Oregon
Kate Brown, Governor

Department of Fish and Wildlife
East Region
61374 Parrell Road
Bend, Oregon 97702
(541) 388-6363
FAX (541) 388-6281

June 3, 2019

Bruce Scanlon, Manager
Ochoco Irrigation District
1001 NW Deer Street
Prineville, Oregon 97754

BY ELECTRONIC FILING

Subject: Bowman Dam Hydroelectric Project
Docket P - 14791; Oregon Department of Fish and Wildlife Comments on the Pre-Application Document

Dear Bruce:

The Oregon Department of Fish and Wildlife (ODFW) has reviewed the Pre-Application Document (PAD) submitted by Ochoco Irrigation District (OID) regarding the development of Bowman Dam hydroelectric facilities on the U.S. Bureau of Reclamation's Arthur R. Bowman Dam near Prineville, Oregon (Project), FERC No. 14791. ODFW participated in the OID public meeting and site visit for the proposed Project held on April 2, 2019 which initiated a 60 day period for commenting on your PAD and the filing of study requests. ODFW notes that the 60 day filing period falls on June 3, 2019 and submits the attached comments and study requests to assist OID in and preparing the Draft License Application (DLA).

ODFW looks forward to working with OID, other agencies and participants to discuss and develop study plans and other considerations for the Project.

Ted Wise
Oregon Department of Fish and Wildlife
East Region Hydropower Coordinator

INTRODUCTION

Oregon Department of Fish and Wildlife
Comments on Bowman Dam Hydroelectric Project
Pre-Application Document
FERC P - 14791

Oregon Statutes and Oregon Department of Fish and Wildlife Plans and Rules

The state's authority and policy for hydroelectric projects and Oregon Department of Fish and Wildlife's (ODFW) management and authority are defined by various rules statutes (OASs) and rules (OARs) as follows:

- **Wildlife Policy (ORS 496.012)**

Establishes wildlife management policy to prevent serious depletion of any indigenous species and maintain all species of fish and wildlife at optimum levels.

- **Oregon Plan for Salmon and Watersheds (ORS 541. 898**

Restore native fish populations, and the aquatic systems that support them, to productive and sustainable levels that will provide environmental, cultural, and economic benefits.

- **Policy to Restore Native Stocks (ORS 496.435)**

Establishes goal of the State of Oregon to restore native stocks of salmon and trout to their historic levels of abundance.

- **ODFW's Fish Passage Law (ORS 509.580 - 509.645)**

Establishes as state policy that upstream and downstream passage is required at all artificial obstructions in those Oregon waters in which migratory native fish are currently or have historically been present.

- **ORS 543.015**

It is the policy of the State of Oregon: (1) To protect the natural resources of the state from possible adverse impacts caused by the use of the waters of this state for the development of hydropower, (2) To permit siting of hydroelectric projects subject to strict standards established to protect the natural resources of Oregon, (3) To require the Water Resources Commission, the Energy Facility Siting Council, the Department of Environmental Quality and other affected state agencies to participate to the fullest extent in any local, state or federal proceedings related to hydroelectric power development in order to protect the natural resources of Oregon.

- **ORS 543.017**

Sets minimum standards for development of hydroelectric power including: (a) No activity may result in mortality or injury to anadromous salmon and steelhead resources or loss of natural habitat....except when applicant proposes to modify an existing facility in such a manner that can be shown to restore, enhance or improve anadromous fish populations within that river system. (c) No activity may result in a net loss of wild game fish or recreational opportunities, unless acceptable alternative mitigation.

- **ORS 537 and 543**

Requires applicant to obtain a state water right to appropriate water for hydropower purposes**.**

- **Native Fish Conservation Policy (OAR 635-007-0502-0509)**

The purpose of this policy is to ensure the conservation and recovery of native fish in Oregon. The policy focuses on naturally produced native fish. This focus is because naturally produced native fish are the primary basis for Endangered Species Act (ESA) delisting decisions and the foundation for long-term sustainability of native species and hatchery programs.

- **Fish and Wildlife Habitat Mitigation Policy (OAR 635-415-0000- thru 0025**)

Require or recommend mitigation for losses of fish and wildlife habitat.

- **Trout Management (OAR 635-500-0100 - thru - 0120)**

Maintain the genetic diversity and integrity of wild trout stocks; and protect, restore, and enhance trout habitat. In addition, ODFW has authority pursuant to Section 10(j) of the Federal Power Act (FPA) and the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) to provide recommended terms and conditions to the Federal Energy Regulatory Commission (FERC), to protect, mitigate and enhance fish and wildlife and their habitat affected by operation and management of the Project.

- **Wildlife Diversity Plan (OARs 635-100-0001 thru -0030)**

Maintain Oregon's wildlife diversity by protecting and enhancing populations and habitats of native wildlife at self-sustaining levels throughout natural geographic ranges.

- **Crooked River Fish Management Plan (OARs 635-500-1850 thru 1940)**

Protect and promote natural production of indigenous species and protect and restore those habitats through coordination and cooperation with other agencies, entities and landowners.

- **Fish Passage (OAR 690-051-0200)**

Project facilities and operations will not unreasonably interfere with upstream and downstream passage of fish through the project vicinity. The project must be consistent with ODFW fishery management programs and plans in force on the effective date.

GENERAL COMMENTS:

State Fish Passage Law

ODFW met with OID representatives and the Regional Solutions Team in Prineville on March 14, 2017 to discuss the fish passage requirements associated with development of the Project. Because it has been over two years since that meeting ODFW is providing the following summary of the passage requirements.

The State of Oregon's fish passage laws (ORS 509.585) as referenced in the above section require that the owner or operator of an artificial obstruction located in waters in which native migratory fish are currently or were historically present must address fish passage requirements when certain "trigger events" occur. One such "trigger event" is a fundamental change in permit status including FERC licensing or the granting of new water rights (ORS 509.580(4)). Addressing fish passage requirements entails 1) providing passage, according to a plan approved by ODFW, or 2) receiving a waiver from providing passage from the Oregon Fish and Wildlife Commission (Commission), or 3) receiving an exemption from providing passage from the

Commission. Waivers to providing fish passage are allowed if alternative mitigation would provide a net benefit to native migratory fish relative to providing actual fish passage at the site. Exemptions are considered when there would be no appreciable benefit to providing passage and mitigation would not be required. In the case of Bowman Dam, ODFW believes that providing fish passage would benefit native migratory fish species, so an "exemption" to the fish passage requirement would not be appropriate. The two alternatives that are available to OID are to provide fish passage, or obtain a Commission approval of a waiver for fish passage.

With these comments for the record, ODFW is providing OID with its determination (ORS 509.585(4)) that several species of native migratory fish as defined in OAR 635-412-0005 are or historically have been present in the Crooked River above and below Bowman Dam. The following native migratory fish should be included for any analysis of the benefits of fish passage and waiver mitigation: redband trout *(Oncorhynchus mykiss)*, steelhead trout (*O. mykiss)*, spring Chinook salmon *(O. tshawytscha)*, Bridgelip sucker (*Catostomus columbianus)*, Largescale sucker (*C. macrocheilus*), Mountain whitefish (*Prosopium williamsoni*), and Bull trout (*Salvelinus confluentus*).

