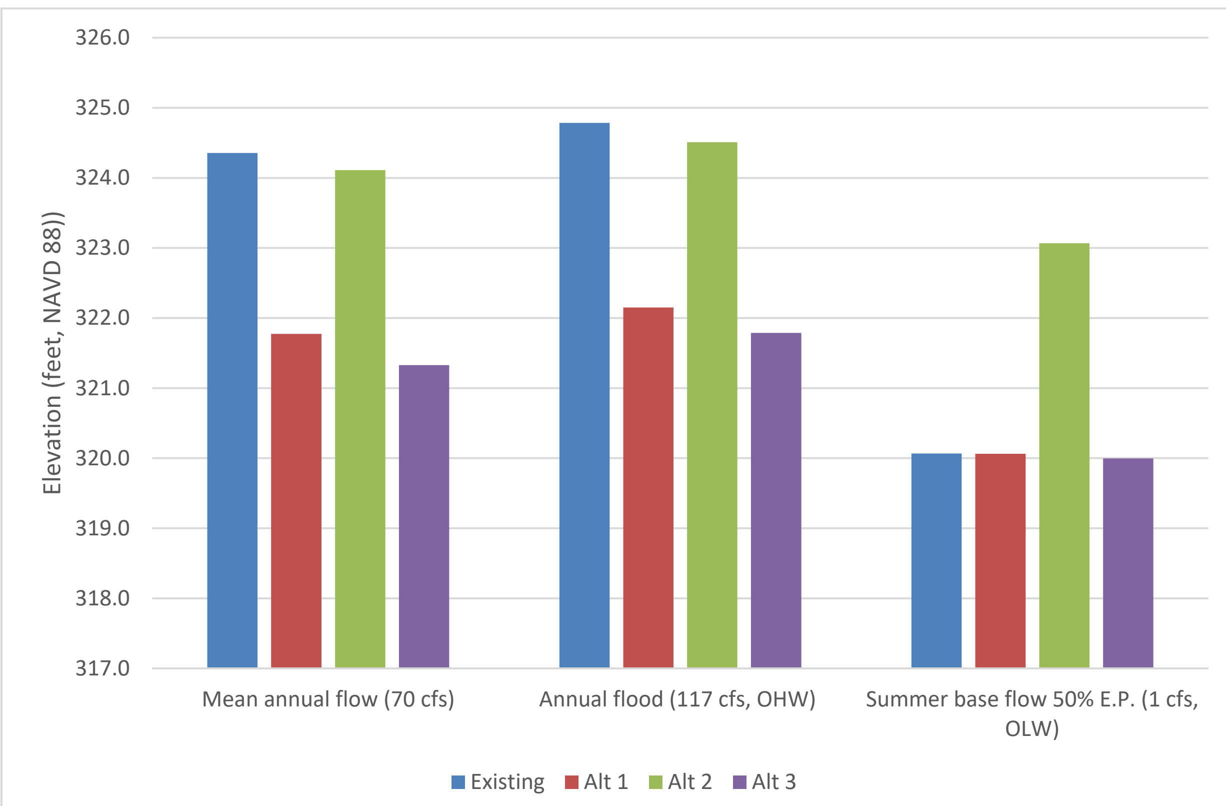

Figure 5. Chambers Lake level comparison for "normal" flow conditions by Alternative.

backwater zone will increase. Alternative 2 in contrast would likely cause an increase in flooding upstream of the restored channel by a foot or more under very large floods (50 year or greater). Because of the higher wintertime flood levels, and higher summertime normal water level, the amount of seasonal wetland area would decrease and convert to open water. Because Alternative 2 increases summer lake levels by about three feet this Alternative requires additional modeling to understand off-site impacts to streamflows and groundwater to determine if it is feasible. The acceptance of this condition by agencies is more uncertain.

2.2.5.1 Lake elevation and inundation area changes under normal flow conditions

Table 1 provides a comparison of modeled inundated acres for the 50 percent exceedance probability summer baseflow discharge (~0 cubic feet per second (cfs), Figure 6), the mean annual discharge (70 cfs, Figure 7), and the 99 percent annual exceedance probability (1-year) high flow discharge (117 cfs, Figure 8) for existing conditions and the three removal alternatives. The limits of the analysis are set to the locations where changes in water surface elevations are observed (between the project site near river mile (RM) 7 and the upstream extent of project influence near Shaver Lake, near RM 9). The baseflow inundation maps (Figure 6) correspond to the primary growing season for wetland plants (ordinary low water, (OLW)) and the 1-year discharge inundation map corresponds to ordinary high water conditions (Figure 8). The average daily flow (Figure 7) represents median conditions for the period of record. Collectively these maps portray the changes in “normal” inundation levels from existing conditions. Presumably the lowest baseflow discharge (and lake elevations) would define the transition between permanent open water and seasonally inundated wetlands. Similarly the highest annual elevations (1-year exceedance) would define the transition from seasonal wetlands to upland (grassland and riparian forest). As seen in Table 1 the existing total area inundated (water ponding above ground surface) inclusive of Muck Creek, Chambers Lake, Dailman Lake, Hamilton Lake and adjoining wetlands under the ordinary high water (OHW) conditions, OLW conditions, and average annual conditions is 175 acres, 76.8 acres and 168.5 acres respectively.

Table 1. Computed inundation acreage summary for average, normal high, and normal flow conditions.

Alternative	**Acres**		
	Mean annual flow (70 cfs)	**Annual flood (117 cfs, OHW)**	**Summer base flow (1 cfs, OLW)**
Existing (no action)	168.5	175.0	76.8
Alt 1	123.2	147.0	76.7
Alt 2	162.4	172.0	140.9
Alt 3	97.1	136.0	75.9

As shown in **Error! Not a valid bookmark self-reference.**, under Alternative 1, where the OLW level drops by 0.1 feet, only 0.1 acres of perennially wetted area (16 percent of the existing area) could convert to riparian wetland or upland flooded less frequently than once per year. Under Alternative 2 and 3, three acres (2 percent) and 39 acres (22 percent) respectively would be converted. If the OHW level drops by 2.6 feet, it is possible that 28 acres of wintertime open water habitat (16 percent of the existing area) could convert to riparian wetland or upland flooded less frequently than once per year. Summertime low lake levels are likely to remain unchanged for Alternative 1, whereas under Alternative 2 they would increase by three feet, and under Alternative 3 decrease by 0.1 feet.

Table 2. Computed inundation acreage change summary for average, normal high, and normal low flow conditions.

Change from Existing by Alternative	Mean annual flow (70 cfs)		Annual flood 117 cfs, OHW)		Summer base flow (1 cfs, OLW)	
	Acres	% Change	Acres	% Change	Acres	% Change
Alt 1	-45.3	-26%	-28.0	-16%	-0.1	0%
Alt 2	-6.1	-3%	-3.0	-2%	64.1	83%
Alt 3	-71.4	-41%	-39.0	-22%	-0.9	-1%

As base flow conditions do not appear to be altered significantly under Alternative 1, the impacts to groundwater would not be as great as Alternatives 2 and 3 which alter base (summer/fall) lake levels. Because Alternative 1 restores pre-disturbance hydrology and topography, it is presumed that there would not be significant objections to this alternative.

Three significant factors will mitigate the potential impacts to wetlands:

1. The groundwater table is high along the lake perimeter and will continue to percolate through the bottom of the lake and shoreline soils into the lake after weir removal. Thus even if the lake level is lower, the average groundwater elevation (primary source of lake inflow for much of the year) is unlikely to be impacted. Therefore, soils in areas where modeling indicates drying may not actually become dryer from the standpoint of water availability for wetland plants.

2. Soils in most of the area of frequent inundation consist primarily of reed canary grass rhizome mats. A relatively small reduction in average water levels is unlikely to alter the soil types significantly, although the frequency that these mats experience flotation will decrease.

3. Beavers are present and active in Chambers Lake. With a flowing stream, it is possible that beavers would construct dams in the Chambers Lake area. Thus the weir controlling lake elevations may be replaced with a series of beaver dams that accomplish the same function. Salmon and beavers have co-evolved to the post-glacial conditions of this watershed, and it is therefore assumed that adult fish passage through potential beaver dams is not likely to be problematic.

The following figures indicate the change of the three alternatives (blue) compared to existing conditions (greenish yellow).

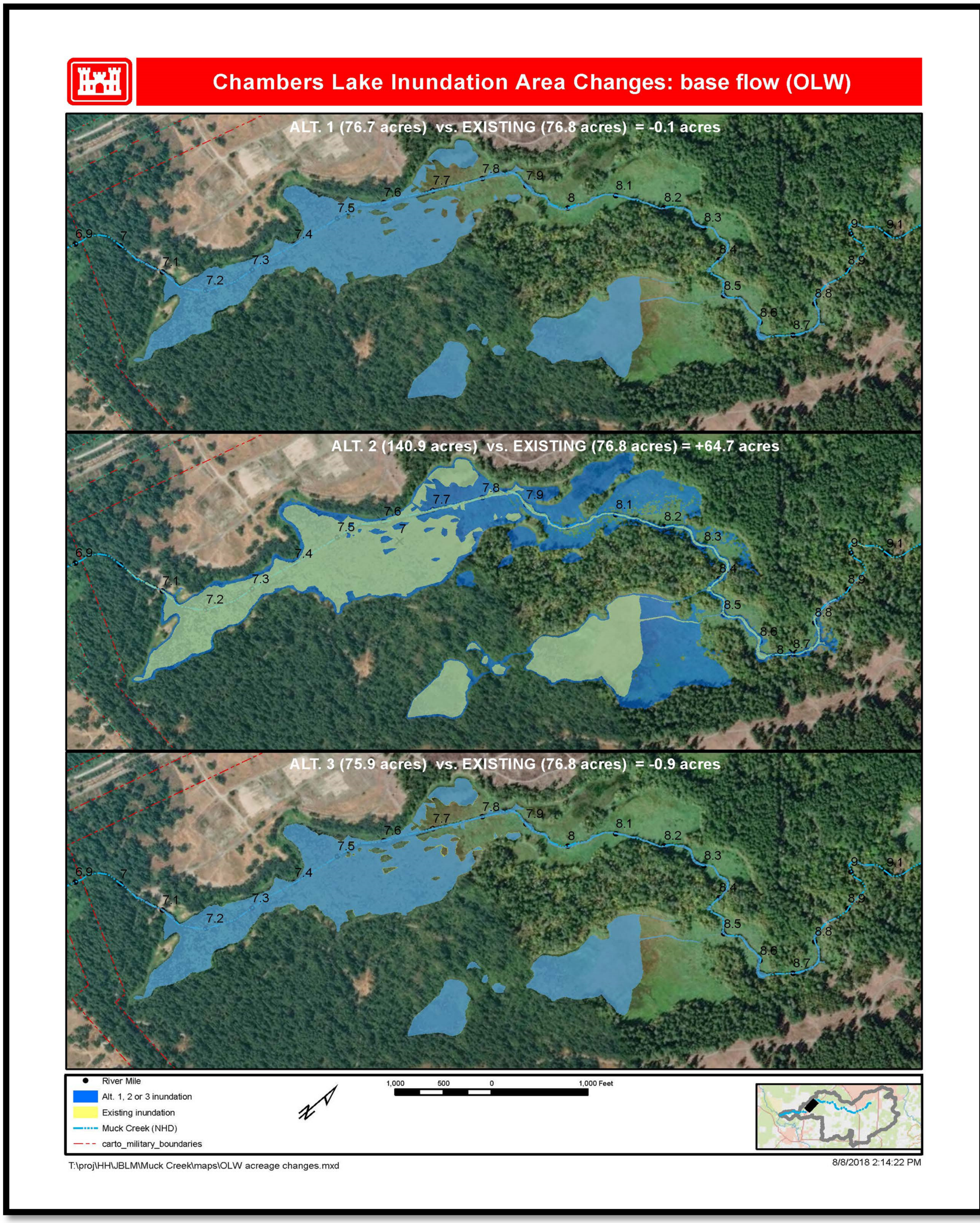

Figure 6. Potential changes in inundation area for three weir removal alternatives under ordinary low water (base-flow condition).

