Chapter 3: General Conservation Measures

3.1 General Conservation Measures Applicable to all Actions

These measures will be implemented on all projects covered under the HIP.

3.1.1 Project Design and Site Preparation

3.1.1.1 State and Federal Permits

A. All applicable regulatory permits and official authorizations will be obtained by the Sponsor before project implementation.

B. These permits and authorizations include, but are not limited to, National Environmental Policy Act (NEPA), National Historic Preservation Act, appropriate state agency removal and fill permits, USACE Clean Water Act (CWA) 404 permits, CWA Section 401 water quality certifications, FEMA no-rise analyses.

3.1.1.2 Timing of in-water work

A. Formal recommendations published by state agencies such as the Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), Idaho Department of Fish and Game (IDFG), and Montana Fish Wildlife and Parks (MFWP), or informal recommendations from the appropriate state Fishery Biologist in regard to the timing of in-water work, will be followed. A maximum of one week past the recommended in-water work window shall be considered and approved by the BPA EC Lead.

B. The regional state biologist shall approve changes exceeding one week to in-water work.

C. Bull trout – In Bull Trout spawning and rearing areas, eggs, alevin, and fry are present nearly year round. In Bull Trout habitats designated as foraging, migration, and overwintering (FMO) habitats, juvenile and adult bull trout may be present seasonally. Some project locations may not have designated in-water work windows for bull trout, or if they do, they may differ from the in-water work windows for salmon and steelhead. If this is the case, the Project Sponsor will contact the appropriate USFWS field office to ensure that all reasonable implementation measures are considered and an appropriate in-water work window is applied to minimize project effects.

D. Lamprey – To minimize disturbance to migrant adults, the Project Sponsor and/or their contractors will avoid working instream or river channels that contain Pacific lamprey from March 1 to July 1 in low- to mid-elevation reaches (<5,000 feet). In high-elevation reaches (>5,000 feet), the Project Sponsor will avoid working instream or river channels from March 1 to August 1. If either timeframe is incompatible with other objectives, the area will be surveyed for nests and lamprey presence, and avoided if possible. If lampreys are known to exist, the

Project Sponsor will utilize best management practices (BMPs) for dewatering and salvage as outlined in LTW 2020[1], or most recent guidance. Salvage should include salvage of larval lamprey from sediments. See conservation measures for fish salvage and electrofishing.

E. The final project in-water work window shall be indicated in the project drawings.

3.1.1.3 Contaminants

A. The Project Sponsor will complete a site assessment to identify the type, quantity, and extent of any potential contamination for any action that involves excavation of more than 20 cubic yards of material.

B. The site assessment, stored with the project files, will summarize:

1. The site visit, condition of property, and identification of areas used for various industrial processes;
2. Available records, such as former site use, building plans, and records of any prior contamination events;
3. Interviews with knowledgeable people, such as site owners, operators, and occupants, neighbors, or local government officials; and
4. The type, quantity, and likelihood of potential contaminants and sources present at the site.

3.1.1.4 Site layout and flagging

A. The project area will be clearly flagged prior to construction.

B. Areas to be flagged include:

1. Sensitive resource areas, such as areas below ordinary high water (OHW), spawning areas, springs, and wetlands;
2. Equipment entry and exit points;
3. Road and stream crossing alignments;
4. Staging, storage, and stockpile areas; and
5. No-herbicide-application areas and buffers.

3.1.1.5 Temporary access roads and paths

A. Existing access roads and paths will be preferentially used whenever possible, and the number and length of temporary access roads and paths through riparian areas and floodplains will be minimized to lessen soil disturbance, soil compaction, and impacts to vegetation.

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[1] Lamprey Technical Workgroup. 2020. Best management guidelines for native lampreys during in-water work. Original Version 1.0, May 4, 2020. 26 pp. + Appendices.
Available: https://www.fws.gov/pacificlamprey/LTWGMainpage.cfm

B. Vehicle use and human activities, including walking in areas occupied by terrestrial ESA-listed species, will be minimized.

C. Temporary access roads and paths will not be built on slopes where grade, soil, or other features suggest a likelihood of excessive erosion or failure. If slopes are steeper than 30%, the road will be designed by a civil engineer with experience in steep road design.

D. The removal of riparian vegetation during construction of temporary access roads will be minimized. When temporary vegetation removal is required, vegetation will be cut at ground level (not grubbed).

E. At project completion, all temporary access roads and paths will be obliterated and the soil will be stabilized and revegetated. Road and path obliteration refers to the most comprehensive degree of decommissioning and involves decompacting the surface and ditch, pulling the fill material onto the running surface and reshaping to match the original contour.