SPECIFIC COMMENTS:

Section 1.3 Statutory and Regulatory Requirements

Page 15: A subsection should be added to this section describing Oregon statutes and ODFW policies and rules pertaining to hydroelectric development as described above.

Section 2.0 Project Description - *2.0 (i):* Provisions if any for future units

Page 17: It is stated that, *"future expansion may be desirable with engineering studies determining what is any provisions may be installed to accommodate future units."* ODFW recommends that it be acknowledged that if additional future capacity is to be considered it could well change the scope and extent of impacts and mitigation provisions. Not knowing what the extent of expanded capacity might be (be it an additional 2 MW or 5MW) is problematic to assessing potential Project impacts.

2.0 Proposed Transmission Line

Page 20: See relevant comments under section 2.3.6

Section 2.3.5 Tailrace

Page 24: The Project will need to provide adequate analysis, design and engineering in regard to an approved tailrace barrier to prevent fish from leaping, becoming attracted to, or moving up into the draft tubes and turbines. Hydroelectric project tailraces are known to falsely attract and delay migrating salmonids (EA Engineering 1991). Attracted fish can be injured or killed in those situations where fish can enter the turbines' draft tubes and can be battered against the tailrace walls due to turbulence of the releases (Fedoreko 1989; Oregon Department of Fish and Wildlife 1985). Installing tailrace barriers can protect fish from these impacts.

2.3.6 Transmission Line

Page 25: The Pad, 2.3.6 state's that, "*Interconnection would be made to the Central Electric Cooperative (CEC) facilities located to the north of the Project at the top of the canyon rim. The maximum 3 MW of generation would be stepped from 4,160 volts to 24.5 kV to match the existing CEC circuit voltage. A portion of the CEC lines would need to be reconductored to accommodate the 3.0 MW of generation. The location and amount of line needing reconductoring, currently estimated to be 1.5 miles, would be confirmed during Project design. A map of the proposed route subject to change based on engineering and environmental studies will be provided at a later date*."
The opened nature of this statement makes it difficult to analyze the extent and degree of potential impacts. It's important that the future draft license application acknowledge, analyze and present options for avoiding and or mitigating for potential impacts to raptors and migratory birds.

The potential for electrocution of raptors inhabiting the Project area and adjacent areas is an important consideration for analysis. While many raptor species may not occupy a nest site directly in the Project boundary, their foraging territories and roosting sites may well fall within the delineated bounds of the Project. Bald eagles and golden eagles are relatively common in the project area and the potential impacts of the proposed Project to these species should be thoroughly assessed and addressed. In addition to the high density of nests in proximity to the proposed route, eagles move through and forage in the project area increasing the risk of collisions with transmission lines.

All practicable actions should be taken to minimize the risk to bald and golden eagles. including locating the any new lines away from nests and known or suspected foraging areas, the use of bird deflectors on the lines to make them more visible, and constructing the transmission line outside of the nesting season to minimize disturbance.

Potential impacts to migratory birds should be assessed and addressed for this project. The Migratory Bird Treaty Act (MBTA) prohibits the taking, killing, possession, and transportation, (among other actions) of migratory birds, their eggs, parts, and nests unless specifically permitted by regulations. The direct effects on migratory birds resulting from project operation of the transmission line can include injury or mortality from transmission line collisions and/or electrocutions. ODFW encourages the identification of protection measures during the development of project plans and implementation of those measures during the construction and operation of facilities and equipment. Clearly marking the transmission lines with bird deflectors as mentioned above will reduce the risk of collisions. Also existing transmission lines that are be "reconductored" should be retrofitted with design features that will reduce and or eliminate the risk of migratory electrocutions.

Section 2.4 Proposed Mode of Operation

Page 25: The proposed mode of operation for the proposed Project as described "*would be operated remotely via a SCADA control system. The control system would be programmed to run through a series of checks in both normal start-up and shut-down procedures, as well as emergency shutdown. In case of an emergency shutdown, the control system would divert the powerhouse flow to the spillway stilling basin insuring instream flow requirements are met at all times. In addition, the control system would disconnect the plant from the grid*." Quickly increasing and reducing the flows through the powerhouse can impact downstream fish and wildlife populations. Natural stream flow changes are usually relatively slow compared to those induced by hydroelectric or irrigation operational changes, particularly during low flow periods. The proposed new valves and controls will provide the capacity to meet a more gradual release schedule that provides more opportunity for an appropriate downstream fish response. To help minimize unintentional changes in flow associated with flow transfers during Project start up or shut down it will be important that the issue of **"instream flow continuity and ramping rates**" be addressed.

A Ramping Prevention Plan **(RAP),** should be prepared that includes ramping criteria and measures that prevent accidental flow interruptions and fluctuations in stream flow below the dam caused by preventable and non-preventable episodes. Integral to this consideration it is recommended that a pressure transducer be installed at the Reclamation gage site located just downstream of the dam to provide information to the valve house and powerhouse controls. The river flow state and stage information would be used to monitor compliance with ramping rates. It recommended that recording and transmitting of stream flow data occur at 15 minute intervals to the Project control room to provide a rigorous monitor level that would enable quick notification in the event that a ramping deviation is occurring.

ODFW also requests that additional information be provided on the type of valve proposed to be installed as replacement for the existing valve as well as further describe the level of mortality or injury that can be sustained by organisms passing through the valve.

Section 3.1 General Description of the Project Area

Page 27: There needs to be a much thorough and accurate description of the Lower Crooked Wild and Scenic River (Chimney Rock Segment) designation and the October 1992 management plan (LCWSRMP), as prepared and adopted by the Bureau of Land Management (BLM) and Reclamation.

In particular the language in the PAD reads, "*The Crooked River Collaborative Water Security and Jobs Act of 2014, defined the segment beginning 0.25 mile below Bowman Dam and extending downstream 7.75-miles as a recreational (H.R. 2640, 2014). H.R. 2640 requires that any non-federal hydropower development at the dam analyze any impacts to the scenic, recreational, and fishery resource values of the Crooked River from the center crest of Bowman Dam to a point ¼-mile downstream that may be caused by a proposed project (H.R. 2640, 2014).*"

The actual language in H.R 260, 2014 reads, "*Section 3(a) (72) of the Wild and Scenic Rivers Act (16 U.S.C. 1274(a) (72)) is amended as follows: (1) By striking ''15-mile'' and inserting ''14.75- mile''.(2) In subparagraph (B)— (A) by striking ''8-mile'' and all that follows through ''Bowman Dam'' and inserting ''7.75-mile segment from a point one-quarter mile downstream from the toe of Bowman Dam''; and (B) by adding at the end the following: ''The developer for any hydropower development, including turbines and appurtenant facilities, at Bowman Dam, in consultation with the Bureau of Land Management, shall analyze any impacts to the Outstandingly Remarkable Values of the Wild and Scenic River that may be caused by such development, including the future need to undertake routine and emergency repairs, and shall propose mitigation for any impacts as part of any license application submitted to the Federal Energy Regulatory Commission.''*

There is an important distinction in the bill language versus the PAD language. The H.R. 2040 language clearly states that any hydropower development shall analyze any impacts to the Outstanding Remarkable Values of the Wild and Scenic River, and the language used in the PAD might mistakenly be construed to limit the analysis for impacts to only one quarter of mile downstream of the proposed Project. As part of the background information for future documents reference should be made to the 1992 WSRMP clearly acknowledging as stated in the WSRMP, "*The Resource Assessment validated the Congressional Record that states scenic and recreation are outstandingly remarkable values. In addition, the Resource Assessment recognized fishery resources as an outstandinging remarkable value within the Lower Crooked River corridor. Other river-related resources such as geology, water quality and quantity, wildlife, cultural vegetation and ecology are very significant as supporting elements but were not determined to be outstandingly remarkable*."