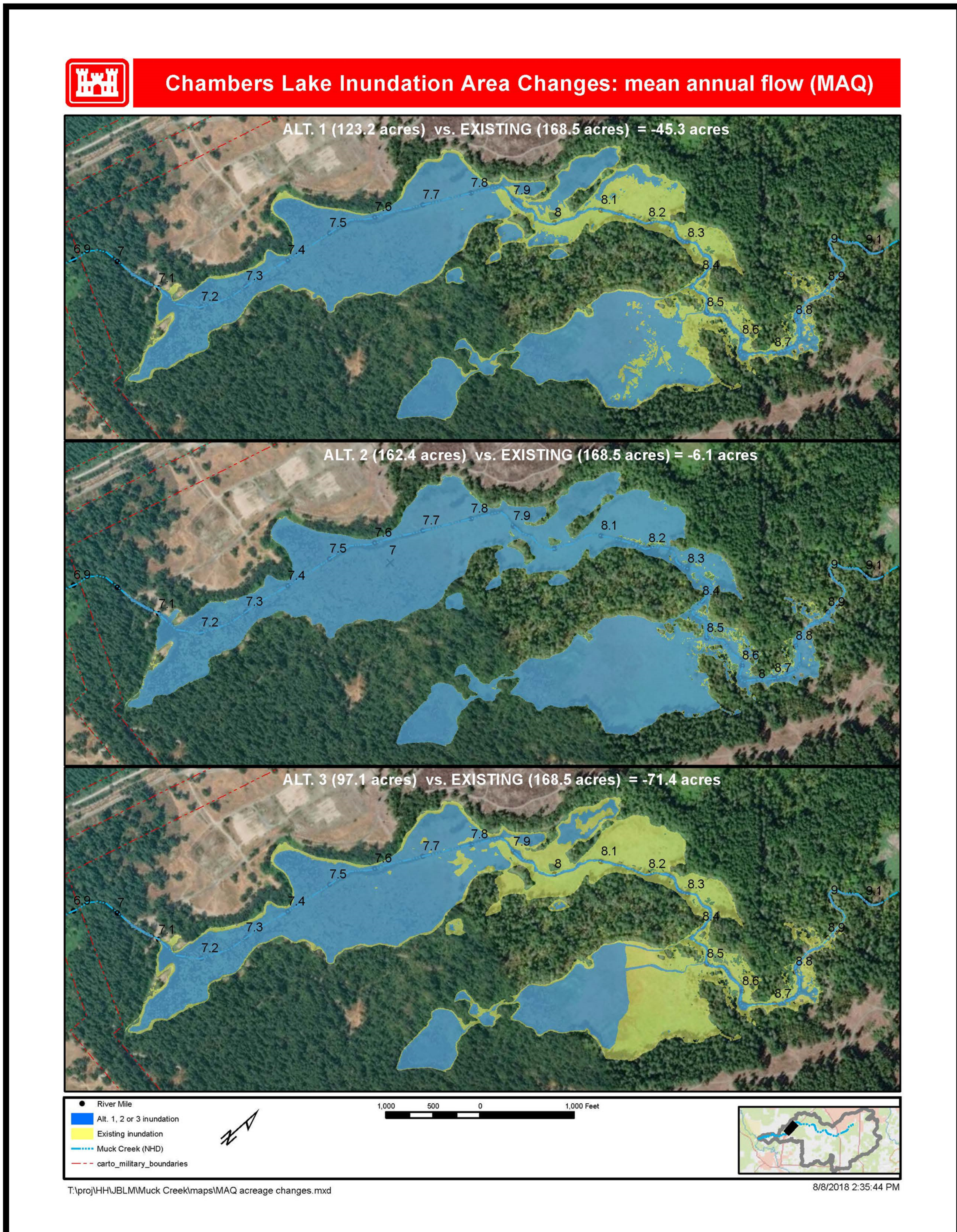

Figure 7. Potential changes in inundation area for three weir removal alternatives under mean annual flow condition.

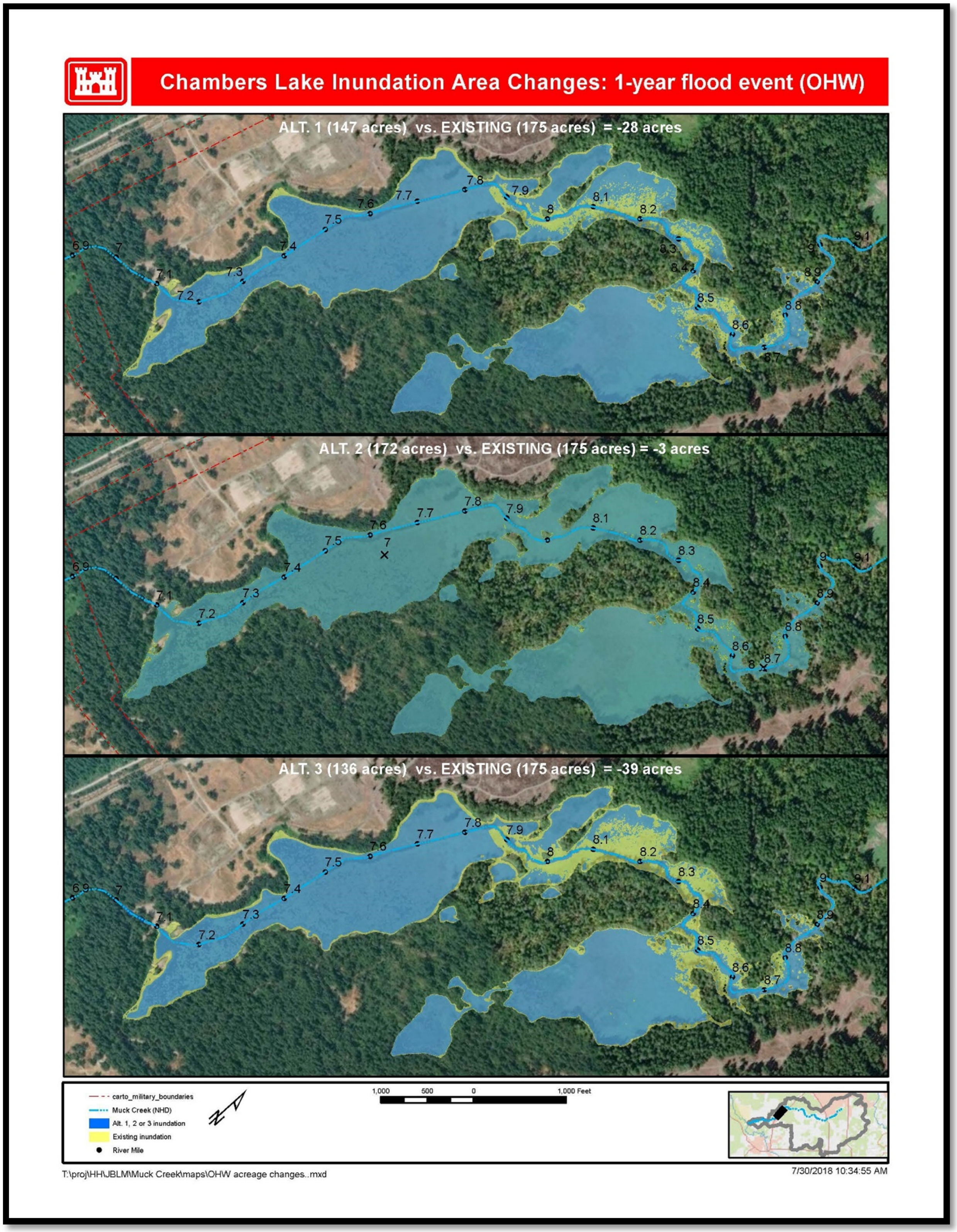

Figure 8. Potential changes in inundation area for three weir removal alternatives under ordinary high water flow condition.

2.2.5.2 Fish Passage and Fish Habitat Conditions

Alternative 1 attempts to restore the geomorphic and hydrologic conditions that existed prior to weir construction by removal of the weir and re-establishment of topography and bathymetry, channel substrate and vegetation that exist downstream of the weir and likely existed prior to the weir. Flow conditions through the restored channel should be identical if not have slightly slower velocities than the channel immediately downstream of the weir. Upstream and downstream fish passage will be unrestricted and the risk of fish stranding eliminated. Alternative 3 is similar to Alternative 1 but would remove small (fish passable) channel blockages downstream of the weir to further lower the lake. Fish passage conditions would be nearly identical as Alternative 1. Alternative 2 would replace the weir with an engineered riffle with a gradient that could pose fish passage concerns for small or juvenile fish trying to migrate upstream. The addition of boulders and large wood is likely necessary to provide adequate resting areas for upstream migrating fish. Fish passage is improved significantly over existing conditions but not as much as Alternatives 1 or 3.

The reduction in lake area and volume will impact fish and wildlife species adapted to that habitat type. Both Alternatives 1 and 3 will result in significant decreases in average lake elevations and acreages however, Alternative 3 would result in the most lowering of the lake and greatest reduction in lake area and volume. Both Alternatives 1 and 3 would reduce available lake habitat. Competition will increase and outmigration of lake adapted fish species could occur. Alternative 2 increases lake acreage and volume and would likely benefit species that thrive in lake conditions.

Downstream of the weir, Alternatives 1 and 3 could cause groundwater discharge to the lake to increase under average flow conditions, whereas Alternative 2 could cause it to decrease. Increased groundwater discharge could cause an increase in average streamflows and elevations in Muck Creek (likely small). Thus available aquatic habitat on Muck Creek could increase modestly under average flow conditions downstream of the weir. Upstream of Chambers Lake no project effects are likely. Conversely, under Alternative 2, decreased groundwater discharge could reduce streamflows downstream and decrease available aquatic habitat. Note that both flood elevations and base flow discharges and elevations are unlikely to change significantly for Alternative 1 because lake level changes for these flow conditions are not as great as under average flow conditions. Also, Alternatives 2 and 3 are likely to experience proportionately greater changes in lake levels and groundwater flows as compared with Alternative 1.

2.2.5.3 Qualitative Cost Considerations for Restoration Alternatives

The cost of removing and disposing of the weir is the same for all Alternatives, however the cost to restore the outlet channel is much greater for Alternative 2 than Alternatives 1 and 3. The cost to grade down to small, isolated high spots in the existing channel as part of Alternative 3 is negligibly greater than the cost to complete Alternative 1.

It is presumable that all work can be completed during the base flow period (late July through early November) when streamflows from the lake cease and the downstream channel dries up. Thus dewatering and turbidity control is primarily needed to protect water quality in the lake. This could be accomplished with gravel filled super sacks placed upstream of the weir and sumps and pumps placed in the primary work area to keep work areas dry enough to work efficiently. Because the downstream channel goes dry about 200 feet downstream it is likely that a small amount of groundwater pumped from the project site could be discharged back to the channel where it would then infiltrate to the subsurface.