F. Helicopter flight patterns will be established in advance, and located to avoid terrestrial ESA- listed species, including their occupied habitat and appropriate buffers, during sensitive life stages (i.e. nesting and critical breeding periods). See species-specific conservation measures for each listed species that may occur within the project area for more information.

3.1.1.6 Temporary stream crossings

A. Existing stream crossings, fords, or bedrock will be used whenever possible, and the number of temporary stream crossing will be minimized.

B. If an existing stream crossing is not accessible, temporary crossings will be installed. Treated wood shall not be used on temporary bridge crossings or in locations in contact with or over water.

C. For projects that require equipment and vehicles to cross in the wet:

1. The location and number of all wet crossings must be approved by BPA and clearly indicated on design drawings;
2. Vehicles and machinery will cross streams at right angles to the main channel wherever possible;
3. No stream crossings will occur 300 feet upstream or 100 feet downstream of an existing redd or spawning fish; and
4. After project completion, temporary stream crossings will be obliterated, and the banks restored.

3.1.1.7 Staging, storage, and stockpile areas

A. Staging areas (used for construction equipment storage, vehicle storage, fueling, servicing, and hazardous material storage) will be 150 feet or more from any natural waterbody or wetland, or on an adjacent established road area in a location and manner that will preclude erosion into, or contamination of, the stream or floodplain. Staging

areas may be closer than 150 feet if the area is above (elevation) the 100-yr floodplain or spill prevention measures are approved by the BPA EC Lead.

B. Natural materials used for implementation of aquatic restoration, such as large wood, gravel, and boulders, may be staged within 150 feet if clearly indicated in plans. Recommend referring to area as "Natural Material Stockpile Area" with a note that states vehicle storage, equipment storage, hazardous materials, fueling, and servicing not permitted in this area.

C. Any large wood, topsoil, and native channel material displaced by construction will be stockpiled for use during site restoration at a specifically identified and flagged area.

D. Any material not used in restoration, and not native to the floodplain, will be removed to a location outside of the 100-year floodplain for disposal.

3.1.1.8 Equipment

A. Mechanized equipment and vehicles will be selected, operated, and maintained in a manner that minimizes adverse effects on the environment (e.g., minimally-sized, low pressure tires; minimal hard-turn paths for tracked vehicles; temporary mats or plates within wet areas or on sensitive soils).

B. Equipment will be stored, fueled, and maintained in a clearly identified staging area that meets staging area conservation measures.

C. Refueled in a vehicle staging area located 150 feet or more from a natural waterbody or wetland, or in an isolated hard zone, such as a paved parking lot or adjacent, established road (this measure applies only to gas or diesel-powered equipment with tanks larger than 5 gallons);

D. Biodegradable lubricants and fluids[2] shall be used on equipment operating in the stream channel and live water.

E. Inspected daily for fluid leaks before leaving the vehicle staging area for operation within 150 feet of any natural water body or wetland; and

F. Thoroughly cleaned before operation below ordinary high water (OHW), and as often as necessary during operation, to remain free of grease.

[2] For additional information and suppliers of biodegradable hydraulic fluids, motor oil, lubricant, or grease. See, Environmentally Acceptable Lubricants by the U.S. EPA (2011); e.g., mineral oil, polyglycol, vegetable oil, synthetic ester; Mobil® biodegradable hydraulic oils, Total® hydraulic fluid, Terresolve Technologies Ltd.® biobased biodegradable lubricants, Cougar Lubrication® 2XT Bio engine oil, Series 4300 Synthetic Bio-degradable Hydraulic Oil, 8060-2 Synthetic Bio-Degradable Grease No. 2, etc.

3.1.1.9 Erosion control

A. Erosion control best management practices (BMPs) will be prepared and carried out, commensurate with the scope of the action. Temporary erosion control measures include:

1. Temporary erosion control BMPs shall be in place before any significant alteration of the action site, and shall be appropriately installed downslope of project activity within the riparian buffer area until site rehabilitation is complete.
2. If there is a potential for eroded sediment to enter the stream, sediment barriers will be installed and maintained for the duration of project implementation.
3. Temporary erosion control measures may include sedge mats, fiber wattles, silt fences, jute matting, wood fiber mulch with soil binder, or geotextiles and geosynthetic fabric. Biodegradable netting may be used so that they can decompose on site.
4. Soil stabilization utilizing wood fiber mulch and tackifier (hydro-applied) may be used to reduce erosion of bare soil if the materials are noxious-weed-free and nontoxic to aquatic and terrestrial animals, soil microorganisms, and vegetation.
5. Sediment will be removed from erosion control once it has reached 1/3 of the exposed height of the control.
6. Once the site is stabilized following construction, temporary erosion controls will be removed.