The Wild and Scenic River designation is an important back drop for the considerations of minimizing potential short term and long term impacts to the native fish assemblage in the river below the proposed Project.

Section 3.1.2.2 Project Effects

Page 30: This section should more thoroughly address impacts/ disturbance to wetlands, riparian habitats and waterbodies. It is stated in this section that, "*this action would expose soils to potential erosion and resulting sedimentation in water bodies*." This statement needs more discussion as to the "what, how, when and where" of the sedimentation and its' potential to enter into the "waterbodies." There should be a description of the "waterbodies' that might be effected by the sedimentation resulting from the proposed Project construction activities or long term operations. Also, there is no reference to any potential construction related effect pertaining to the proposed transmission line.

Section 3.1.2.3 Protection, Mitigation and Enhancement Measures

Page 30: Please include a more detailed description of what the referenced "*Best Management Practices*" entails. It is important to note that use of straw mulch and wattles have the potential to carry noxious and invasive plants.

Section 3.2.3.1 Water Quality Existing Conditions –

Water Temperature

Page 38: Please include a figure showing the seven day averages of daily maximum temperatures in the Crooked River immediately below Bowman Dam during the irrigation season.

Section 3.2.4. 1 Fishery Resources – Existing Conditions

Page 56: Prineville Reservoir - ODFW is providing the following table for inclusion in this section:

Resident Species—Prineville Reservoir

Common Name	Scientific Name	Native status
Brown Bullhead	*Ameiurus nebulosus*	Non-native
Largemouth Bass	*Micropterus salmoides*	Non-native
Smallmouth Bass	*Micropterus dolomeiu*	Non-native
Rainbow Trout	*Oncoryhnchus mykiss*	Stocked non-native
Black Crappie	*Pomoxis nigromaculatus*	Non-native
Chiselmouth	*Acrocheilus alutaceus*	Native
Largescale sucker	*Catostomus macrocheilus*	Native
Three-spine Stickleback	*Gasterosteus aculeatus*	Introduced
Redband trout	*O. mykiss gairdeneri*	Native
Mountain whitefish	*Prosopium williamsoni*	Native
Northern pikeminnow	*Ptychocheilus oregonensis*	Native
Bridgelip sucker	*Catostomus columbianus*	Native

Section 3.2.4.1 Existing Conditions - Fisheries Resources

Crooked River Below Bowman Dam

Page 56 – 62: This section includes discussion on Bull Trout, steelhead trout and Chinook Salmon but is devoid of any discussion of the native resident Redband Trout (*Oncorhynchus mykiss a)* and Mountain whitefish (*Prosopium williamsoni*). These omissions should be rectified in any ensuing document for the proposed Project. We have also included a life history periodicity chart for reference and inclusion in future documents for the proposed Project:

LIFE HISTORY PERIODICITY CHART
FOR NATIVE SALMONIDS IN THE CROOKED RIVER BASIN
ODFW May 1, 2019

	LIFE STAGE PRESENCE AND ACTIVITY PERIODS											
SPRING CHINOOK SALMON	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**
• UPSTREAM MIGRATION/HOLDING								■	■	■	■	■
• SPAWNING	■											■
• EGG/INCUBATION	■	■	■	■	■							■
• OCEAN REARING	**One to Three Years**											
• STREAM/RIVER REARING	**One Year**											
• SMOLT EMIGRATION						■	■	■				
• HATCHING/EMERGENCE					■	■	■	■				
SUMMER STEELHEAD TROUT	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**
• UPSTREAM MIGRATION/HOLDING	■	■	■	■	■	■						■
• SPAWNING						■	■	■				
• EGG/INCUBATION							■	■	■			
• OCEAN REARING	**One – Three Years (Mostly One – Two)**											
• STREAM REARING	**One – Three Years (Mostly Two – Three)**											
• SMOLT EMIGRATION							■	■	■			
• HATCHING/EMERGENCE								■	■			
REDBAND TROUT	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**
• SPAWNING						■	■	■	■			
• EGG/INCUBATION							■	■	■	■		
• HATCHING/EMERGENCE								■	■	■		
• REARING	■	■	■	■	■	■	■	■	■	■	■	■
MOUNTAIN WHITE FISH	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**
• SPAWNING		■	■	■								
• EGG/INCUBATION		■	■	■	■	■						
• HATCHING/EMERGENCE				■	■	■						
• REARING	■	■	■	■	■	■	■	■	■	■	■	■
BULL TROUT	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**
• UPSTREAM MIGRATION/FORAGING[1]	■	■	■	■	■	■	■	■	■	■	■	■
• SPAWNING												
• EGG/INCUBATION												
• HATCHING/EMERGENCE												
• REARING												

LEGEND:

■ Occurrence

Source: ODFW – East Region Hydropower Program

[1] **November 1– April 31 upper extent of potential upstream foraging is City of Prineville (RM??), May 1 – October 31 upper extent of foraging use is Highway 97 Bridge (RM??). Source personal com. Brett Hodgson ODFW, Tim Porter ODFW.**

Page 59: Bull Trout - It should be noted that with the upstream fish passage at the Opal Springs hydroelectric facility scheduled to be completed the summer of 2019, bull trout will be able to swim upriver pass the town of Prineville to the base of Bowman dam. Thus, there is the need to ensure that any developed hydropower facility is adequately designed and constructed to prevent bull trout from being attracted to the tailrace area and being able to swim into the draft tubes and sustain turbine injury.

Page 60 Steelhead - This section should be updated with the most current information on adult steelhead trout returns to the Crooked River both above and below the Opal Springs Hydropower Project. Overall there should be a more thorough update on the entirety of the anadromous reintroduction program as it pertains to the Crooked River and the proposed Project. Please consult with Portland General Electric staff at the Pelton Round Hydroelectric Project and local ODFW district fisheries staff for this information.

Importantly, it should be noted here that there will be volitional fish passage at Opal Springs as of August of 2019 and movement of steelhead trout into the upper reaches of river to and below Bowman dam is expected.

Page 60: Chinook Salmon - This section should be updated with the most current information on adult Chinook Salmon returns to the Crooked River both above and below the Opal Springs Hydropower Project. Overall there should be a more thorough update on the entirely of the anadromous reintroduction program as it pertains to the Crooked River and the proposed Project. Please consult with Portland General Electric staff at the Pelton Round Hydroelectric Project for this information.