The demolition would likely entail marking of the clearing limits, clearing and grubbing of vegetation, including trees. Next, the fencing and steel hardware will be removed and scrapped. Following that, the concrete structure will be rubbelized in place with pneumatic breakers attached to tracked excavators and the rubble will be hauled by dump trucks to a nearby upland disposal area on JBLM. A ground penetrating radar survey by U.S. Army Corps of Engineers (USACE) geologist detected a rebar mat in the abutment slabs and it is assumed similar reinforcement exists in the retaining walls and floor slab. If desired the rubble can be crushed and the steel reinforcement removed for scrap.

It is assumed that concrete and foundation material exists to a depth 3-feet below the invert elevation of the existing weir and that all of this would be removed and replaced as part of the lake outlet channel restoration. Alternatives 1 and 3 assume the existing channel grade through the structure will be maintained. Approximately 150 lineal feet of channel will be restored. The channel design for Alternatives 1 and 3 is intended to match the dimensions and materials of the natural channel downstream. This includes a channel substrate consisting of small rounded boulders, cobble, gravel, and sand with enough fines to allow compaction of the material to minimize subsurface flows. The side slopes of the channel and bankfull width match the natural channel downstream and include a low flow bench (consisting of placed boulders or large woody debris (LWD) for habitat and complexity) and a bankfull bench for establishing riparian vegetation and providing some velocity refuge during overbank high flow events. Tapering the channel to meet existing contours with side slopes that do not require significant erosion control work requires clearing a width of about 100 feet at maximum, which for safety reasons may require removal of trees next to the work area that have their rootmats undermined by the channel construction. Transitions to match existing grade will occur at both ends of the project and will be accomplished with the same channel fill materials as those used to construct the channel. Disturbed areas will be covered with imported topsoil, hydroseeded, covered with bio-degradable erosion control fabric above the bankfull channel, and planted with native riparian trees and shrubs. Willow lifts will be incorporated into the cobble banks below the bankfull elevation.

For Alternative 2, an engineered riffle would be constructed at an elevation of 5-feet above the invert elevation of the existing weir at its upstream point. This would require reconstructing 150 feet or more of the channel downstream of the weir to smoothly transition into the engineered riffle. The amount of imported streambed material for this Alternative is several times that needed for Alternative 1 and 2. The existing amount of standing trees and vegetation disturbed by this Alternative is significantly greater than the other Alternatives.

2.2.5.4 Recommended Restoration Alternative for Detailed Analysis

Alternatives 1 and 3 are based on re-establishing the pre-weir geomorphology and hydrology. Alternative 2 presumes maintenance of existing (elevated) inundation is more desirable than restoring pre-weir conditions. Hydrologic impacts resulting from restoration are assumed to be a necessary and beneficial condition of a restoration project. Because base flow conditions (streamflows, elevations) do not appear to be altered significantly by Alternative 1 the impacts to groundwater would not be as great as Alternatives 2 and 3 that alter base (summer/fall) lake levels. The ecological benefit of maintaining a permanently higher lake level and connecting the lake to the downstream channel with an engineered riffle is not yet clearly established and is likely to require additional modeling to demonstrate its feasibility. The construction cost and environmental impacts for Alternative 2 are far greater than Alternatives 1 and 3. For these reasons Alternative 2 is not recommended for further consideration. Development of restoration designs based on Alternative 1 is recommended.

Modification of the design to include the additional downstream grading associated with Alternative 3 could be easily accommodated at a later date if warranted after discussion with resource agencies. While additional technical studies may be needed to improve the understanding of the impacts of removing the channel blockages to fully restore hydrologic conditions at the Lake outlet channel, the small differences in seasonal water levels and inundation suggest that the additional effort may not be warranted. Should this alternative be pursued in the future, a supplemental EA may be required.

2.3 DESCRIPTION OF THE PREFERRED ALTERNATIVE

The Army proposes to remove the entire weir and foundation material, including all concrete rubble in the channel, import suitable streambed material that would be compacted and shaped to restore pre-weir channel topography, add streambank stabilization measures (rounded rock, large wood, soil lifts), and revegetate disturbed areas with native plants (Figure 3). The design cross section for the restoration is based on the channel dimensions of the natural channel 150 feet downstream of the weir. The finished width of the restored area ranges from 70 feet to 100 feet at its maximum. The channel has 6-foot wide, 5-foot high bankfull flow benches on both banks to establish vegetation at elevations that would create ample shade near the channel. The constructed bankfull width between the benches is 50 feet, with a bottom width of about 30 feet. The channel length to be restored is approximately 170 feet, including transitions into the upstream and downstream undisturbed channel banks. Quantities for demolition and restoration are given in **Error! Reference source not found.**.

Table 3. Demolition and Restoration Quantities

Demolition	**Area (sq ft)**	**Volume (CY)**
Total excavation and off-site disposal	9272	986
Concrete rubble (including steel)	2270	390
Soil	7005	596
Channel Restoration		
Imported streambed material	5680	8831
Imported topsoil	3145	10,214
Anchored LWD		20 ea

Water, erosion, and sediment control. It is expected that all work can be completed during the base flow period (late July through early November) when streamflows from the lake typically cease and the downstream channel dries up. This overlaps with the fisheries conservation in-water work window of 1 July through 15 September. Dewatering and turbidity control is primarily needed to protect water quality in the lake. This could be accomplished with gravel-filled Super Sacks placed upstream of the weir; pumps may be placed in the primary work area to keep conditions dry enough for efficient work. Because the downstream channel goes dry about 200 feet downstream, the small amount of groundwater pumped from the project site would be discharged back to the channel where it would then infiltrate to the subsurface.

Demolition and disposal of the existing weir, including the downstream concrete block energy dissipater and slope revetments. The demolition would entail marking of the clearing limits (approximately 1.5 acres) and clearing and grubbing of vegetation, including 4 to 5 mature trees. Demolition would then consist of mechanical removal (hydraulic excavators with pneumatic breakers) and hauling to an upland disposal site on JBLM property (site to be determined), and salvage of metal planking, guardrail, fences, etc. Assuming the concrete slab thickness at the base of the structure is 4 feet, the sub-excavation depth for the weir is expected to be about 5 feet to remove all of the concrete and non-native materials. The bottom width of the excavation trench is 20 feet, and the length of the excavation trench is 107.4 feet. Temporary cut side slopes for the demolition area were assumed to be 1.5H:1V or flatter.

Tapering the channel to meet existing contours with side slopes that do not require significant erosion control work would require clearing a width of about 100 feet at maximum, which, for safety reasons, may require removal of trees next to the work area that could have their rootmats undermined by the channel construction. Transitions to match existing grade would occur at both ends of the project and would be accomplished with the same channel fill materials as those used to construct the channel. Trees felled during demolition would be salvaged and reused as in-stream LWD, and their branches/twigs would be mulched for ground cover.

Restoration of the demolition area by constructing a restored natural stream channel. The restored stream channel will be excavated to span a distance of 170 feet along Muck Creek with a 30 foot bottom width. The side lopes will be 2H:1V, rising about 4-5 feet vertically to a 3-foot-wide planting bench that is expected to define the bankfull flow level. Cut slopes from the benches to existing ground will be 2H:1V. The bottom elevation of the restored channel will range from 317.5 to 319 ft NAVD88, matching the ground elevations upstream and downstream of the project. The restored streambed material will consist of suitable onsite materials combined with imported streambed material consisting of small rounded boulders, cobble, gravel, and sand, with enough fines to allow compaction of the material to minimize subsurface flows.

Vegetation and fish habitat improvements. The side slopes of the channel and bankfull width match the natural channel downstream and include a low flow bench (consisting of placed boulders and/or LWD for habitat and complexity) and a bankfull bench for establishing riparian vegetation and providing some velocity refuge during overbank high flow events. Disturbed areas would be covered with imported topsoil, hydroseeded, covered with biodegradable erosion control fabric above the bankfull channel, and planted with native riparian trees and shrubs. Willow lifts will be incorporated into the cobble banks below the bankfull elevation.

Staging Areas. The existing gravel parking areas and roads to the site are trafficked frequently by military vehicles and are sufficient to accommodate all expected construction equipment, including low boy trailers, off-road dump trucks, or heavy excavators. The most likely staging area will be the cleared area just north and west of the weir.

2.4 Conservation Measures and Best Management Practices

To minimize environmental impacts during demolition and construction activities the following Conservation Measures and Best Management Practices would be implemented:

2.4.1 Conservation Measures during Construction

- Potential impacts to aquatic species and fish would be avoided by performing all in-water work during the established work window (July 1 to September 15) and/or low flow conditions when Muck Creek is typically dry due to the ephemeral nature of the stream (i.e., through November; Section 3.2).
- The demolition area would be isolated from open water through the use of silt curtains or super-sacks to isolate the construction area and to prevent disturbed sediments from exceeding Washington State Water Quality standards upstream or downstream of the construction zone.

2.4.2 Best management Practices

Below are Best Management Practices that would be incorporated into the action. Some are integrated into the repair, while others are guides to operation and care of equipment.

2.4.2.1 General site conditions

- All stockpiled materials and equipment (excavated soils held for revegetation efforts, wood, heavy machinery) would be protected against surface run-off using measures such as perimeter silt fencing.
- All weir materials such as concrete will be removed from the site and disposed of at an appropriate upland location.
- Equipment would not be allowed to idle longer than 15 minutes when not in use.
- No new access roads would be constructed.
- Vegetation removal would be limited to the repair sites.
- Noxious weeds would be disposed of separately from other organic materials at an approved off-site location.
- Any large wood generated on-site would be salvaged and placed within the restored stream channel.
- At least one biologist would be available via phone during demolition and construction. JBLM or Service Biologists may visit the construction site. All visits would be coordinated with the Project Manager and Construction Manager.
- Remove all trash and unauthorized fill in the project and staging area, including concrete blocks or pieces, bricks, asphalt, metal, treated wood, glass, floating debris, and paper, that is waterward of the ordinary high water line and dispose of properly after work is completed.

2.4.2.2 Water Quality

- Maximum turbidity levels would be monitored (visually or physically) during in-water work to meet State water quality standards according to WAC 173-201A-200; a water quality monitoring plan would be coordinated with the Washington State Department of Ecology (WDOE).
- Measures to minimize erosion and sedimentation caused by runoff from disturbed soils or from in-water work would be implemented. Measures would be tailored to site conditions and may include silt curtains, super-sacks, hay bales, and/or coir logs and jute.

2.4.2.3 Use of Equipment

- Equipment that would be used near or in the water would be cleaned prior to construction. Equipment will be cleaned and inspected prior to entering the project area to prevent the introduction of invasive plants and noxious weeds.
- Construction equipment would be regularly checked for vehicle-fluid drips or leaks. Any leak would be fixed promptly or the equipment would be removed from the project site.
- At least one fuel spill kit with absorbent pads would be on-site at all times, and construction crews would be trained on its proper use.
- Re-fueling would occur a minimum of 100 feet away from the streambank.
- Vegetable based hydraulic fluid would be used in heavy equipment assigned to work in or near Muck Creek. Construction equipment would be regularly checked for drips or leaks.