B. Emergency erosion controls. The following materials for emergency erosion control will be available at the work site:

a. A supply of sediment control materials; and

b. An oil-absorbing floating boom whenever surface water is present.

3.1.1.10 Dust abatement

A. The Project Sponsor will determine the appropriate dust control measures by considering soil type, equipment usage, prevailing wind direction, and the effects caused by other erosion and sediment control measures. In addition, the following criteria will be followed:

B. Work will be sequenced and scheduled to reduce exposed bare soil subject to wind erosion.

C. Dust-abatement additives and stabilization chemicals (typically magnesium chloride, calcium chloride salts, or lignin sulfonate) will not be applied within 25 feet of a natural waterbody or wetland and will be applied so as to minimize the likelihood that they will enter streams. Applications of lignin sulfonate will be limited to a maximum rate of 0.5 gallons per square yard of road surface, assuming a 50:50 (lignin sulfonate to water) solution.

D. Application of dust abatement chemicals will be avoided during or just before wet weather and at stream crossings or other areas that could result in unfiltered delivery of

the dust abatement chemicals to a waterbody (typically these would be areas within 25 feet of a natural waterbody or wetland; distances may be greater where vegetation is sparse or slopes are steep).

E. Spill containment equipment will be available during application of dust abatement chemicals.

F. Petroleum-based products will not be used for dust abatement.

3.1.1.11 Spill prevention, control, and counter measures

A. A description of hazardous materials (fuel, lubricants, hydraulic fluid[3], or other contaminants) that will be used, including inventory, storage, and handling procedures, will be available on-site.

B. Written procedures for notifying environmental response agencies will be posted at the work site.

C. Spill containment kits (including instructions for cleanup and disposal) adequate for the types and quantity of hazardous materials used at the site will be available at the work site.

D. Workers will be trained in spill containment procedures and will be informed of the location of spill containment kits.

E. Any waste liquids generated at the staging areas will be temporarily stored under an impervious cover, such as a tarpaulin, until they can be properly transported to, and disposed of, at a facility that is approved for receipt of hazardous materials.

F. Pumps used adjacent to water shall use spill containment systems.

3.1.1.12 Invasive species control

A. Prior to entering the site, all vehicles and equipment will be power-washed, allowed to dry fully, and inspected to make sure no plants, soil, or other organic material adheres to the surface.

B. Watercraft, waders, boots, and any other gear to be used in or near water will be inspected for aquatic invasive species.

C. Wading boots with felt soles are not to be used due to their propensity for aiding in the transfer of invasive species unless decontamination procedures have been approved by the EC Lead.

[3] For additional information and suppliers of biodegradable hydraulic fluids, motor oil, lubricant, or grease. See, Environmentally Acceptable Lubricants by the U.S. EPA (2011); e.g., mineral oil, polyglycol, vegetable oil, synthetic ester; Mobil® biodegradable hydraulic oils, Total® hydraulic fluid, Terresolve Technologies Ltd.® biobased biodegradable lubricants, Cougar Lubrication® 2XT Bio engine oil, Series 4300 Synthetic Bio-degradable Hydraulic Oil, 8060-2 Synthetic Bio-Degradable Grease No. 2, etc.

3.1.2 Work Area Isolation & Fish Salvage

3.1.2.1 Work Area Isolation

A. Any work area requiring excavation or mobilization of sediment within the wetted channel will be isolated from the active stream whenever ESA-listed fish are reasonably certain to be present, or if the work area is less than 300-feet upstream from known ESA-listed fish spawning habitats. If the work area isolation practices would cause greater impacts than it would prevent, is located in deep or swiftly flowing water, or if fish can be effectively excluded by nets or screens, then an approval from a NMFS habitat biologist may be pursued.

B. **Work area isolation & fish salvage activities are considered incidental to construction-related activities and shall occur during the state-recommended in-water work windows.**

C. When work area isolation is required, design plans will include all isolation elements, fish release areas, a pump to be used to dewater the isolation area, and, when fish are present, a fish screen that meets NMFS's fish screen criteria (NMFS 2011[4], or most current). Wider mesh screens may be used after all fish have been removed from the isolated area.

D. Work area isolation and fish capture activities take place during periods of the coolest air and water temperatures possible, normally early in the morning versus late in the day, and during conditions appropriate to minimize stress to fish species present.

3.1.2.2 Fish Salvage

A. Monitoring and recording will take place for the duration of salvage activities. The salvage report will be communicated to the Agencies via the project completion form (PCF).

B. Salvage activates should take place during conditions to minimize stress to fish species, typically periods of the coolest air and water temperatures which occur in the morning versus late in the day.