Page 60: It states in paragraph four that, "*Although juvenile steelhead trout and spring Chinook salmon fry are released annually in this reach segment as part of an ongoing reintroduction effort, the primary management strategy for fish species in this reach focuses on resident redband trout. As such, there are no key segments for spawning summer steelhead trout or spring Chinook salmon*" This statement is inaccurate. It is very much expected that summer steelhead and or Chinook Salmon will be spawning in the Crooked River reach below Bowman dam. Please change the language in the document to reflect this eventuality. It is very likely that the river extending upstream from the OID Prineville diversion to Bowman dam will in fact be an important spawning area, "key segment" for steelhead trout returning from the ocean to spawn. If upstream passage above Bowman dam is not provided this area because extremely important as both a spawning and rearing area for steelhead trout.

Also it should be noted that the date referred to in this section for expiration of the 10(j) designation is incorrect.

The PAD as required by 18 CFR 5.6 regarding fish and wildlife resources should include a section describing the fish and other aquatic resources, including invasive species, in the project vicinity. This section must discuss the existing fish and macroinvertebrate communities, including the presence or absence of anadromous, catadromous, or migratory fish, and any known or potential upstream or downstream impacts of the project on the aquatic community. Components of the description must include: **(A)** Identification of existing fish and aquatic communities; **(B)** Identification of any essential fish habitat as defined under the Magnuson-Stevens Fishery Conservation and Management Act and established by the National Marine Fisheries Service; and **(C)** Temporal and special distribution of fish and aquatic communities and any associated trends with respect to: ***(1)*** Species and life stage composition; ***(2)*** Standing crop; ***(3)*** Age and growth data; ***(4)*** Spawning run timing; and ***(5)*** The extent and location of spawning, rearing, feeding, and wintering habitat.

A significant point of omission in this section is the lack of any information regarding the existing and historical fish assemblage in the Crooked River and its tributaries above Bowman Dam. Information

regarding historic and current fish population of Redband Trout, steelhead trout and Chinook Salmon above Bowman dam is necessary in assessing the options for addressing fish passage above the dam.

3.2.4.2 Project Effects – Fishery Resources

Page 62: It should be noted as stated above, that with the upstream fish passage at the Opal Springs hydroelectric facility scheduled to be completed the summer of 2019, bull trout will be able to swim all upriver pass the town of Prineville to the base of Bowman dam. Thus, a potential Project effect will be the potential for bull trout, steelhead trout, Chinook Salmon and Redband Trout to be attracted to the tailrace draft tubes.

Ramping Rate - Quickly increasing or reducing reservoir releases for project operations to meet irrigation demands, or as affected by potential hydropower operations can impact downstream fish and wildlife populations.

Page 62: Please add: Quickly increasing or reducing reservoir releases for project operations to meet irrigation demands, or as affected by potential hydropower operations can impact downstream fish and wildlife populations. Changes to hydropower releases should be designed towards a gradual release schedule that provides more opportunity for an appropriate downstream fish response.

3.2.4.3 Protection, Mitigation and Enhancement Measures – Fishery Resources

Page 62: There is the need to ensure that any developed hydropower facility is adequately designed and constructed to prevent fish from being attracted to the tailrace area and accessing the draft tubes and sustain turbine runner.

Ramping Rate – As mentioned above quickly increasing or reducing reservoir releases for project operations to meet irrigation demands, or as affected by potential hydropower operations can impact downstream fish and wildlife populations. Hydropower releases should be designed towards a more gradual release schedule that provides more opportunity for an appropriate downstream fish response. A ramping rate study should be conducted by OID as part of the proposed hydroelectric process to further determine the appropriate release schedule necessary to mitigate ramping impacts to the aquatic resources below the dam.

The construction period should be restricted to November 1 – February 28. This corresponds with reduced instream flows during the non-irrigation season and avoids the redband trout spawning and incubation period occurring from March through August. During construction, a cofferdam should be constructed to isolate the project work area and capture excessive sediment. This will likely entrain fish resulting in necessary salvage operations. Backpack electrofishing units should be used to capture entrained fish for transfer downstream.

The power plant should have adequate bypass and emergency capabilities to avoid disruption of normal releases during emergency shutdown of the power plant.

Other than efforts to reduce TDG downstream of the dam, there are no protection or mitigation measures proposed to prevent potential impacts to fishery resources of the Crooked River. Likewise there are no fishery resource enhancement measures proposed. More thought should be put into PME measures for addressing potential impacts and providing enhancement opportunities to the fishery.

3.2.5.2 Project Effects – Vegetation Cover

Page 71: Please elaborate more in this section as to potential project effects on the wetlands within the Area of the proposed Project.

3.2.5.3 Protection, Mitigation and Enhancement Measures – Vegetation Cover

Page 72: Please elaborate more in this section as to potential PME's pertaining to ensuring no short term or long term impacts to identified wetland areas.

Section 3.2.6.1 Wildlife Resources

Page 74: Birds - This section is severely lacking and needs a more thorough description of resident and migratory birds that occupy the habitats in or adjacent to the vicinity of the proposed Project. ODFW recommends the applicant research and utilize other potential literature sources available beyond the cited 2003 Department of Interior reference.

Page 77: Raptors - ODFW requests that more effort be put into describing the existing conditions in respect to all the wildlife resources associated with Project area. A generalized statement such as contained in the PAD, "*The bald eagle is likely present in Crook County (Biota Pacific 2012)*" is insufficient. The potential effects the proposed Project on the wildlife including bald eagles, golden eagles and raptors is an extremely important consideration of the proposed Project effects analysis. The Applicant should update information on use of the proposed Project area and adjacent areas through pre-project surveys.

There is considerable information available on historical use of golden eagle and other raptors in the area. For instance on June 22, 2012, ODFW staff observed an adult golden eagle with a chick at a nest site on the east side of the Crooked River, approximately 0.25 miles below Big Bend campground. This site is a little over 0.5 miles from the dam site and visually protected by a ridgeline. A second golden eagle nest site, .25 miles from the Project site, was also observed at that time by ODFW staff. There is additional information from pervious Bowman hydropower applications (FERC P-11925), available to add to the record. Even with the amount of substantial information base available, these surveys are more than a few years old and updated surveys are necessary to help inform the status of the nesting breeding and nesting sites and the proposed Project impact analysis.

Page 79: Project Effects - In respect to nesting eagles and other raptors in the vicinity of the proposed Project: Construction traffic and equipment may pass by the sites and ODFW recommends that if any construction is proposed to take place during the nesting season, the nests be monitored for occupancy and disturbance by construction activities.

Page 80: Protection, Mitigation and Enhancement Measures - If identified raptor nesting sites are occupied and the birds have the potential to be disturbed by activities, construction activities will need to be delayed or mitigated until fledging occurs. The seasonal restriction for golden eagles is February 1st through Jul 31st. Restrictions can be lifted if no nesting is observed by May 15th.

ODFW is providing the following information on raptor nest in the vicinity of the Project as a means of helping bolster section 3.2.6.1 and inform new studies and the preparation of the draft license application.