2.4.3 Post Construction Conservation Measures

The following conservation measures would be taken to minimize impacts after completion of the proposed action:

- Native plantings, including some native trees, would be planted along the slope of the project (Appendix A) according to USACE (2017) guidelines for riparian planting. Clearing of vegetation will be limited to that which is necessary for construction.
- The weir removal area will be rehabilitated to integrate into the surrounding environment of the creek bed and riparian area.
- Beaver activity such as dam building or downing trees will not be discouraged after the proposed project is constructed to allow development of complex woody habitat and off-channel areas.

3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This section presents a consolidated discussion of the affected environment (baseline environmental conditions assessed) and the environmental impacts anticipated as a result of implementation of the alternatives. Although the No-Action Alternative does not meet the objective of removing the weir, it is carried forward under NEPA to serve as a comparison.

3.1 Geology and Soils

The Muck Creek watershed is located within the south Puget Sound lowland, an area underlain by thick unconsolidated Quaternary sediments. This sedimentary sequence represents deposition from at least four major glacial periods during the Quaternary, and by non-glacial processes during interglacial periods. The near-surface deposits that influence modern-day surface hydrology in Muck Creek date to 13,000 to 15,000 years ago, during the most recent major glacial advance into the south Puget Sound. This period is referred to as the Vashon Stade of the Frasier Glaciation, or by some sources simply as the Vashon Glaciation. Earlier named intervals represented by deposits in this region include, listed from youngest to oldest, the Olympia Interglaciation (15-35 *kilo-annum* (ka)), the Salmon Springs Glaciation, the Puyallup Interglaciation, the Stuck Glaciation, the Alderton Interglaciation, and the Orting Glaciation. Periods prior to the Olympia Integlaciation are too old for carbon dating methods (>40ka) (Borden and Troost 2001).

The major soil types in order of frequency in the basin are tills (located primarily in the South Creek and Lacamas Creek sub-watersheds), outwash gravels (primarily in the project area), loams, clays, and organics (peat) in lakes and wetlands. The soils occupying the lower lying gently sloping and hummocky prairie lands along Muck Creek and Chambers Lake typically consist of deposits from the inter-fingered braided outwash channels that include fluvial features such as deltas, terraces, bars, scour holes and islands. These deposits are locally known as Steilacoom gravels. The Steilacoom gravel deposits also include ice contact deposits such as eskers and drumlins (channel filled with sand and gravel under the ice, hills formed by passage of ice). Steilacoom gravels are pervasive in the Fort Lewis area and typically consist of a fairly uniform mixture of sand, gravels, cobbles and small boulders in thicknesses of less than 30 feet to more than 150 feet (USGS 2010). Topsoil thicknesses are generally low because vegetation establishment is difficult on the Steilacoom deposits which are highly porous allowing for rapid infiltration of surface runoff to the groundwater table below. Within the Steilacoom gravels are outcrops of undifferentiated glacial drift and glacial till. These deposits were partially eroded by the outwash channels and typically protrude 10-50 feet above the outwash plain.

Surface soils are predominately Spanaway gravelly sandy loam (Natural Resource Conservation Service (NRCS) 2018), which are described as nearly level, somewhat excessively drained soils that formed in glacial outwash on uplands (NRCS 1979). Spanaway soils formed in glacial outwash mixed in the upper part with volcanic ash on the very extensive plain from Lakewood to Roy. Permeability is moderately rapid, with slow surface runoff and low available water capacity (NRCS 1979).

3.1.1 No Action Alternative

Under the No Action Alternative, existing conditions are expected to persist, where soil conditions and topography would not be substantially affected. There would be no change in sediment transport or accumulation.

3.1.2 Weir Removal Alternative

Approximately 986 CY of material would be removed from the site and disposed in an environmentally acceptable location. This material consists of approximately 390 CY of concrete rubble and 596 CY of soils. Approximately 8,821 CY of streambed material consisting of mall rounded boulders, cobble, gravel, and sand would be used to restore the channel. Approximately 10,314 CY of imported topsoil would be used to restore the channel banks and to support plantings.

3.2 Water Resources and Water Quality

Water Resources. Chambers Lake is a small lake in Pierce County, WA, located just within the boundary of Joint Base Lewis-McChord. While the lake is natural in origin, a small dam was constructed at the outlet in 1967 to increase lake level and storage as a wildland firefighting water supply. Outflows from the lake are controlled by adding and removing boards at the outlet structure, impounding water during the wet season and releasing water to augment flows during the dry season. The surface area of the lake is approximately 108 acres when filled to capacity, but varies considerably throughout the year. Significant portions of the lake, especially in the upper half, become dry or marshy during the summer due to falling lake levels.

Chambers Lake is located within the Muck Creek watershed, which includes Muck Creek, South Creek, and Lacamas Creek. Chambers Lake is located along the main stem of Muck Creek. Flows in Muck Creek are intermittent both above and below Chambers Lake, with certain reaches becoming dry most summers. Water levels in Muck Creek and Chambers Lake are controlled to a significant degree by interactions with groundwater. Much of the lowland prairie of the northern and western portion of the Muck Creek watershed, including the Chambers Lake area, is underlain by the Steilacoom Gravel, a coarse grained and highly conductive glacial outwash gravel. This high hydraulic conductivity allows for rapid exchange of water between the surface water and the shallow aquifer, as well as efficient horizontal transport of groundwater.

Muck Creek is a losing stream for the majority of its lower reaches, losing water to the shallow aquifer, though streamflows are replenished in several locations by springs. The lakes within the watershed, including Chambers Lake, are fed by these springs, which provide inflows to the lakes even when the creek is dry.

The Muck Creek watershed covers an area of approximately 91 square miles in southwestern Pierce County, within the south Puget Sound lowland region. Approximately 25 percent of the Muck Creek watershed, including the middle reaches of Muck Creek and the area around Chambers Lake, lie within JBLM. The geography and hydrology of this region is influenced heavily by a history of glaciation and the thick deposits of glacial sediments that remain. These sediments define two distinct geographic and topographic regions of the watershed: a till-covered upland lying at 500 to 960 feet elevation in the southern and eastern portion of the watershed, and an outwash-covered lowland prairie lying at 300 to 500 feet in the northern and western portions. Elevations in the watershed reach a low point of 100 feet where Muck Creek enters the Nisqually River; a small, steep ravine has formed at that location.

Discharge measurements for Muck Creek are limited. The Roy gaging site (Figure 9) was reactivated from April 1999-March 2000 for a WDOE study "*Assessment of Surface Water and Groundwater Interchange within the Muck Creek Watershed Pierce County*." The Roy gaging site illustrates the timing when Muck Creek experiences low to no flow—typically July through November. This occurs in multiple stream locations.

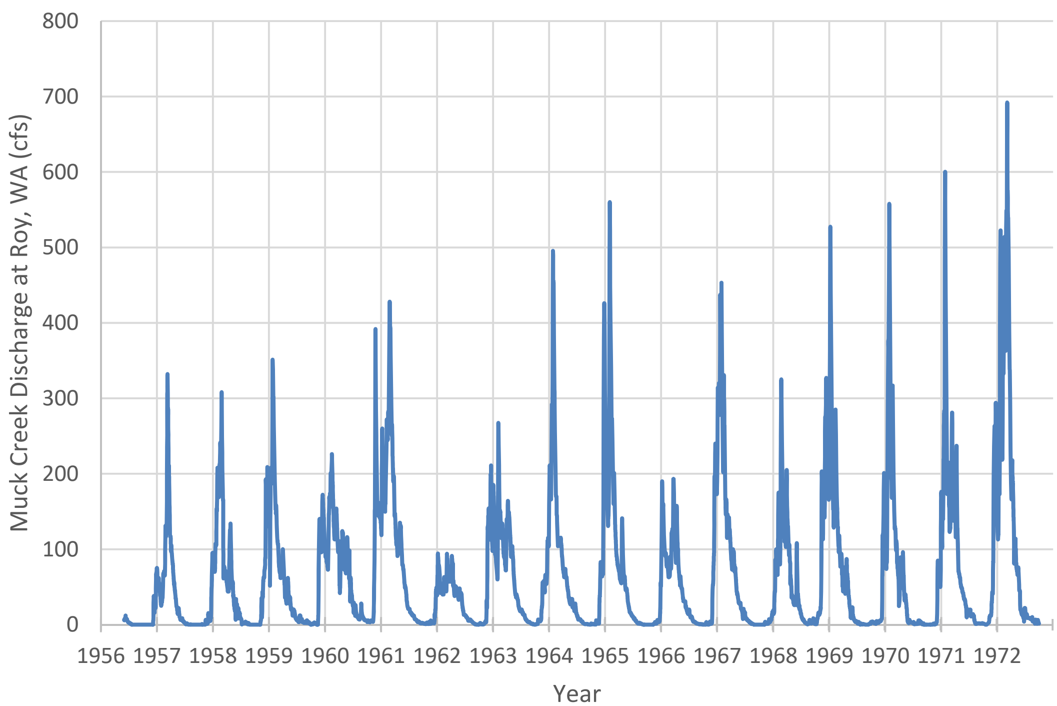

Figure 9. Muck Creek Discharge 1956-1972 from USGS Stream Gage at Roy, WA.

Water Quality. WDOE classified Muck Creek for several criteria (WAC 173-201A-602). Muck Creek and tributaries are designated as suitable for primary contact recreational uses, suitable for domestic, industrial, agricultural, and stock water supply uses, and suitable for wildlife habitat, harvesting, commerce and navigation, boating, and aesthetics. Under aquatic life uses, Muck Creek is listed as core summer salmonid habitat, which is identified as summer (June 15 – September 15) salmonid spawning or emergence, or adult holding; use as important summer rearing habitat by one or more salmonids; or foraging by adult and sub-adult native char. Other common characteristic aquatic life uses for waters in this category include spawning outside of the summer season, rearing, and migration by salmonids.

The 303(d) list contains Washington waters that are impaired or threatened (Figure 10). Impairment categories range from Category 1 (meets tested standards for clean waters) to Category 5 (polluted waters that require a water improvement project; WDOE 2018). Muck Creek upstream of Chambers Lake is listed as Category 2 (waters of concern) for bacteria and dissolved oxygen while Muck Creek downstream of Chambers Lake is listed as Category 5 for bacteria (WDOE 2018). Lacamas Creek, a tributary to Muck Creek, is also listed as Category 2 for dissolved oxygen (WDOE 2018).