C. A fish biologist will determine an operational plan to remove ESA-listed fish, with least harm to the fish, before in-water work begins. This will involve either passive movement of fish out of the project reach through slow dewatering, or actively removing the fish from the project reach. Should active removal be warranted, a fish biologist will clear the area of fish before the site is dewatered using one or more of a variety of methods including seining, dipping, or electrofishing, depending on specific site conditions. Salvage operations will follow the ordering, methods, and conservation measures specified as follows:

[4] NMFS. 2011. Anadromous salmonid passage facility design. Northwest Region. Available online at: http://www.habitat.noaa.gov/pdf/salmon_passage_facility_design.pdf

1. Slowly reduce water from the work area to allow some fish to leave the work area volitionally. If dewatered area contains large fine/ sandy sediment deposits, larval lamprey could be present, and potentially in large numbers. If so, consider electrofishing using lamprey electrofishing settings (which do not affect bony fish) prior to or during drawdown. See electrofishing conservation measures.
2. Block nets will be installed at upstream and downstream locations and maintained in a secured position to exclude fish from entering the project area.
3. Block nets will be secured to the stream channel bed and banks until fish capture and transport activities are complete. Block nets may be left in place for the duration of the project to exclude fish as long as passage requirements are met.
4. Nets will be monitored hourly anytime there is instream disturbance.
5. If block nets remain in place more than one day, the nets will be monitored at least daily to ensure they are secured to the banks and free of organic accumulation. If the project is within bull trout spawning and rearing habitat, the block nets must be checked every 4 hours for fish impingement on the net.
6. Capture fish through seining, and relocate to streams.
7. While dewatering, any remaining fish will be collected by hand or dip nets.
8. Seines with a mesh size to ensure capture of the residing ESA-listed fish will be used.
9. Minnow traps may be left in place overnight and used in conjunction with seining.
10. Electrofish to capture and relocate fish not caught during seining. This step is to be used as a last resort; after all passive techniques have been exhausted. See electrofishing conservation measures.
11. Continue to slowly dewater the stream reach.
12. Collect any remaining fish in cold-water buckets and relocate to the stream;
13. Limit the time fish would be in a transport bucket, and release them as quickly as possible.
14. The number of fish within a bucket will be limited, and fish will be of relatively comparable size to minimize predation.
15. Aerators for buckets will be used, or the bucket's water will be frequently changed with cold, clear, water at 15 minute, or more-frequent, intervals.
16. Buckets will be kept in shaded areas; or if in exposed areas, covered by a canopy.
17. Dead fish will not be stored in transport buckets but will be left on the streambank to avoid mortality counting errors.

D. In areas occupied by bull trout, lamprey, mussels[5], or native fish, the following salvage guidelines shall be met. See USFWS 2010, "Conservation Measures for Salvage of Native Fish, Lamprey and Mussels" (LTW 2020[6]) and guidance developed by the Xerces Society (Blevins et al. 2018, 2019) or most recent guidance for additional information. Salvage guidelines are as follows:

1. Conduct native mussel and lamprey presence and absence surveys; approximate numbers for salvage to aid in planning for salvage.
2. Pre-select site(s) for release and/or mussel bed relocation.
3. Salvage of bull trout will not take place when water temperatures exceed 15 degrees Celsius.
4. If drawdown less than 48 hours, salvage of lamprey and mussels may not be necessary if temperatures support survival in sediments.
5. Salvage mussels by hand after locating by snorkeling or wading. If mussels are numerous (or staff is limited), it may be necessary to do this step in the days before drawdown, as relocation/placement can be time consuming.
6. Salvage lamprey by electrofishing. See electrofishing conservation measures for lamprey and larval lamprey dry shock settings.
7. Salvage bony fish after lamprey with nets or electrofishing (see electrofishing conservation measures for appropriate settings).
8. Regularly inspect dewatered site since lamprey likely to emerge and mussels may become visible after dewatering.
9. Mussels may be transferred in coolers.
10. Mussels will be placed individually to ensure ability to burrow into new habitat.

3.1.2.3 Electrofishing Based on NMFS's Electrofishing Guidelines (NMFS 2000[7])

A. Initial Site Surveys and Equipment Settings

1. In order to avoid contact with spawning adults or active redds, researchers must conduct a careful visual survey of the area to be sampled before beginning electrofishing.
2. Prior to the start of sampling at a new location, water temperature and conductivity measurements shall be taken to evaluate electrofisher settings and

[5] For mussels, Blevins et al. 2018. Conserving the Gems of Our Waters: Best Management Practices for Protecting Native Western Freshwater Mussels, and Blevins et al. 2019. Mussel-Friendly Restoration. Both available on line at https://xerces.org/western-freshwater-mussels/

[6] Lamprey Technical Workgroup. 2020. Best management guidelines for native lampreys during in-water work. Original Version 1.0, May 4, 2020. 26 pp. + Appendices.
Available: https://www.fws.gov/pacificlamprey/LTWGMainpage.cfm

[7] https://www.fisheries.noaa.gov/resource/document/additional-agency-guidance

adjustments. No electrofishing should occur when water temperatures are above 18°C or are expected to rise above this temperature prior to concluding the electrofishing survey.