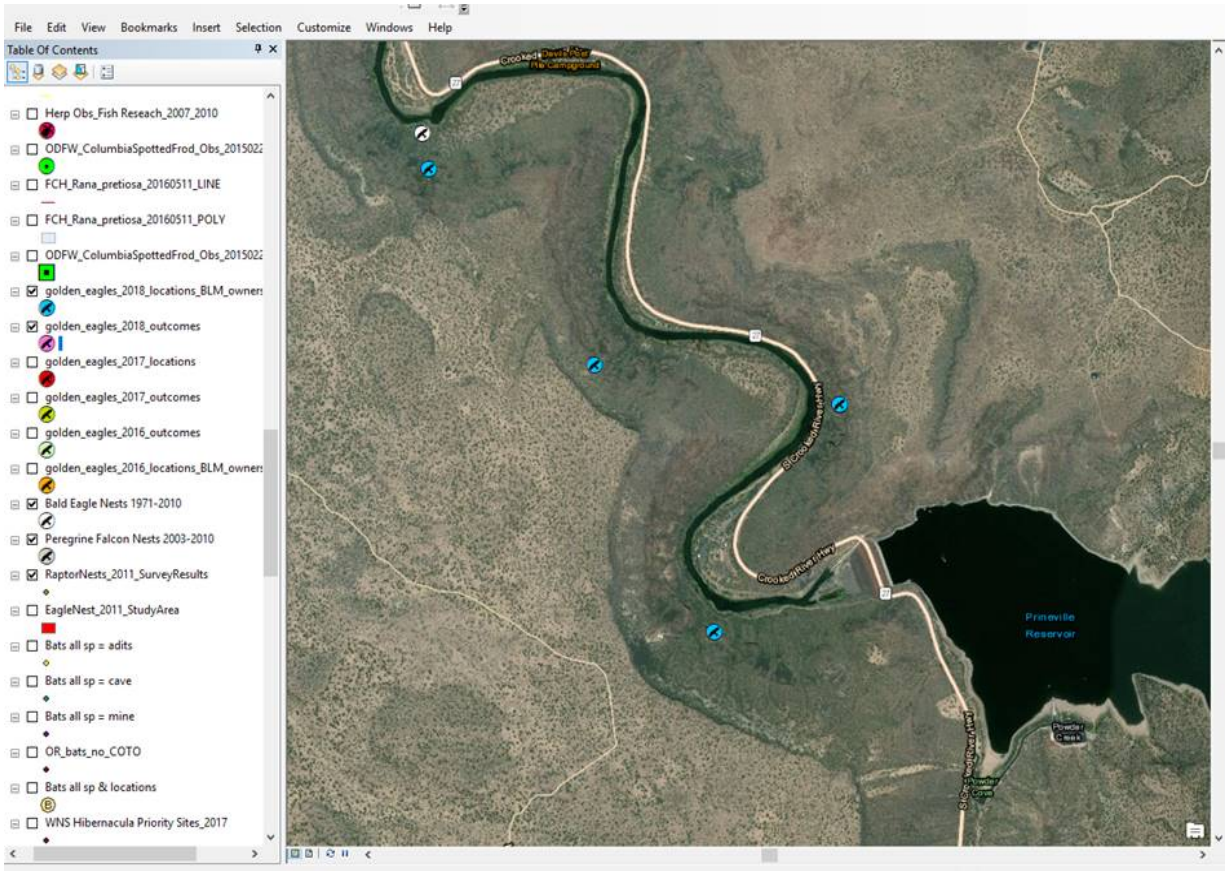

Figure 1. The screen capture above shows raptor nests from datasets available to ODFW. The most current dataset (includes the 2018 breeding season) relates to golden eagles (blue circles). The two closest nests to Bowman Dam are both approximately 0.46 miles from the Dam (measured from each nest to the closest portion of the dam structure). Both nests are believed to be used by same pair of eagles with the nest just north of the dam receiving primary use. The dataset includes nesting observations from 2011 to 2018. During those years the pair are known to have raised 1 young each in 2012 and 2013. Evidence of eggs were reported three separate years either failed or the outcome was unknown. The outcome for the remaining three years was either unknown or believed to have failed prior to egg laying. The white circle to the northwest denotes a bald eagle nest.

3.2.6.2 Project Effects

Wildlife Entrainment - During construction wildlife species, especially deer, may become captured in steep-walled excavations. After construction, spillways and deep ditches may also inadvertently capture wildlife. During the construction period there is the potential for winter and spring disturbance to big game winter range (mule deer and pronghorn antelope). The transmission may well cross through important mule deer winger range and new towers or roads may result in some degree of fragmentation of this winter range.

3.2.6.3 Protection, Mitigation and Enhancement Measures

ODFW recommends that a ramp or other means of escape be established in any potentially wildlife capturing structure, alternatively, fencing designed to exclude wildlife may also be used to prevent accidental capture. Impacts to big game can be mitigated to some degree by utilizing existing roads

during construction. New roads associates with the Project should provide adequate mitigation for any possible of loss of habitat value and should be effectively closed for winter use.

OID should consult with biologists from ODFW, BOR and the USFWS to determine the location of bald and golden eagle nest and roost sites in the project vicinity. Specific protective guidelines should be put in place that direct proposed Project activity near these sites.

Section 3.2.8.1 Land and Water Use - Existing Conditions:

Page 89: It is stated that, "*Oregon DFW has the primary responsibility of preserving habitat for game and non-game mammals, birds, and fish on all lands within the county and state*." This statement is incorrect. ODFW's mission is to "protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations". ODFW is responsible for regulating harvest, health, and enhancement of fish and wildlife populations in the state of Oregon. State and Federal Land management Agencies and city and county government are primarily responsible for managing fish and wildlife habitats in their respective jurisdictions or land ownership.

Section 3.2.8.2 Project Effects – Land and Water Uses

Page 89: It is stated in this section that "*the Project will have no effect on existing land and water uses."* This statement is overly presumptuous. Until a thorough analyses is undertaken, the potential effects/impacts of the proposed Project have yet to be determined. In fact there is potential for impacts on the recreational uses (camping, fishing etc.) during construction through noise, traffic, sedimentation etc. Also, during the period of operation impacts may result from impacts to the downriver fishery. Please discuss these potential impacts in more detail.

Section 3.2.9.1

Page 96: Crooked River - Wild and Scenic River Designation
As stated in earlier in our comments the Lower Crooked River Wild and Scenic River (LCRWSR) designation is an important back drop for the considerations of minimizing potential short term and long term impacts to the native fish assemblage in the river below the proposed Project. This section of the PAD is lacking in its description and signification LCRWSR designation. This includes in part its outstanding fisheries resources and the economic benefits to the local area stemming from the year round fishery in that reach of river from Bowman dam downstream through the 7.75 miles of the designated wild and scenic reach.

Page 97: Fishery
There should be a more comprehensive discussion of this the fishery in this section that might be potentially affected by the Project. There should be an analysis completed regarding the recreational, economic and social values of this important fishery.

A creel survey conducted by ODFW in 2013 showed that the Wild and Scenic Section below Bowman Dam is an extremely popular fishery (ODFW unpublished data). In eight months (May – December), anglers from 30 different states and two international countries expended an estimated 46,543 hours angling. Based on a rough estimate of about 10,300 angler trips, ODFW estimates that approximately $600,000 was spent by anglers in trip-related expenditures for this Crooked River fishery in 2013. Trip-related expenditures included costs for transportation (gas, etc.), groceries, restaurants/bars, and overnight accommodations (camping, hotel, B&B), however the expenditures do not account for equipment costs for waders, rods, etc. Much of the angler trip spending occurs in the Prineville. Since the survey data

covers only eight months of angling in 2013, the actual number of trips and expenditures would likely be higher for the full year.