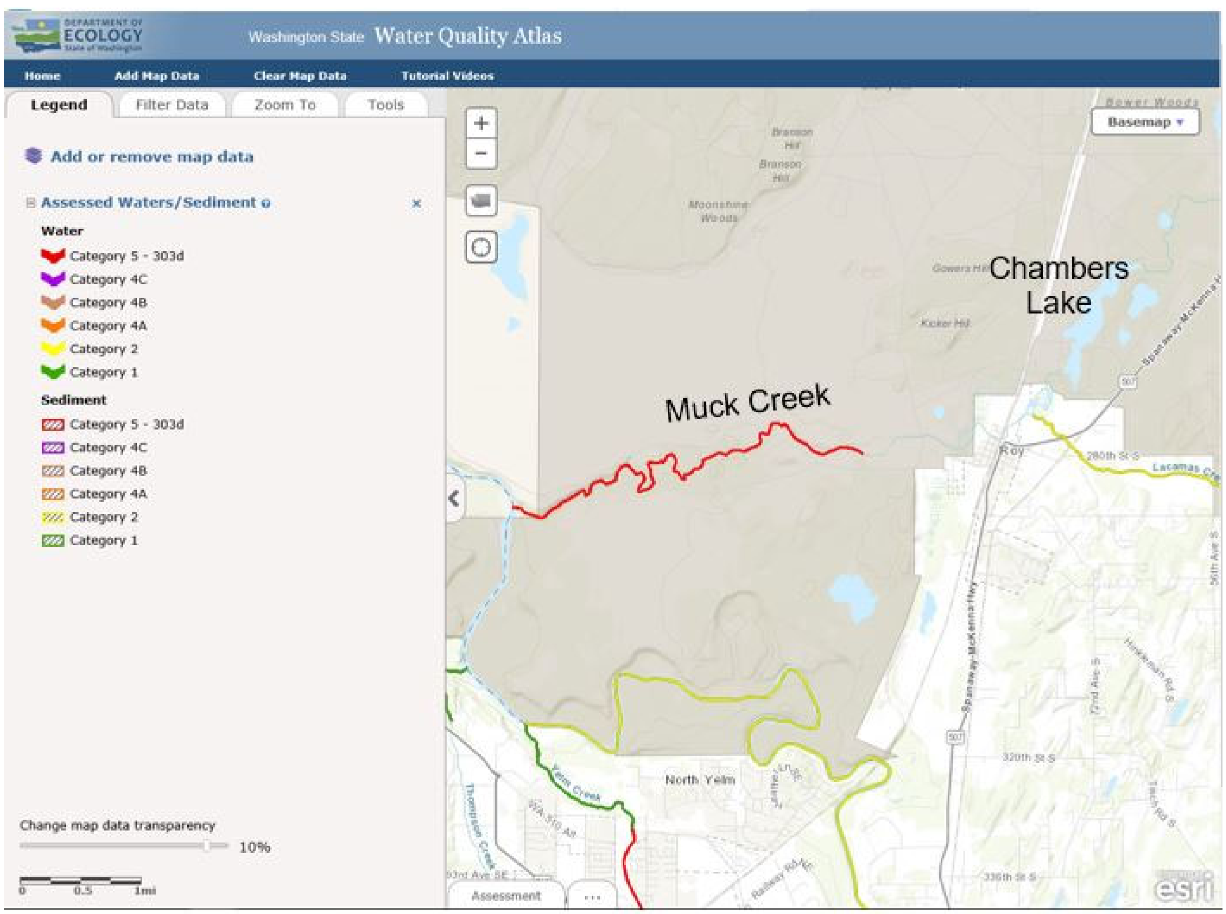

Figure 10. Water Quality Assessment Map for Muck Creek and nearby tributaries (Ecology 2018).

3.2.1 No Action Alternative

Surface and groundwater would remain unchanged under the No Action alternative.

3.2.2 Weir Removal Alternative

Water Resources. Muck Creek flood discharges are unlikely to change; however, seasonal discharges may be altered slightly because of the interaction with the shallow aquifer around the lake. Downstream of Chambers Lake, including Roy, WA, streamflows in the spring and summer may decline after removal because of loss of the seasonal impoundment of Chambers Lake, but the strong influence of groundwater and complex geology makes this unlikely (USACE 2019).

Instead, reductions in seasonal lake levels may increase the groundwater gradient into the lake, which would increase the amount of groundwater discharging to the lake and reduce the amount of lake water discharging to the groundwater table. The net effect of this is likely to be increased streamflows on Muck Creek downstream of Chambers Lake during the spring recession up to the annual base flow. The annual base flow lake level is expected to remain unchanged. Thus the OLW level of the lake will remain unchanged, however the OHW level will likely be lower by about 2.5 feet, resulting in a 16 percent reduction of inundated acreage (38 acres).

A summary of computed seasonal elevations for the primary hydrologic “seasons” in Chambers Lake with the proposed project are shown below in Table 4 for various probabilities of exceedance. The changes from existing conditions for the same seasons/statistics appear below (Table 5). The primary effects of the proposed project are a reduction in “Winter Flooding” lake elevations under normal or “average” flow conditions, and no change in the “Summer & Fall Baseflow” or “November Rise” lake levels except during wet years when there is a ten percent chance of flow or lake level being higher than indicated. During normal years, the annual average condition may be as much as 2.9 feet lower (over the entire year).

Table 4. Modeled seasonal inundation elevations (feet) in Chambers Lake based on monthly flow duration analysis.

Percent time elevation exceeded	Summer & Fall Base Flow (ft)	November Rise (ft)	Winter Flooding (ft)	Spring & Summer Recession (ft)	Annual Average (ft)
10	320.4	322.1	323.3	321.9	322.4
50	320.0	320.1	322.2	321.2	322.0
90	317.8	317.8	321.4	320.7	320.9

Table 5. Modeled seasonal inundation elevation changes (feet) in Chambers Lake based on flow duration analysis.

Percent time elevation exceeded	Summer & Fall Base Flow (ft)	November Rise (ft)	Winter Flooding (ft)	Spring & Summer Recession (ft)	Annual Average (ft)
10	-0.1	-2.6	-2.5	-2.0	-2.9
50	0.0	0.0	-2.6	-1.1	0.1
90	0.0	0.0	-1.7	-0.4	0.9

With weir removal, Dailman Lake and Chambers Lake elevations will be lower during flood season, which allows for some of the high flows on Muck Creek to divert into Dailman Lake, attenuating downstream flood peaks. During prolonged high water periods of very large floods, however, Dailman Lake and Chambers Lake would rise to the same elevations as under existing conditions. Downstream attenuation does not occur with weir removal, nor are flood peaks increased for very large floods, unless they occur at the beginning of flood season. This is very similar to current conditions, where the weir causes Muck Creek flows to fill in the active storage areas of the lakes and wetlands prior to the onset of flood season (which means that there is no active flood storage provided by the existing weir, and thus no increase in downstream flood peaks caused by weir removal). Changes in inundation during the theoretical 1 percent Annual Exceedance Probability (AEP)[1] flood are insignificant.

Water Quality. Muck Creek is expected to be dry and isolated from Chambers Lake during construction, so weir removal and restoration of the stream are not expected to degrade water quality. The removal of 4 to 5 trees and vegetation in the vicinity of the weir could contribute to slightly higher water temperatures but would be offset by native plantings along150 feet downstream of the former weir. Plantings are expected to become established in 3-10 years.

Sediment loads on Muck Creek coming into the lake are low and the current volume of stored sediment is low (USACE 2018). In addition, an existing stream channel exists within the lake and the natural lake that will remain upstream of the weir is likely to continue to trap all of the mobilized coarse sediments and most of the fine sediments. After weir removal the sediment mobility post-weir removal will increase but remain low; therefore, there is no need for special treatment of the stream channel upstream of Chambers Lake after weir removal as is commonly the case when a reservoir has a large sediment wedge or delta. The downstream risks posed by sediment are negligible to low and there is no need for mechanical removal of sediment or special considerations other than to verify that no contamination concerns are present within the lake or upstream.

[1] In the 1960's, the United States government decided to use the 1-percent annual exceedance probability (AEP) flood as the basis for the National Flood Insurance Program. The 1-percent AEP flood was thought to be a fair balance between protecting the public and overly stringent regulation. Because the 1-percent AEP flood has a 1 in 100 chance of being equaled or exceeded in any 1 year, and it has an average recurrence interval of 100 years, it often is referred to as the "100-year flood" (USGS 2018).

3.3 VEGETATION AND WETLANDS

This portion of the watershed contains few permanent structures and consists of broad grass-covered prairies, oak savanna, coniferous woodlands, and riparian/wetlands. It is generally unused except during periodic military training maneuvers. The remainder of the watershed, which includes the communities of Roy and Graham, consists of mixed woodlands, agricultural fields, and low-to-moderate density residential development.

Prairie. Traditional prairie habitat exists in the watershed, but in limited quantities. It is found in areas of dry soils, mostly within or adjacent to Fort Lewis lands. Land development, both urban and agricultural, have modified the traditional prairie vegetation species.

Oak Savannah. Oak woodlands range from communities of pure Oregon white oak (*Quercus garryana*) to a mix of oak, conifer, and deciduous trees. Pure oak stands are found on the prairie edges.

Conifer Forests. Three semi-distinct forest types are contained within the watershed; western redcedar (*Thuja plicata*), Douglas fir (*Pseudotsuga menziesii*), and ponderosa pine (*Pinus ponderosa*). The western redcedar type occupies the moist soil regimes within the Basin, with western hemlock (*Tsuga heterophylla*) scattered within the upper watershed of this habitat type. Douglas fir dominates the majority of the conifer habitats in the watershed. This forest type grows in the variety of habitat conditions (soil moisture and topography) between the spruce/fir/cedar and prairie ecotones. Scattered ponderosa pine forest types are present in ridge lines with pure stands accompanying dry soil conditions associated with prairie habitats. Nearly all of the area's historical coniferous forests are either in second growth or have been lost to agricultural or residential land uses.

Riparian/Wetlands. Downstream of Chambers Lake, and upstream of the influence of the lake, vegetation conditions are more similar to typical alluvial stream channels with vegetation zonation corresponding to the ordinary low and ordinary high water levels. Because of the geologic history as a glacial outwash plain, the Muck Creek floodplain is inset within the much larger paleo meltwater channels. Topographic bankfull indicators for those channels (tops of banks) are not relevant to the modern Muck Creek because the bankfull discharge in these meltwater channels is an order of magnitude greater than the largest recorded flood flow on Muck Creek. Thus, indicators such as establishment of permanent woody vegetation and recent erosion/deposition are most appropriate for establishing the OHW plane for a given channel segment. Note that the typical OLW zonation (herbaceous vegetation to open water transition) is not present in many channel segments due to ephemeral (sub-surface) streamflow conditions for several months of the year. The low flow channel is covered by a thin mat of reed canary grass in areas where it is not persistently under several feet of water. Floating aquatic plants are present in the low to moderate gradient reaches where lake and wetland conditions predominate. Typical species within the riparian habitat are red alder (*Alnus rubra*), Indian plum (*Oemleria cerasiformis*), snowberry (*Symphoricarpos albus*), Himalayan blackberry (*Rubus armeniacus*), and reed canary-grass (*Phalaris arundinacea*). Both Himalayan blackberry and reed canary-grass are listed as Class C noxious weeds by the State of Washington (Washington Department of Agriculture 2018). Of note, near the weir is a stand of native trailing blackberry (*Rubus ursinus*).

Figure 11. Riparian habitat downstream of weir.

Upstream of the weir there is a clear zonation between the upland vegetation (forest), lake fluctuation zone vegetation and wetland/lake vegetation communities. The zonation is based on elevation contours. Elevation contour 325 feet roughly corresponds with the transition to upland to fluctuation zone vegetation. Elevation contour 321 feet corresponds with the transition from the fluctuation zone to permanent open water/marsh zone. Water levels are typically not less than elevation 320 feet in Chambers Lake. Typical species in the wetland/lake habitat is dominated by reed canary-grass, but also includes, English plantain (*Plantago lanceolata*), timothy grass (*Phleum pratense*), common duckweed (*Lemna minor*), water-pepper (*Polygonum hydropiperoides*), and floating pondweed (*Potamogeton natans*).

Figure 12. Wetland habitat upstream of weir.

3.3.1 No Action Alternative

Wetlands including floodplain habitat will remain unaffected by the No Action alternative.