3. Whenever possible, a block net should be placed below the area being sampled to capture stunned fish that may drift downstream.
4. Each electrofishing session must start with all settings (voltage, pulse width, and pulse rate) set to the minimums needed to capture fish (Table 1).
5. Equipment must be in good working condition and operators should go through the manufacturer's preseason checks, adhere to all provisions, and record major maintenance work in a logbook. Records for conductivity, water temperature, air temperature, electrofish settings, electrofisher model, electrofisher calibration, fish conditions, fish mortalities, and total capture rates shall be included in the salvage log book.

Table 1 Guidelines for initial and maximum settings for backpack electrofishing for salmonids.

	Initial Settings	Maximum Settings	
Voltage		Conductivity	Max Voltage
	100V	<100	1100 V
		100-300	800 V
		>300	400 V
Pulse Width	500 µS	5 mS	
Pulse Rate	30 Hz	70 Hz	

B. Electrofishing Technique

1. Sampling should begin using straight DC. The power needs to remain on until the fish is netted when using straight DC. If fish capture is unsuccessful with initial low voltage, gradually increase voltage settings with straight DC while remaining below maximum levels.
2. Maximum voltage will be 1100 volts when conductivity is less than 100 milliseconds, 800 volts when between 100 and 300 milliseconds, and 400 volts when less than 300 milliseconds (Table 1).
3. If fish capture is not successful with the use of straight DC, then set the electrofisher to lower voltages with PDC. If fish capture is unsuccessful with low voltages, increase pulse width, voltage, and pulse frequency (duration, amplitude, and frequency) within maximum values (Table 1).
4. Maximum pulse width is 5 milliseconds. Maximum pulse rate is 70 hertz.
5. Electrofishing will not occur in one area for an extended period. Electrofishing should be performed in a manner that minimizes harm to the fish. Stream segments should be sampled systematically, moving the anode continuously in a herringbone pattern (where feasible) through the water. Care should be taken when fishing in areas with high fish concentrations, structure (e.g., wood, undercut banks) and in shallow waters where most backpack electrofishing for juvenile salmonids occurs. Voltage gradients may be high when electrodes are in shallow water where boundary layers (water surface and substrate) tend to intensify the electrical field. Netters should not allow the fish to remain in the electrical field any longer than necessary by removing stunned fish from the water immediately after netting.
6. The anode should not intentionally contact fish. The zone of potential injury for fish of 0.5 m from the anode shall be avoided.
7. Settings will be lowered in shallower water since voltage gradients are likely to increase.
8. Electrofishing will not occur in turbid water where visibility is poor (i.e. unable to see the bed of the stream).
9. Electrofishing crews should be generally observant of the condition of the fish and change or terminate sampling when experiencing problems with fish recovery time, banding, injury, mortality, or other indications of fish stress. If mortality or obvious injury (defined as dark bands on the body, spinal deformations, de-scaling of 25% or more of body, and torpidity or inability to maintain upright attitude after sufficient recovery time) occurs during electrofishing, operations will be immediately discontinued, machine settings, water temperature, and conductivity checked, and procedures adjusted or electrofishing postponed to reduce mortality.

C. Sample Processing

1. Fish shall be sorted by size to avoid predation during containment.
2. Samplers must be aware of the conditions in the containers holding fish; air pumps, water transfers, etc. to maintain safe conditions. All sampling procedures must have a protocol for protecting held fish.
3. Fish should be observed for general condition and injuries (e.g., increased recovery time, dark bands, and visually observable spinal injuries).
4. Fish should be processed as soon as possible after capture to minimize stress. This may require a larger crew size. Each fish should be completely revived before releasing at the location of capture. A plan for achieving efficient return to appropriate habitat should be developed before each sampling session. Every attempt should be made to process and release ESA-listed specimens first.

D. Bull Trout Electrofishing Conservation Measures

1. For salvage operations in known bull trout spawning and rearing habitat[8], electrofishing shall only occur from May 1 to July 31. In FMO[9] habitats, electrofishing may occur any time of year.
2. Bull trout are very temperature sensitive and generally should not be electrofished or otherwise handled when temperatures exceed 15°C in spawning and rearing habitats.