Section 3.2.9.2 Project Effects – Recreation Resources
Page 98: See comments pertaining to Section 3.2.8.2. The potential effects of Project Construction, including sedimentation, constructing noise and other associated activities is yet to be fully analyzed for potential impacts to the recreational fishery and the Wild and Scenic River values.

STUDY REQUESTS

The July 1, 2016 Ochoco Irrigation District Preliminary Permit Application for the Bowman Dam Hydroelectric Project filed with the Commission reads, "*Ochoco Irrigation District intends to request Commission Approval to use the "traditional licensing process," which the District believes is appropriate in this case under the criteria set forth in 18 C.F.R. 5.3. The District has completed a preliminary feasibility study and proposes to continue to refine the feasibility as information becomes available from engineering and environmental resources studies. Specific study plans will be prepared following the preparation of the Per-Application (PAD) and consultation with state and federal agencies, Indian tribes and interested parties as required by 18 C.F.R. 4.3.8 Consultation Requirements.*

Anticipated studies include:

- *Continued Engineering and Design*
- *Geology and Soil Conditions*
- *Water Quantity*
- *Water Quality*
- *Fisheries resources*
- *Botanical Resources*
- *Wildlife Resources*
- *Sensitive, Threatened and Endangered Species*
- *Historic and Archeological resources*
- *Recreational Resources*
- *Aesthetic Resources*

Statement of Cost and Financing
The District estimates that the total cost of carrying out the studies, investigations and surveys described above in this exhibit during the term of preliminary permit will be approximately $1,000,000 to 1,500,000. The District has a variety of funding sources that it may use to secure Project funding including federal, state and local sources. The energy Trust of Oregon (ETO) and District funds have been used to project work to date and will continue to be used to move forward. The funds will be supplemented as required as Project moves forward into the latter stages of development."

To help further identify and define the aforementioned mentioned studies in the Preliminary Permit Application and per 18 C.F.R. §5.9(b) ODFW provides the following study requests and guidance.

Study 1. Determine the impacts of construction of hydroelectric facilities at Arthur R Bowman Dam on redband trout productivity.

1.1. Goals and Objectives - §5.9(b)(1) — *Describe the goals and objectives of each study proposal and the information to be obtained*

The Crooked River below Bowman Dam is inhabited by a highly productive population of native Columbia basin redband trout (Onchorynchus mykiss gairdneri). This population supports a widely renowned fishery that contributes revenue to Prineville and Crook County. This study will help describe the effect of project operations on fish populations. ODFW will use this information to make recommendations as to whether the yet-to-be proposed mitigation will result in no net loss to fish populations. ODFW will also use this information to develop and implement strategies for fish management.

Construction of the project is anticipated to elevate sediment levels downstream from the project area. Impacts of sediment on salmonid spawning success are well documented. Fine sediment deposited in spawning gravel can reduce interstitial water flow, leading to depressed dissolved oxygen concentrations, and can physically trap emerging fry in the gravel (Meehan and Swanston 1977). In addition information on juvenile Redband Trout will help inform any ramping rate considerations.

An additional objective of the study would be to map areas of spawning gravels and assess their embeddedness. This would provide a baseline for monitoring actions associated with the proposed Project and potential provide avenues for mitigation.

1.2. Relevant Resource Management Goals - §5.9(b)(2) — *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

Overriding resource goals and objectives are sited in the aforementioned OARs and ORSs. Specifically, the potentially affected area in the lower Crooked River is directed through OAR 635-500-1870 to be "managed for natural production consistent with the Wild Fish Management for trout (OAR 635-007-0525). This alternative states "the productive capacity of waters...will be maintained or enhanced so no net loss of natural fish production occurs. ODFW will actively pursue and promote habitat protection and enhancement."

1.3 Background and Existing Information - §5.9(b)(4) — *Describe existing information concerning the subject of the study proposal, and the need for additional information.*

The Crooked River below Bowman Dam is inhabited by a highly productive population of native Columbia basin redband trout (Onchorynchus mykiss gairdneri). Due to various anthropogenic factors depressing regional populations range wide, this subspecies is listed as both State sensitive and Federal candidate. The affected population is ecologically, socially and economically significant. The eight river miles below the dam represent a stronghold for redband trout. Favorable habitat and water conditions in this reach contrast with the degraded conditions in many other parts of the subbasin. Genetic analysis indicates Crooked River redband trout are unique from other sympatric redband trout (Currens, 1994). Population sampling conducted in 2000 estimated the trout population in this reach to be over 4,000 trout per mile (ODFW files, 2000

ODFW conducted population estimates for Redband Trout in the Crooked River below Bowman dam in 1989, 1993-1995, 2001, 2003 and annually from 2006-2016. Population estimates for Mountain Whitefish were also conducted annually from 2007-2016. (Porter, T, and B. Hodgson. 2016) However very little information is available on juvenile Redband Trout or Mountain Whitefish. This is an important data gap that is lacking in respect to informing potential impacts from the proposed hydroelectric project.

1.4 Project Nexus - §5.9(b)(5) — *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

Construction of the project is anticipated to elevate sediment levels downstream from the project area. Impacts of sediment on salmonid spawning success are well documented. Fine sediment deposited in spawning gravel can reduce interstitial water flow, leading to depressed dissolved oxygen concentrations, and can physically trap emerging fry in the gravel (Meehan and Swanston 1977).

The data gathered from these studies is necessary to determine if activities associated with construction of hydroelectric facilities negatively impact the reproductive success of native redband trout. ODFW anticipates appropriate mitigation measures will be employed by OID if losses occur. ODFW will use this information to make recommendations as to whether the yet-to-be proposed mitigation will result in no net loss to fish populations.

ODFW has multiple resource management goals derived from Oregon statute and adopted rules that guide our recommendations in hydro licensing processes. Permeating each of these policies is the goal of protecting and restoring native fish and wildlife populations for use and enjoyment by present and future generations. Key directives to ODFW for implementing fish and wildlife management strategies include; avoidance of impacts to these populations, protection of genetic diversity, and protection and restoration of natural habitats on which these populations are dependent.

1.5. Proposed Methodology - §5.8(b)(6) — ***Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field seasons(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.***

The Applicant would monitor project impacts to redband trout productivity by conducting studies estimating numbers of age 0 trout and redds in the one-mile reach below the dam. This section addresses the "Crooked River tailwater age-0 redband trout study." ODFW supports the basis for this study in evaluating project impacts, however, the proposed study protocol may not be successful at collecting the targeted data. This study should be conducted during the spring and fall of 2020 and 2021. While ODFW considers a two-year period for defining baseline conditions somewhat lacking, given the proposed FERC Traditional License Process (TLP), schedule a longer study period may not be possible. Still the study is necessary and valuable information for informing the impacts analysis. If time were to allow, a three year study is preferable. The effects of inter-annual variability in reproductive success could mask potential impacts from the project and thus a minimum of a three-year study period is therefore would be preferred prior to project construction. Sampling should be conducted during and after construction to evaluate impacts on age 0 redband trout. OID will need to procure a scientific taking permit from ODFW prior to engaging in this study (ORS 497.298).