3.3.2 Weir Removal Alternative

Impacts to wetlands and riparian habitat will be avoided and minimized. During construction, disturbance will be limited to staging areas, the weir removal site, and approximately 150 feet downstream from the weir so the stream channel can be reshaped and banks planted with native vegetation, approximately 1.5 acres. Disturbance to the project area is expected to be temporary, including the felling of four to five mature trees. The area should return to pre-construction function after the native vegetation plantings have been established, in approximately three to ten years. In addition, the approximately 150 feet of stream that will be reshaped during the in-water work window and/or typically dry period of the year is a small proportion of the overall stream habitat available and is not likely to constitute a substantial disturbance.

Removal of the weir and the large concrete blocks that function as energy dissipaters downstream of the weir will result in restoration of natural topography and bathymetry between 30 feet upstream and downstream of the existing weir. The restored channel gradient will slope adversely (increase in the downstream direction) to blend in with bathymetry from the lake into the Muck Creek outlet channel. The existing channel bottom width through the site of the former structure will be increased to its natural width of 34 feet from 18 feet. The bankfull width will change from 18 feet to 50 feet. The existing population of native plants on the streambanks will be matched to revegetate disturbed areas. Large wood will be placed to add cover and complexity to the restored streambed and banks, which will consist of well-graded gravels and cobbles compacted to a density comparable to glacial till. No changes to the existing bridge or concrete ford downstream are necessary to complete this project.

The groundwater table is high along the lake perimeter and will continue to percolate through lake's bottom and shoreline soils into the lake after weir removal. Even if the lake level is lower following weir removal, the average groundwater elevation (primary source of lake inflow for much of the year) is unlikely to be impacted. Thus, soils in areas where modeling indicates drying may not actually become dryer from the standpoint of water availability for wetland plants. In addition, soils in most of the area of frequent inundation consist primarily of RCG rhizome mats. A relatively small reduction in average water levels is unlikely to alter the soil types significantly, although the frequency that these mats experience flotation will decrease.

Beavers are present and active in Chambers Lake. With a flowing stream, it is possible that beavers would construct dams in the Chambers Lake complex. The weir controlling lake elevations eventually may therefore be replaced with a series of beaver dams that accomplish the same function. Beaver ponds may change vegetation types and patterns with a series of inundated ponds and willow lined stream banks.

3.4 Fish and Wildlife

3.4.1 Fish

The Nisqually River drainage supports seven anadromous fish species. In the Nisqually River, Winter Steelhead and Coho, Fall Chinook, Winter Chum, and Pink (odd year) Salmon spawning has been documented, and Bull Trout and Sockeye Salmon are present (WDFW 2018). Resident fish species in the Nisqually River basin include both native and non-native fish: including Lamprey (family Petromyzontidae), Sculpin (*Cottus* spp.), Dace (*Rhinichthys* spp.), Three-Spine Sticklebacks (*Gasterosteus aculeatus*), Sunfish (Lepomis spp.), Yellow Perch (Perca flavescens), Black Crappie (*Pomoxis nigromaculatus*), Smallmouth Bass (*Micropterus dolomieu*), Largemouth Bass (*Micropterus salmoides*), mountain whitefish (*Prosopium williamsoni)*, suckers (*Catostomus* spp.), Fathead Minnow (*Pimephales promelas*) and Brown Bullhead (*Ameiurus nebulosus*; Klungle et al. 2018).

At least 25 fish species live in lakes and streams on JBLM, and several are salmonids (JBLM DPW 2010). Muck Creek supports populations of Sea-Run Cutthroat Trout, Coho salmon, and Steelhead Trout. Approximately one third of the Nisqually River basin Chum salmon spawning occurs in Muck Creek (Pierce County 2005; Klungle et al. 2018). In years with good returns chum salmon will be spread throughout the system and reach as far up stream as the confluence of Johnson Creek and Muck Creek. Pink and Chinook salmon spawn mainly in the mainstem of the Nisqually River, but Chinook and Pink salmon will spawn in the lower half mile of Muck Creek when water levels are sufficient to allow access (Nisqually Chinook Recovery Team 2001). Johnson Creek, a tributary to Muck Creek, supports small runs of Coho and Chum salmon and Steelhead Trout. South and Lacamas creeks, which flow into Muck Creek, receive little fish use because of low flows (Nisqually Chinook Recovery Team 2001).

Chambers Lake and Johnson Marsh provide shallow, warm water habitat for Largemouth Bass, Yellow Perch, Pumpkinseed Sunfish, Brown Bullhead, and Black Crappie, and contain Cutthroat Trout (Army 1984, as cited in JBLM DPW 2010). Halverson Marsh provides rearing habitat for sea-run and resident coastal Cutthroat Trout, and Winter-Run Chum and Coho salmon are presumed to be present (Army 1984, as cited in JBLM DPW 2010).

Management and monitoring of fish populations in the Nisqually River watershed is performed by multiple groups. A rotary screw trap at RM 12.8 of the Nisqually River near the Centralia City Light Yelm Hydro Powerhouse run by WDFW monitors out-migrating juvenile salmonids from Clear Creek, which is two miles upstream from Muck Creek (Klungle et al. 2018). The Nisqually Indian Tribe operates a fish hatchery on Clear Creek, a tributary to the Nisqually River, which is approximately 4.5 miles downstream from the mouth of Muck Creek. About four million Chinook salmon smolts and one million Coho salmon smolts are produced annually; about 12,000 adult Chinook salmon and up to 4,000 adult Coho Salmon return to the hatchery each year (Tacoma Public Utilities 2018).

The Nisqually River drainage basin supports a tribal winter chum fishery. Recreational fishing on the Nisqually River is also popular. In the 2016-2017 season, anglers harvested 2,047 adult and 1,813 Jack Chinook salmon and 10 adult and 10 Jack Coho salmon (Kraig and Scalici 2018). Harvest of Steelhead in the Nisqually River has been limited to incidental catch during harvest of other species (Madel and Losee 2016).

Based on data collected at the Clear Creek rotary screw trap from 2009-2015, Chinook Salmon outmigration timing is typically peaks twice a year, with Chinook fry out-migrating from January through mid-May and river-reared Chinook parr out-migrating from mid-May through August (Klungle et al. 2018). Steelhead, Coho, Chum, and Pink Salmon tend to have one peak out-migration annually; where steelhead and Coho Salmon out-migrated from April through June while Chum and Pink Salmon out-migrated from late March through early June (Klungle et al. 2018). Although the screw trap would not capture out-migrating salmonids from Muck Creek, it provides information on species and migration timing in the basin.

<u>Wildlife</u>
The Muck Creek/Chambers Lake area contains a mosaic of wildlife habitat. The variety of habitat types results from the marine influence of Puget Sound, the glacial plains, and associated vegetation, and various hydrologic and topographic features within the watershed.

The conifer, oak/mixed oak, and deciduous forests provide habitat for black bear (*Ursus americanus*), mountain lion (*Puma concolor*), mule deer (*Odocoileus hemionus*), raccoon (*Procyon lotor*), coyote (*Canis latrans*), and a variety of rodents, shrews, and bat species. The wetland/lake areas provide habitat for beavers (*Castor canadensis*).

Bird species are vast and diverse. The various forest, riparian, and wetland communities support eagles, hawks, owls, woodpeckers, and various resident and migrant passerine and warbler species. Waterfowl, primarily geese and ducks inhabit the lake, wetlands, and prairie communities for nesting, loafing, and foraging.

Coniferous and riparian forests can support regional reptile species such as western toad (*Anaxyrus boreas*), northwestern salamander (*Ambystoma gracile*), and the common garter snake (Thamnophis sirtalis). Amphibians such as American bullfrog (*Rana catesbeianus*), newt (*Pleurodelinae*), and salamanders are typically found in wetlands and along riparian corridors. Chambers Lake is home to experimental populations of Oregon spotted frog (*Rana pretiosa*), although there hasn't been evidence of successful breeding.

3.4.2 No Action Alternative

Leaving the weir in place would continue to affect fish populations in the Muck Creek / Chambers Lake watershed. The weir would continue to serve as a partial barrier to fish species migrating upstream to reach needed spawning habitat.

3.4.3 Weir Removal Alternative

Construction related effects from equipment used during weir removal and downstream channel rehabilitation such as trampling, disturbance from vibration, or water quality impacts are temporary and expected to be minimal since the work will occur during the dry season when water levels will likely be low.

The objective of the proposed project is to restore the geomorphic and hydrologic conditions that existed prior to weir construction by removal of the weir and re-establishment of the topography and bathymetry, channel substrate, and vegetation that exist downstream of the weir and likely existed prior to the weir. Flow conditions (velocities, shear stresses, turbulent kinetic energy) through the restored channel should be equal to or less than the channel immediately downstream of the weir. Upstream and downstream fish passage will be unrestricted and the risk of fish stranding greatly reduced. The weir traps fish at low flows and has a velocity close to nine feet per second (fps) during high flows, making it difficult to pass.

The reduction in lake area and volume will impact fish and wildlife species adapted to that habitat type. The proposed project will result in a decrease in average lake elevations and acreages and would reduce available lake habitat to create more stream-like habitat. Non-native warmwater species (e.g. bass and sunfish) that are more suited for a lentic environment could face increased competition for suitable habitat or other resources. This habitat shift may result in reduced warmwater fish species population abundance.

Fish passage should improve at the outlet of Chambers Lake following weir removal because the current weir is poorly maintained and requires frequent adjustment. Fish can be trapped in the fish ladder as flows drop, causing fish stranding and mortality. High velocities and high jump heights, even at low flows, make upstream fish migration under existing conditions difficult. During flood flows, water jets out of the 36-inch outlet orifice and overtops the weir walls, creating a hydraulic jump at the downstream end of the weir which further impacts fish passage. With use of a channel designed to mimic natural conditions, no fish ladder would be necessary for upstream migration. The highest velocities at the weir (close to 9 feet per second) during floods would drop to match those of the natural stream channel downstream (roughly 3 feet per second), allowing for upstream adult and juvenile fish migration during flood flows and normal flows.

With a free flowing stream restored, there is the potential that beavers further colonize the watershed and construct dams in the area. Beaver dams provide benefits to salmonids, such as increased habitat complexity, wetland creation, and water storage, and are well known to be beneficial for Coho Salmon (Pollock et al. 2015). Therefore, coexistence with beaver-built structures and fish passage through the beaver dam at the lake outlet is not likely to be problematic.

Downstream of the weir, the proposed project could cause groundwater discharge to the lake to increase under average flow conditions. Increased groundwater discharge could cause an increase in average streamflows and elevations in Muck Creek (likely small). Thus, available aquatic habitat on Muck Creek could increase modestly under average flow conditions downstream of the weir. Upstream of Chambers Lake, no project effects are likely. Flood elevations and base flow discharges and elevations are unlikely to change significantly because lake level changes for these flow conditions are not as great as under average flow conditions.

3.5 Threatened and Endangered Species

In accordance with Section 7(a)(2) of the ESA, federally funded, constructed, permitted, or licensed projects must take into consideration impacts to federally listed and proposed threatened or endangered species. Three species protected under the ESA may occur in the vicinity of the project (Table 6). The following sections briefly summarize relevant information for the protected species, evaluate how the proposed project may affect the species, and conclude with a determination of effect. As JBLM has an Endangered Species Management Plan, the Sikes Act precludes designation of Critical Habitat on military land so long as the installation maintains and implements an Integrated Natural Resource Management Plan (INRMP). Therefore potential critical habitat is considered Priority Habitat on military lands with an INRMP.