E. Electrofishing settings for larval Lamprey

1. Electrofishing should be performed in a manner that minimizes harm to fishes. Handling techniques as described in NMFS Electrofishing Guidelines are protective of lamprey. If there is a conflict between conservation measures for ESA-listed salmonids and lamprey/mussels notify BPA EC Lead and prioritize protections towards the ESA-listed fish. Verify electrofisher model with EC Lead if not one of the following:
    a. AbP-2 "Wisconsin" electrofisher (ETS Electrofishing, Verona, WI)
    b. Smith-Root LR-24 model electrofisher with lamprey settings;
    c. Smith Root Apex Backpack electrofisher with lamprey settings.
2. Electrofishers used for larval lamprey sampling should be set with two wave forms, a lower frequency "tickle" wave form to coax larval lampreys out of the substrate and a higher frequency "stun" wave form to immobilize larval lampreys for netting (Table 2).
3. First stage: use 125V direct current with a 25 percent duty cycle applied at a slow rate of 3 pulses per second, to induce larval lampreys to emerge from the sediment. At low water temperature (<10C˚), voltage may need to be raised (150-200V) to maintain its effectiveness (gradually increase voltage to find the appropriate setting to avoid the risk of electronarcosis). Use a pattern of 3 slow pulses followed by a skipped pulse (bursted pulse) helps larval lampreys to emerge.
4. Second stage: immediately after larval lampreys emerge, use a fast pulse setting of 30 pulses per second to immobilize and net them. It is not necessary to stun lamprey for netting for experienced netters. Avoid exposing larval lampreys to extended periods of electrofishing as it has also been linked to electronarcosis. Recovery from electronarcosis takes about 15 minutes.
5. Use dip nets to capture larval lampreys where they are readily visible. Where not visible, seines may be effective. Using fine mesh nets to "sweep" the water ("blind-netting") may increase the number of small larvae collected.

[8] Bull Trout Spawning and Rearing habitat is not foraging, migrating, and overwintering (FMO) habitats.
[9] Bull Trout Spawning and Rearing habitat is not foraging, migrating, and overwintering (FMO) habitats.

6. Within each reach, electrofishing should be conducted in a downstream to upstream direction (for the purpose of reducing turbidity/maintaining visibility) with one person operating the electrofisher and at least one person netting larval lampreys. Each reach should be thoroughly and slowly sampled (60-90 sec/m), with more effort directed at suitable lamprey rearing habitat and less effort in areas with hard substrates or high water velocity.
7. Multiple electrofishing passes should be made to ensure a more complete removal of larval lampreys. A fifteen-minute break between passes should be taken to reduce the chance of electronarcosis. Some research indicated on average, only 30% lamprey emerge per pass, thus the need for multiple passes.
8. Post-Drawdown: Larval lamprey may continue to emerge from sediments after drawdown. The following "Dry- Shocking" Guidelines can be used to encourage larvae to emerge from the sediments so they can be salvaged.
    a. During and after dewatering, dewatered areas where lamprey may be burrowed should be shocked, aka "dry-shocking." Dry shock in depositional areas of fine and sandy sediment for larval lamprey. Juveniles (eyed migrants) and adults are sometimes found buried in rockier areas, and those areas should also be shocked if other these life stages may be present.
    b. Dry-shock a square meter at a time. Place the anodes about 1 meter apart and tickle-pulse for 60 to 90 seconds. Remove emerged lamprey once the shocking has stopped. Move to next square meter and continue. Adjust to local conditions – in some instances, 60 seconds of shocking will be sufficient; in other areas 90 seconds is needed. In cold temperatures, it can be beneficial to raise the voltage to increase efficiency. A general guideline is at temperatures less than 100C, the voltage can be increased to 150-175 V. If emergence is really slow (or on the last salvage pass prior to complete dewatering), the voltage can be increased to 200 V initially, and up to 400 V if lower voltage is not effective (dry shocking only).

Table 2: Electrofishing Guidelines for Larval Lampreys.

	"Tickle" Bursted Slow Pulse Primary Way Form	"Stun" Standard Fast Pulse Secondary Wave Form
Voltage	125 v	125 v
Pulse Frequency	3 Hz	30 Hz
Duty Cycle	25%	25%
Burst Pulse Train	3:1	X
Maximum duration/set	60-90 seconds	

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3.1.2.4 Dewatering

A. Dewatering, when necessary, will be conducted over a sufficient period of time to allow species to naturally migrate out of the work area and will be limited to the shortest linear extent practicable.

B. Diversion around the construction site may be accomplished with a cofferdam and a by-pass culvert or pipe, or a lined, non-erodible diversion ditch. Where gravity feed is not possible, a pump may be used, but must be operated in such a way as to avoid repetitive dewatering and rewatering of the site. Impoundment behind the cofferdam must occur slowly through the transition, while constant flow is delivered to the downstream reaches.