Proposed methodology involve randomly selecting 20 shoreline transects each 15 meters long and three meters wide. Backpack electrofishing using three removal passes will be conducted to estimate abundance. ODFW recommends the 20 transects be landmarked using global positioning satellite coordinates. This would standardize inter-annual results and facilitate data analysis. The sampling design should employ accepted multiple pass removal estimation techniques including the use of block nets to isolate emigration and immigration from the sampling area during and between passes. Number of passes required to generate population estimates is dependent upon observed reduction in capture rate. A minimum of 67% reduction between passes is required to preclude additional passes (Seber and LeCren 1967; Nicholson et. al 1990). ODFW can work with OID to further refine the aspects of the study design.

Backpack electrofishing surveys have been successfully utilized to sample populations of both adult and juvenile salmonids (Seber and LeCren 1967). Rodgers et al (1992) evaluated the efficiency of multiple pass removal techniques. This technique was found very effective in small streams in all habitat types

excluding large pools with an abundance of structure. Van Deventer and Platts (1989) have developed software to generate statistical results from electrofishing data.

This type of analysis is consistent with other fish protection analyses completed during licensing proceedings for hydroelectric projects that have the potential to adversely affect resident and anadromous salmonids and ESA-listed fish species.

1.6 Level of Cost and Effort - §5.9(b)(7) — *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

OID will need to obtain a scientific taking permit from ODFW. In the best of conditions the study would be designed, permits obtained, and field studies initiated before the end of 2020. OID should begin the study in fall of 2020 and continue through the fall drawdown of the reservoir in 2021, with results reported by December of 2021 or if there are three years of data collected, by December of 2022.

The total cost for conducting the analysis and preparing the report is estimated to be approximately $15,000. Two analysts would be expected to work for approximately 15 – 20 days on the collection of data. Additionally, two analysts would be expected to work for approximately 7-10 days preparing the draft report and final report.

Study 2. Prineville Reservoir Fish Entrainment Study.

2.1 Goals and Objectives – §5.9(b)(1) — *Describe the goals and objectives of each study proposal and the information to be obtained.*

The primary purpose of this study is to determine entrainment rates of various fish species from Prineville Reservoir over a two to three year period. Installation of the proposed hydroelectric facility may cause increased mortality of entrained fishes due to turbine-related injuries.

The objectives of this study are to: 1) Estimate total entrainment rates of various fish species over a two to three year period; 2) Describe temporal variation in entrainment rates of entrained fishes in relation to reservoir pool elevation and discharge; 3) Describe the physical condition of entrained fishes; and 4) Estimate survival of entrained fishes.

2.2. Relevant Resource Management Goals - §5.9(b)(2) — *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

ODFW's Native Fish Conservation Policy mandates considering the biology and population status of wild and naturally producing fish when making resource and management decisions. This policy directs ODFW to "prevent the serious depletion of any indigenous fish species through the protection of native ecological communities, the conservation of genetic resources,... such that fish production is sustainable over the long term" (OAR 635-07-0503). Consistent with these objectives, ODFW can recommend the installation of screening or by-pass devices on water diversions to protect fish. ODFW's mission is to "provide diverse recreational opportunities for present and future generations". In certain waterbodies, including Prineville Reservoir, this is achieved through hatchery stocking programs and warmwater game fish management (OAR635-500-0055). Angling opportunity and success in the Reservoir is compromised by entrainment through the unscreened outlet.

The State of Oregon's fish screen law (Oregon Revised Statute 498.306) requires the owner or operator of a diversion located in waters in which native and naturally spawning fish are currently present to address

fish screen requirements. ODFW recommends the Applicant to conduct an entrainment study to provide data to document how native resident and migratory fish and non-native fish are migrating out of the reservoir, and identify the timing and magnitude of passage. No data is available that describes fish entrainment in the water outlet used at the Bowman Dam.

By assembling the entrainment rates gained from this study, the description of dam facility operation, and information on fish distribution and abundance in the reservoir, the Applicant can report potential entrainment during downstream migration under current conditions. This study will help describe the effect of project operations on fish populations. ODFW will use this information to make recommendations as to whether the yet-to-be proposed mitigation will result in no net loss to fish populations. ODFW will also use this information to develop and implement strategies for fish management.

Proposals and construction of new hydroelectric projects in the State of Oregon are subject to state regulation. ORS 543 governs new projects and sets minimum standards for development of hydroelectric projects. A new project cannot be approved by the state if the project will cause a net loss of wild game fish, unless the losses are mitigated. ODFW considers information on downstream fish passage to be important for concluding whether the applicant can construct the project to meet the minimum standards for developing hydroelectric power in Oregon.

2.3 Background and Existing Information - *§5.9(b)(4) — Describe existing information concerning the subject of the study proposal, and the need for additional information*.

A literature review of fish entrainment risk at hydroelectric facilities for the Carmen Smith Hydroelectric Project (Stillwater 2005) concluded, "A major source of direct and indirect mortality for certain fish populations residing in the vicinity of hydroelectric projects is the physical damage or stress individuals incur as they attempt passage through hydropower facilities (OTA 1995, NRC 1996, Cada et al. 1997, all cited in Coutant and Whitney 2000)." (Stillwater Sciences 2005). The authors of the fish entrainment review concluded that, "As an alternative to conducting site-specific evaluations, making confident inferences from other studies about the rate of entrainment-related mortality or injury is not broadly supported by the literature. As noted in the EPRI (1992) study, the limited number of observations and substantial variability between studies precludes establishing a predictive relationship between turbine mortality and variables such as fish size, turbine head and peripheral runner speed associated with the turbine structure itself. In particular the authors caution that variability between different studies designed to examine relationships between fish size, species, and mortality or injury rates makes forming simple conclusions difficult and risky (EPRI 1992). There was generally little or no agreement on the relative contribution to entrainment "risk" of physical attributes associated with hydropower facilities, including: the type of turbine; the efficiency of turbines as operated; the capacity in terms of flow volume; the size, depth, and approach velocities at the intake; or the dimensions and turnover rate of the reservoir (FERC 1995, EPRI 1992). The significance of a given feature at one facility may be less at another, and there is no statistically valid way to assign a quantitative entrainment risk for a given condition.

In the evaluation of studies at 46 hydropower facilities, variability in entrainment results between projects allowed little statistical basis for extrapolation of study results to untested facilities (FERC 1995). The one specific example most relevant to the objectives of this review done for the Chester Morse Reservoir complex on the Cedar River, Washington, found very little basis for making reliable estimates of entrainment rates from other studies (Knutzen 1997). These estimates of entrainment rates spanned two orders of magnitude."

There are desk analysis of existing data used at some project developments, including one collected as part of an earlier Bowman Dam Hydropower FERC application (Symbiotics LLC. - FERC No 11925). However, as indicated by the Stillwater Sciences review and per ODFW's review it is not one that ODFW feels is an adequate methodology.