Table 6. Protected species potentially occurring in the action area.

Species	Listing	Designated Priority Habitat
Birds		
Yellow-billed cuckoo (*Coccyzus americanus*)	Threatened	Designated, not in action area
Fish		
Bull trout, Coastal-Puget Sound DPS (*Salvelinus confluentus*)	Threatened	Designated, not in action area
Chinook salmon, Puget Sound DPS (*Oncorhynchus tshawytscha*)	Threatened	Designated, not in action area
Steelhead trout, Puget Sound DPS (*Oncorhynchus mykiss*)	Threatened	Designated
Amphibians		
Oregon spotted frog (*Rana pretiosa*)	Threatened	Designated, not in action area
Flowering Plants		
Water howellia (*Howellia aquatilis*)	Threatened	Not designated

North American wolverine (*Gulo gulo luscus*), Roy Prairie pocket gopher (*Thomomys mazama glacialis*), Yellow-billed cuckoo (*Coccyzus americanus*), Streaked horned lark (*Eremophila alpestris strigata*), and Northern spotted owl (*Strix occidentalis caurina*) are not in the action area, due to specialized habitat requirements not found there, lack of tolerance for human activity, or both. Thus, they would not be affected by the proposed action, and will not be treated further in this document.

Bull trout

Bull trout (*Salvelinus confluentus*) distribution around the action area[2] is limited to foraging, migration, and overwintering (FMO) habitat in the lower Nisqually River, and

[2] All areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action [50 CFR §402.02].

there is no confirmed or presumed bull trout presence in Muck Creek (WDFW 2018). However, in the late 1990s a migratory adult was observed in Clear Creek, another tributary to the Nisqually River approximately 4 miles downstream of Muck Creek, and a sub-adult was captured in the lower Nisqually River in July 2004 (USFWS 2009). Therefore, some foraging individuals from other core areas could enter the action area in Muck Creek from the lower Nisqually River to access prey items (e.g., juvenile salmonids; USFWS 2015). Although it is unlikely for bull trout to be present in the project area due to the small number present in the Nisqually River and the distance upstream to the project area, bull trout could enter the lower reaches of Muck Creek within the action area to forage or overwinter. There is no designated priority habitat in the action area for bull trout.

Chinook

Adult Chinook (*Oncorhynchus tshawytscha*) enter the mainstem Nisqually River beginning in August, and generally spawn from late September to late October (PSIT and WDFW 2017). They spawn in the mainstem of the Nisqually River, in numerous side channels, in the lower reaches of the Mashel River, and in tributaries if flow allows. In Muck Creek, fall Chinook have been documented within the lower half mile at the confluence with the Nisqually River and are presumed to be present in the system. They have been documented spawning in the lower quarter-mile of Muck Creek during high water years (JBLM DPW 2013); however, spawning varies considerably from year to year depending on whether discharge is sufficient to allow entry to the spawning grounds (PSIT and WDFW 2017). Chinook do not have designated priority habitat in the action area.

Steelhead

Anadromous steelhead (Puget Sound DPS, *Oncorhynchus mykiss*) are present in the Nisqually River. Muck Creek has documented Steelhead spawning and rearing in the lower reaches of the creek and their presence has been documented upstream to Chambers Lake. Adult steelhead may be less affected than other salmonids by intermittent flow in Muck Creek creating barriers to upstream migration because steelhead return later in the year (as late as May) when there is more water (Pierce County 2005). Muck Creek lies within the designated priority habitat for this species.

Oregon spotted frog

The Oregon spotted frog (*Rana pretiosa*) population has been extirpated from large portions of its Washington State range due to loss of riparian and wetland habitat with the introduction of invasive and non-native plants and animals such as reed canarygrass and bullfrogs (Hallock 2013). JBLM is within the historic range of the Oregon spotted frog and a few populations persist in Whatcom, Skagit, Thurston, and Klickitat counties (Hallock 2013). In 2008, a reintroduction program was initiated to release captive-reared juvenile Oregon spotted frogs into Dailman Lake of the Muck Creek system at JBLM. Over the course of the reintroduction project from 2008 to 2015, 7,344 juvenile Oregon spotted frogs were released averaging 1,050 frogs per year (range: 581-1,364). Releases have not occurred since 2015 but surveys continue. Annual visual encounter surveys for egg masses are conducted for the duration of the

Oregon spotted frog breeding season, typically between February and April. Based on recent survey data and lack of an established breeding population, it is unlikely for Oregon spotted frogs to be in the project area. The action area where effects to hydraulics, wetlands, and riparian habitat are likely to occur overlaps with their known distribution in the Dailman Lake area. Designated priority habitat for this species does not occur in the action area.

Water howellia

Water howellia (*Howellia aquatilis*), a wetland dependent plant, was first discovered on Joint Base Lewis-McChord (JBLM) in the spring of 1994. It has now been found in 23 wetlands within the installation. Water howellia is restricted to the seasonally inundated zone of ephemeral kettle wetlands because a cycle of inundation and drying is necessary for germination. However, this zone can move from year to year, depending on the water levels within individual wetlands. Therefore, population size in a given year is affected by the extent to which the pond dries out at the end of the previous year and water levels during the growing season (Lesica 1992). Water howellia has been found in the upper portions of Chambers Lake, Muck Creek upstream of Chambers Lake, and in Dailman Lake.

3.5.1 No Action Alternative

Under the no action alternative existing conditions are expected to persist. Stream flows would continue to be controlled by the weir and human manipulation of the weir. The weir would continue to impair upstream fish passage, potentially expose fish to extreme high water temperatures during the summer, and expose out-migrant juvenile fish to predation.

3.5.2 Weir Removal Alternative

Fish passage at the entrance to Chambers Lake is expected to improve with the removal of the current fish ladder, which can trap fish at low flows and has a velocity close to nine feet per second (fps) during high flows. After removal, fish will not be able to be trapped and the velocities would match those of the undisturbed stream channel downstream at a maximum of about three fps, within the cruising speed range for Steelhead, Coho, and Chinook salmon (Bell 1990).

Downstream of the weir, the proposed project could cause groundwater discharge to the lake to increase under average flow conditions. Increased groundwater discharge could cause an increase in average streamflows and elevations in Muck Creek (likely small; USACE 2018). Thus, available aquatic habitat in Muck Creek could increase modestly under average flow conditions downstream of the weir. Upstream of Chambers Lake, no project effects are likely. Flood elevations and base flow discharges and elevations are unlikely to change significantly because lake level changes for these flow conditions are not as great as under average flow conditions.

Bull trout

Minimal project effects are expected to bull trout as they have not been documented and are not presumed to inhabit Muck Creek. If bull trout enter Muck Creek they would have to travel approximately five miles upstream to enter the project area through areas that have intermittent flow and at times are choked with reed canarygrass. Bull trout could use Muck Creek as FMO habitat based on proximity to the Nisqually River. Downstream of the weir, the proposed project could cause groundwater discharge to the lake to increase under average flow conditions. Increased groundwater discharge could cause an increase in average streamflows and elevations in Muck Creek (likely small; USACE 2018). Thus, available aquatic habitat in Muck Creek could increase modestly under average flow conditions downstream of the weir. Upstream of Chambers Lake, no project effects are likely. Flood elevations and base flow discharges and elevations are unlikely to change significantly because lake level changes for these flow conditions are not as great as under average flow conditions. Removal of the weir would remove the intermittent passage barrier so if bull trout do travel to Chambers Lake, they would be able to freely access habitat.

The proposed project **may affect, but is not likely to adversely affect** Bull trout because they may use Muck Creek as FMO habitat, although it is unlikely based on the low numbers of observed Bull trout in the Nisqually River system. The proposed project would have **no effect** on priority habitat because there is none in the action area.

<u>Chinook salmon</u>

Chinook salmon are unlikely to occur in the immediate project area due to distance from known spawning areas and intermittent flow blocking passage but are presumed to be present throughout the Muck Creek system. Therefore, effects from equipment used during weir removal and downstream channel rehabilitation such as trampling, disturbance from vibration, or water quality impacts are expected to be unlikely to occur and discountable.

If Chinook salmon travel to Chambers Lake, weir removal is expected to improve fish passage because fish could no longer be trapped at low flows and the velocity at the entrance to the lake would drop from nine feet per second (fps) during high flows to less than approximately three fps. After removal, the velocities would match those of the undisturbed stream channel downstream at a maximum of about three fps, within the cruising speed range for Chinook salmon (Bell 1990).

Downstream of the weir, the proposed project could cause groundwater discharge to the lake to increase under average flow conditions. Increased groundwater discharge could cause an increase in average streamflows and elevations in Muck Creek (likely small; USACE 2018). Thus, available aquatic habitat in Muck Creek could increase modestly under average flow conditions downstream of the weir and could provide a positive benefit to spawning Chinook salmon since they tend to only spawn in Muck Creek when flows are high.

The proposed project **may affect, but is not likely to adversely affect** Chinook salmon due to their distance from the project area and minimal changes to the hydraulics of lower Muck Creek where they are typically found. The proposed action would have **no effect** on Chinook salmon priority habitat because there is none within the action area.

Steelhead

The proposed action would ultimately restore a free-flowing creek in accordance with the MOU between JBLM and NMFS. It is assumed that all work can be completed during the base flow period (late July through early November) when streamflows from the lake typically cease and the downstream channel dries up. The in-water work window of July 1 to September 15 falls within this time. The project area would be further isolated from Chambers Lake by super sacks upstream of the weir. Effects from equipment used during weir removal and downstream channel rehabilitation such as trampling or water quality impacts are unlikely to occur since the disturbed area will likely be dry and therefore discountable.

Once construction is completed, effects to steelhead is expected to be similar to those stated above for Chinook. These include improved opportunities for fish passage, improved groundwater discharge downstream, and potentially increased average stream flow. Upstream of Chambers Lake, no project effects are likely. Flood elevations and base flow discharges and elevations are unlikely to change significantly because lake level changes for these flow conditions are not as great as under average flow conditions. Removal of the weir would remove the intermittent passage barrier so that steelhead can freely access habitat in and above Chambers Lake.

The proposed project **may affect, but is not likely to adversely affect** steelhead or their priority habitat due to the habitat and passage improvements, minor or beneficial changes to Muck Creek hydraulics, and the use of best management practices to isolate the project area during construction.

Oregon spotted frog

It is unlikely that Oregon spotted frogs would occur in the project area. The population is concentrated in Dailman Lake and largely separated by terrestrial habitat. Due to this distance, effects from construction such as trampling or disturbance such as vibrations or noise to individuals or egg masses would be discountable and are not expected to negatively impact Oregon spotted frogs.

Removal of the weir could affect the inundation elevation around Dailman Lake, where most survey detections are concentrated. Future changes to seasonal inundation around Dailman Lake are unlikely during summer base flow (OLW) but would reduce winter flooding elevation (OHW) by up to 2.5 feet (see Section 3.2 for greater detail). Lower OHW elevations around Chambers Lake (approximately 16 percent less open water) would not be expected to substantially limit the habitat available to the JBLM Oregon spotted frog population. Long-term effects to wetlands are not expected to be substantial due to the extensive groundwater influence, presence of beavers, and high percentage of reed canarygrass rhizomes. Therefore, potential water level fluctuations from construction are not expected to have more than a negligible impact to the Oregon spotted frog population.