C. All pumps will have fish screens to avoid juvenile fish impingement or entrainment, and will be operated in accordance with NMFS's current fish screen criteria (NMFS 2011, or most recent version). If the pumping rate exceeds 3 cubic feet per second (cfs), a NMFS Engineering review will be necessary. If the screen is in an isolated area with no fish (salmonids or larval lamprey), a larger mesh screen may be used.

D. Dissipation of flow energy at the bypass outflow will be provided to prevent damage to riparian vegetation and/or stream channel.

E. Seepage water will be pumped to a temporary storage and treatment site or into upland areas to allow water to percolate through soil or to filter through vegetation prior to reentering the stream channel.

3.1.3 <u>Construction and Post-Construction Conservation Measures</u>

3.1.3.1 Fish passage

A. Fish passage will be provided for any adult or juvenile fish likely to be present in the project area during construction, unless passage did not exist before construction, or the stream is naturally impassable at the time of construction, or if it shall increase negative effects on ESA-listed species or their habitat.

B. Fish passage alternatives shall be approved by BPA EC lead under advisement by NMFS habitat biologist.

3.1.3.2 Construction and discharge water

A. Surface water may be diverted to meet construction needs, but only if developed sources are unavailable or inadequate.

B. Diversions will not exceed 10% of the available flow.

C. All construction discharge water will be collected and treated using the best available technology suitable for site conditions. Treatments to remove debris, nutrients, sediment, petroleum hydrocarbons, metals and other pollutants likely to be present will be provided.

3.1.3.3 Time and extent of disturbance

A. Earthwork (including drilling, excavation, dredging, filling and compacting) in which mechanized equipment is used in stream channels, riparian areas, and wetlands will be completed as quickly as possible.

B. Mechanized equipment will be used in streams only when project specialists believe that such actions are the only reasonable alternative for implementation, or would result in less sediment in the stream channel or damage (short- or long-term) to the overall aquatic and riparian ecosystem relative to other alternatives. To the extent feasible, mechanized equipment will work from the top of the bank, unless work from another location would result in less habitat disturbance.

3.1.3.4 Cessation of work

A. Project operations will cease when high flow conditions may result in inundation of the project area, except for efforts to avoid or minimize resource damage.

B. Project operations will cease when allowable water quality levels are exceeded as defined by the state CWA section 401 water quality certification or HIP Turbidity Monitoring Protocol. See CWA Section 401 Water Quality Certification for more information.

3.1.3.5 Site restoration

A. All streambanks, soils, and vegetation will be cleaned up and restored as necessary using stockpiled large wood, topsoil, and native channel material.

B. All project-related waste will be removed.

C. All temporary access roads, crossings, and staging areas will be decompacted and re-contoured. When necessary for revegetation and infiltration of water, compacted areas of soil will be loosened.

D. All disturbed areas will be rehabilitated in a manner that results in similar or improved conditions relative to pre-project conditions. This will be achieved through redistribution of stockpiled materials, seeding, and/or planting with local native seed mixes or plants.

3.1.3.6 Revegetation

A. Planting and seeding will occur prior to or at the beginning of the first growing season after construction.

B. Use a mix of species, appropriate to the site that will achieve establishment, shade, and erosion control objectives. These would, preferably be forb, grass, shrub, or tree species native to the project area or region.

C. Vegetation, such as willow, sedge and rush mats, will be salvaged from disturbed or abandoned floodplains, stream channels, or wetlands, and replanted at the site in appropriate locations.

D. Short-term stabilization measures may include the use of non-native sterile seed mix (when native seeds are not available), weed-free certified straw, jute matting, and other similar techniques.

E. Surface fertilizer will not be applied within 50 feet of any stream channel, waterbody, or wetland.

F. Fencing will be installed as necessary to prevent access to revegetated sites by livestock or unauthorized persons.

G. Invasive species will not be used. Invasive plants will be removed or controlled until native plant species are well-established (typically within 3 years post-construction to achieve 70% of pre-project conditions).

3.1.3.7 Site access and implementation monitoring

A. The Project Sponsor will retain the right of reasonable access to the site in order to monitor the success of the project over its life. Project Sponsor staff or their designated representative will provide implementation monitoring to ensure:

   a. General conservation measures are adequately followed.

   b. Effects to listed species are not greater than predicted and incidental take limitations are not exceeded.

   c. Turbidity monitoring is being conducted in accordance with the HIP turbidity monitoring protocol.

B. The Project Sponsor or designated representative will submit the Project Completion Form (PCF) to ensure compliance with the applicable BiOp.

3.1.3.8 CWA section 401 water quality certification

A. The Project Sponsor or designated representative will complete and record water quality observations to ensure that in-water work is not degrading water quality.