The proposed action **may affect, but is unlikely to adversely affect** Oregon spotted frogs based on their unlikely presence within the project area, their ability to move with water fluctuations, and minor changes to habitat. There would be **no effect** to Oregon spotted frog priority habitat because there is none located in the project area.

Water howellia

The known water howellia locations around Chambers Lake are not located within the areas that are expected to have inundation area changes. In addition, the species also has the ability to disperse seeds to the wetlands' edge and many free-floating fragments with well-developed fruits were observed at the edge of a JBLM wetland in 1996 with no evidence suggesting that these fragments had been rooted nearby (JBLM DPW 2013). This indicates some movement within the available habitat that does not rely entirely on seasonal inundation. Overall, lower OHW elevations around Chambers Lake (approximately 16 percent less open water) would not be expected to substantially limit the habitat available to water howellia or cause a meaningful reduction in population size on JBLM.

Due to the minimal effect to wetlands and dynamic, ephemeral habitat preferred by water howellia, the proposed project **may affect, but is not likely to adversely affect** water howellia.

3.6 Cultural Resources

The Chambers Lake dam was constructed in 1967. The dam was altered in 1982 to include a fish passage structure. The dam has no architectural or cultural significance. Due to its scale and lack of significance the USACE Dam Safety does not track or maintain this structure. In the 1960s Chambers Lake was used for picnicking and aquatic recreation. Today the visitation to the site is reduced. State Historic Preservation Office (SHPO) consultation will occur prior to the removal of the weir. There are no other cultural resources besides the weir that are in the vicinity of the project area.

3.6.1 No Action Alternative

Under the No Action alternative, existing conditions are expected to persist. The Cultural Resources Program will consult with SHPO on the eligibility determination and impacts of weir removal for the project. No other work will occur at the site. The shallow lake will remain open for small boat use and fishing.

3.6.2 Weir Removal Alternative

Under the Weir Removal alternative, the weir structure as well as the short concrete retaining and wing walls, the chain link security fence and the concrete blocks located in the channel downstream of the weir will be removed. Cultural Resources Program will consult with SHPO on the eligibility determination and impacts of weir removal for the project. No other work will occur at the site. The shallow lake will remain open for small boat use and fishing.

3.7 Recreation

Chambers Lake and the surrounding area is open to fishing, boating, wildlife viewing, picnicking, and unimproved (primitive) camping. People who fish on JBLM waters must have valid Washington State fishing licenses and follow all applicable federal, state, and Army regulations, including Washington State's Game and Fisheries Code, the current WDFW Fishing Regulation Pamphlet, and the JBLM Fishing Rules. The lake is relatively shallow, therefore best suited for canoes, kayaks, or smaller fishing boats. With a mix of wetlands, open water, and forest habitats the area offers opportunities for wildlife viewing, especially bird watching. Although some picnic tables remain on the western side of the lake, the area has not been maintained and is overgrown with blackberries. Most of the lake area is accessible by unimproved roads. Campers or day-use visitors are advised to use higher ground clearance vehicles.

3.7.1 NO ACTION ALTERNATIVE

Under the No Action alternative, existing conditions are expected to persist. The Directorate of Family Morale, Welfare, and Recreation/Outdoor Recreation Program does not have current plans to refurbish the former picnic area, nor construct improved camping areas around the lake. The shallow lake will remain open for small boat use and fishing.

3.7.2 WEIR REMOVAL ALTERNATIVE

With the weir removed, the seasonal elevation would change slightly as discussed in Section 3.2.2. At OHW, the lake will be slightly reduced, from 175 surface acres to 147 surface acres (decrease of 28 acres). However, as the lake is shallow and used by small watercraft, the change should not be noticeable. Overall, recreation in the area is not expected to change.

4 CUMULATIVE IMPACTS

Cumulative effects address the incremental environment impacts of the proposed action, together with impacts of past, present, and reasonably foreseeable future actions. The cumulative effects address the impacts from projects that may be individually minor, but result in collectively significant impacts when taking into account actions occurring over a period of time (40 CFR §1508.7).

Geographic Area:

1. Immediate Vicinity of the Chambers Lake Weir: This area contains the weir removal and is the area of direct effect. The streambed in the footprint of the weir would be restored to pre-weir channel topography with suitable streambed material and large woody debris for migration, spawning, and rearing habitat for fish, as well as microhabitat for various invertebrates and other aquatic organisms at the site. Sediment that exists behind the weir are minimal, however silt fences and other best management practices would be used in project area to minimize erosion and sedimentation in the riparian corridor.

2. Upstream of Chambers Lake Weir. The weir seasonally impounds water approximately 1-mile upstream, which effects water temperature, groundwater or water table level, sediment transport, and aquatic species, such as fish, frogs, and aquatic invertebrates. With the weir removed, the lake's surface acreage would decrease approximately 28 acres (at OHW); however the wetland plant community is not

expected to change as the lake is fairly shallow overall. With the restoration of natural flow conditions, the habitat is expected to favor cold-water fisheries species over warm-water species, allowing for upstream adult and juvenile fish migration during flood flows and normal flows.

3. Downstream of Chambers Lake Weir. Negative effects of the weir would be temporary and are associated only with the actual construction of the project, concentrated mainly in the channel and forest and wetlands. Cumulatively, removal of the weir is not expected to increase flood flows or elevations downstream of the weir. However, streamflows during the fall months, when the lake would typically begin filling, will increase slightly. Streamflows in the spring and summer are not expected to decline due to the strong influence of groundwater and complex geology.

Assessment of impacts from the project:
As described in Section 3, Affected Environment and Environmental Consequences, projected impacts on noise, water quality, groundwater, sediment, flooding, effects on species and habitat, environmental justice, recreation and public safety, are minimal in comparison to the improvements in human safety, potential increases in species populations, improvements in connectivity, and improved recreational opportunities after project completion.

Identification of other actions that have had or are expected to have impacts in the same geographic area:
Cumulative effects with implementation of future habitat improvement actions would be positive in nature for fish and wildlife and would continue to build resiliency to thermal factors. The proposed weir removal should provide long-term improvements to the environment through improved hydrological connectivity, fish passage, and biological integrity and diversity.

The proposed project is located on Federal property that is largely undeveloped. Current land uses in the vicinity for training and low-impact recreation are expected to continue into the future.

5 OTHER CONSIDERATIONS REQUIRED BY NEPA

In accordance with 40 CFR Section 1502.16(c), analysis of environmental consequences shall include discussion of possible conflicts between the proposed action and the objectives of Federal, regional, State and local land use plans, policies, and controls. Table 5-1 identifies the principal federal and state laws and regulations that are applicable to the proposed action, and describes briefly how compliance with these laws and regulations would be accomplished.

Table 7. Principal Federal and State Laws Applicable to the Proposed Action

Federal, State, Local and Regional Land Use Plans, Policies, and Controls	Status of Compliance
National Environmental Policy Act (NEPA) (42 USC §4321 *et seq.*); CEQ NEPA implementing regulations (40 CFR 1500-1508);	Preparation of this EA has been conducted in compliance with NEPA and in accordance with CEQ regulations and the Army's NEPA procedure
Clean Air Act (42 USC §7401 et seq.)	Southwest Pierce County is in attainment. The proposed action would not change air quality attainment status or conflict with attainment and maintenance goals established in the Washington State Improvement Plan. Therefore, a CAA conformity determination is not required.
Clean Water Act (Sections 401 and 404, 33 USC §1251 *et seq.*)	In process. A Pre-Construction Notification (PCN) will be submitted to USACE Regulatory and U.S. Environmental Protection Agency.
Coastal Zone Management Act (16 USC § 1451 *et seq.*)	In process. Submission is inclusive with the PCN.
National Historic Preservation Act (Section106, 54 U.S.C. § 300101, *et seq.*)	In process
Endangered Species Act (16 USC 1531 *et seq*)	Partial. The Biological Assessment has been submitted to USFWS and NMFS on April 30, 2019.
Magnuson-Stevens Fishery Conservation and Management Act, (16 U.S.C. § 1801 *et.seq.*)	Partial. Analysis included in the BA submitted to NMFS on April 30, 2019.
Migratory Bird Treaty Act (16 USC §§ 703-712)	Approximately 0.2 acres of forested habitat may be cleared during demolition, including the felling of 4-5 trees. Clearing of existing trees and shrubs will be accomplished prior to April 1 or after September 1 to minimize adverse effects to nesting birds.
Executive Order 11990 Protection of Wetlands	No net loss of wetlands, approximately 28 acres will change from inundated to seasonally inundated.
Executive Order 12898, Federal Actions to Address Environmental Justice in Minority and Low-income Populations	No disproportionately high and adverse impacts to minority and low-income populations would be expected for the resource analyzed in this EA.

5.1 Irreversible and Irretrievable Commitments of Resources

Resources that are irreversibly or irretrievably committed to a project are those that are used on a long-term or permanent basis. This includes the use of non-renewable resources such as metal and fuel, and natural or cultural resources. These resources are irretrievable in that they would be used for this project when they could have been used for other purposes. Human labor is also considered an irretrievable resource. Another impact that falls under this category is the unavoidable destruction of natural resources that could limit the range of potential uses of that particular environment.

Implementation of the proposed action would involve human labor, the consumption of fuel, oil, and lubricants for construction vehicles and loss of approximately four or five mature trees. Implementation of the proposed action would not result in significant irreversible or irretrievable commitment of resources.

5.2 Relationship between Local Short-Term Use of the Human Environment and Maintenance and Enhancement of Long-Term Natural Resource Productivity)

NEPA requires an analysis of the relationship between a project's short-term impacts on the environment and the effects that these impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. This refers to the possibility that choosing one development site reduces future flexibility in pursuing other options, or that using a parcel of land or other resources often eliminates the possibility of other uses at that site.

The Prosed Action would not result in any impacts that would significantly reduce environmental productivity or permanently narrow the range of beneficial uses of the environment.

5.3 Means to Mitigate and/or Monitor Adverse Environmental Impacts

The Proposed Action would not result in any significant adverse environmental impacts with implementation of the following measures to avoid, minimize and/or mitigate impacts as described above in Section 2.4.

5.4 Any Probable Adverse Environmental Effects that Cannot be Avoided and are Not Amenable to Mitigate

This EA has determined that the proposed action would not result in any significant impacts; therefore, there are no probable adverse environmental effects that cannot be avoided or are not amenable to mitigation.

6 SUMMARY / CONCLUSION

Implementation of the Proposed Action or the No-Action Alternative would not result in significant impacts to any resource area when considered individually or cumulatively in the context of NEPA, including both direct and indirect impacts. Implementation of the Proposed Action would not constitute a "major Federal action significantly affecting the quality of the human environment." Therefore, this EA supports a Finding of No Significant Impacts (FONSI) and the preparation of an Environmental Impact Statement (EIS) is not warranted or required.

7 LIST OF PREPARERS AND PERSONS CONSULTED

USACE Seattle District:

- Nathan Cheng, Hydraulic Engineer
- Zach Corum, Sr. Hydraulic Engineer
- Fred Goetz, Sr. ESA Biologist
- Beth McCasland, Biologist / NEPA Lead
- Kaitlin Whitlock, Fisheries Biologist
- Zach Wilson, Ecologist

JBLM:

- Dave Clouse, Natural Resources Branch Chief
- Chris Runner, NEPA Program Manager
- Donna Turnipseed, Cultural Resources Manager

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