B. During construction, CWA section 401 water quality certification provisions provided by the Oregon Department of Environmental Quality, Washington Department of Ecology, or Idaho Department of Environmental Quality will be followed.

3.2 Staged Rewatering Plan and Conservation Measures

A. When appropriate, the Project Sponsor shall implement a staged rewatering plan for projects that involve introducing streamflow into recently excavated channels under activity category 2a) Improve Secondary Channel and Wetland Habitat or 2f) Channel Reconstruction. This plan may be altered according to site specific conditions with coordination and feedback from BPA and the Services.

B. The following will be applied to all rewatering efforts. Complex rewatering may require additional notes or a dedicated sheet in the construction details.

1. Turbidity monitoring protocol will be applied to rewatering efforts.
2. Pre-wash the newly-excavated channel before rewatering[10]. Turbid wash water will be detained and pumped to the floodplain or into a reach with sediment capture devices, rather than discharging into fish-bearing waters.
3. Install seine nets at upstream end to prevent fish from moving downstream until 2/3 of total flow is restored to the channel.
4. Starting in the early morning, introduce 1/3 of the flow into the new channel over a period of 1-2 hours.
5. Introduce the second 1/3 of the flow over the next 1-2 hours. Salvage fish from the old channel at this time, so that the old channel is fish-free before dropping below 1/3 of the flow. *Note: the fish will be temporarily blocked from moving downstream into either channel until 2/3 of the flow has been transitioned to the new channel. This blockage to downstream fish passage is expected to persist for roughly 12 to 14 hours, but fish will still be able to volitionally move out of the channel in the downstream direction.* Perform monitoring as in #3 above.
6. After the second 1/3 of flow is introduced over 2 hours, and turbidity is within 10% of the background level, remove seine nets from the new channel, and allow fish to move downstream back into the channel.
7. Introduce the final 1/3 of flow. Once 100% of the flow is in the new channel, install plug to block flow into the old channel and remove seine nets from the old channel. Additional efforts to salvage larval lamprey emerging from fine sediment deposits should be conducted after the flow is gone and possibly for a few hours after flow is gone, as the larvae will continue to emerge.
8. Install plug to block flow into old channel or bypass if not part of project. Remove any seine nets.
9. In lamprey systems, lamprey salvage and dry shocking may be necessary.

[10] The contractor may find it useful to have prewashed gravel bags available onsite to control the flow of water.

3.3 HIP Turbidity Monitoring Protocol and Conservation Measures

The Project Sponsor is responsible for monitoring turbidity during implementation. If the geomorphology of the project area (e.g., silty or claylike materials) or the nature of the action (e.g., large amounts of bare earth exposure) shall preclude the successful compliance with these triggers, notify the BPA EC Lead in advance of the likelihood of an exceedance and seek additional recommendations. Turbidity protocol is as follows:

A. Take a background turbidity measurement approximately 100 feet upstream from the project area using a recently-calibrated turbidimeter or estimated using visual observations (Figure 1). Note the turbidity level, location, and time of the background measurement.

B. Record the turbidity measured using a calibrated turbidimeter or estimated by visual observation (Figure 1) before work begins at the downstream point, known as the measurement compliance point. Note the turbidity level, location, and time. The compliance point shall be located downstream of the disturbance area, approximately:

   1. 50 feet downstream for streams that are less than 30 feet wide;
   2. 100 feet downstream for streams between 30 and 100 feet wide;
   3. 200 feet downstream for streams greater than 100 feet wide; and
   4. 300 feet from the discharge point or nonpoint source for locations subject to tidal or coastal scour.

C. Turbidity shall be measured by turbidimeter or estimated by visual observation (Figure 1) at the background and compliance points every **4 hours** while work is being implemented.

D. If there is a visible difference between a compliance point and the background then an exceedance (10% or more) has occurred and must be noted in the PCF. Adjustments or corrective measures must be taken in order to reduce turbidity.

E. If exceedances occur for more than **two consecutive monitoring intervals** (after 8 hours), the activity must stop until the turbidity level returns to background, and the BPA EC Lead must be notified after the project is concluded. The BPA EC Lead shall document the reasons for the exceedances and the corrective measures taken. This is very important as BPA is required to report to the Services upon all exceedances.

F. If at any time, monitoring, inspections, or observations/samples show that the turbidity controls are ineffective, immediately mobilize work crews to repair, replace, or reinforce controls as necessary. Document those occurrences in the Project Completion Form (PCF).

G. The Project Sponsor shall submit a summary of readings, exceedances, control failures, adaptive measures to BPA using the HIP Project Completion Form (PCF).

Figure 1 Suggested Visual Observational Differences in Turbidity

NOTE: A visual observation of a difference between compliance points shall be assumed to be about a 10% increase in natural stream turbidity.