The outlet from Prineville Reservoir is a hypolimnetic release of water from the bottom of the reservoir. This structure is unscreened and enables an unquantified level of entrainment of fish from the reservoir into the lower Crooked River. High emigration rates appear to coincide with severe drawdown (Stuart et. al 1996). Entrainment of hatchery rainbow trout and non-native warmwater species are of primary concern. Hatchery rainbow trout may successfully spawn in the lower river resulting in genetic introgression with wild redband trout. This could lead to reduced viability of the native population. Additionally, the consumptive trout fishery in Prineville Reservoir has declined in recent years. This is largely due to interspecific competition with illegally introduced species. However, losses to entrainment are cumulative with other depressing factors on the Reservoir trout fishery. Entrained warmwater fish compete with native fish for available forage, distribute pathogens and disrupt the aquatic ecology. Currently no information exists on entrainment of fish from the reservoir into the stream below the dam. ODFW will require this information to assess the potential impacts of Project operation, and determine whether the Project can be constructed and operated consistent with state law. This information will assist ODFW in making management decisions for native and non-native game fish affected by the Project and assessing mitigation measures proposed by the Applicant.

2.4 Project Nexus - §5.9(b)(5) — ***Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.***

By assembling the entrainment rates obtained from this study, the description of dam facility operation, and information on fish distribution and abundance in the reservoir (study request #1), the Applicant can report potential entrainment during downstream migration under current conditions. This study will help describe the effect of project operations on fish populations. . ODFW will also use this information to develop and implement strategies for fish management. The entrainment study is necessary to provide data for ODFW to quantify the impacts of Project operation on native game fish**.** ODFW will use this information to make recommendations as to whether the yet-to-be proposed mitigation will result in no net loss to native game fish populations. ODFW will also use this information to determine the need for fish screens, and to develop and implement management strategies for fish management such as trapping, sorting, and relocating warm water game fish. Proposals and construction of new hydroelectric projects in the State of Oregon are subject to state regulation. ORS 543 governs new projects and sets minimum standards for development of hydroelectric projects. ODFW considers information on downstream fish passage to be important for concluding whether the applicant can construct the project to meet the minimum standards for developing hydroelectric power in Oregon.

It's the policy of the state of Oregon (ORS 543.015): 1) to protect the natural resources of the state from possible adverse impacts caused by the use of the waters of this state for the development of hydropower; 2) to permit siting of hydroelectric projects subject to strict standards established to protect the natural resources; and. 3) to participate to the fullest extent in federal proceedings related to hydroelectric power development in order to protect the natural resources of Oregon". Assessment of current out-migration of fishes from the reservoir and potential turbine-related mortality is therefore necessary to determine the potential impacts of entrainment on these resources and eventually to work toward an acceptable form of mitigation to compensate for these impacts.

2.5 Proposed Methodology - §5.8(b)(6) — *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field seasons(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

The methodology involves operating a rotating screw trap immediately downstream from the dam to sample and estimate the numbers of fish exiting the reservoir. To the extent possible ODFW recommends year round trap operation to monitor emigration rates at variable release flows and reservoir pool levels. Location of the trap will be critical in facilitating adequate efficiency rates to quantify entrainment levels. The trap should be located as close to the outlet structure as possible where water depth is adequate for screw rotation at variable flows. We recommend the trap be anchored utilizing an overhead cable system with blocks and pulleys. This will enable moving the trap to optimize efficiency.

A floating, 5-foot or 8-foot rotary downstream migrant collector, or screw trap, would be used to address Objectives 1, 2, and 3. The size of the trap used would depend on the water depth at the site during base flows. These types of traps are commonly used in reservoir entrainment and salmon smolt out-migrant studies (McLemore et al. 1989, Downey and Smith 1990, Thedinga et al. 1994, Roper 1995, Demko et al. 2000). The trap should be installed as close to the outlet as possible to reduce potential incursion from the river. Trap installation and operation would be coordinated with ODFW biologists. It is anticipated that the screw trap would be operated most days per week as necessary to obtain statistically robust estimates of fish entrainment for the duration of the study.

It may be necessary to construct a weir isolating the trapping site from upstream migrating redband trout and whitefish. These fish may be attracted to release flows from the outlet particularly during spawning periods in the spring (redband) and fall (whitefish). Capture of these fish would distort results Calibration of trapping efficiency would be achieved by periodic, upstream releases of a known number of different sized, group marked - fish obtained from the trap. Different marks would be used on alternating days. Calibration releases would occur opportunistically depending on the availability of fish and changes in flow releases and reservoir elevation. The intent would be to determine trap efficiency for various sizes of each species over a broad range of stream discharges and to apply the appropriate flow-related efficiency correction factor to each sampling week based on mean flow during that week.

Estimation of the total number of fishes annually passing the trap would be achieved using the following formula (modified from http://oregonstate.edu/Dept/ODFW/life-cycle/TRPMETH3.HTM).

$$Nt\sim = r.N\sim = (n\ )/(mrecap/mreD$$

where: N~ = total number of migrants passing the trap during week i

n~ = number of unmarked fish caught in the trap during week i

mrecapt = number of marked fish recaptured during week i

mre~ = number of marked fish released above the trap during week i

The trap would be checked in the morning because downstream migration is often most intense after dusk. Traps may be checked more than once each day, if necessary, during periods of intense out-migration. All fishes of a particular species would be classified into estimated size categories as proposed by the applicant and conditional upon approval by ODFW. The intent of this technique would be to reduce handling stress that would be incurred if actual length measurements were taken. AQUI-S would

be used as an anesthetic as fishes will be released. The physical condition of captured fishes under existing operational conditions would be assessed using protocol described by Downey and Smith (1990) via three general categories: uninjured, injured, and dead on arrival. The physical condition of each injured fish will be evaluated using a general description of the type and location of a particular injury. Opportunistically, a random sample of injured and uninjured fish will be held in a floating live box for a period of 72 hours to estimate delayed mortality by species and life stage, if possible. Surviving fishes would be released downstream of the screw trap. This information would be vital toward assessing background survival rates of fishes exiting the reservoir under current operations.

This type of analysis is consistent with other fish protection analyses completed during licensing proceedings for hydroelectric projects.

While a desk analysis of existing data used at some project developments, including one collected as part of an earlier Bowman Dam Hydropower FERC application (Symbiotics LLC. - FERC No 11925) are available, it is not one that ODFW believes is an adequate methodology and therefore we recommend that data be collected onsite using field sampling methods consistent with generally accepted practices in the scientific community, such as the use of screw traps with a statistically robust sampling schedule, both weekly and seasonally.

A similar entrainment study was conducted by Symbiotics LLC as part of the proposed Wickiup Dam Hydropower Project (FERC Project No. 12965-002).

2.6 Level of Effort and Cost - §5.9(b)(7) — *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

OID will need to obtain a scientific taking permit from ODFW. In the best of conditions the study would be designed, permits obtained, and field studies initiated before the end of 2020. The highest magnitude of fish migration may coincide with reservoir drawdown in the fall. Therefore, OID should begin the study in fall of 2020 and continue through the fall drawdown of the reservoir in 2021, with results reported by December of 2021 or if three years of data are collected, December of 2022.

The total cost for conducting the analysis and preparing the report is estimated to be approximately $100,000. Two analysts would be expected to work for approximately 7 days a week, 4 hours a day on the collection of data. Additionally, two analysts would be expected to work for approximately twenty days preparing the draft report and final report.

The evaluation of anadromous fish habitat above Bowman Dam study would be completed during the 2020 study season with the draft annual report available for comment by the federal agencies and ODFW prior to December 31 for each year of the study.

Study 3 Turbine Passage Survival Analysis

3.1 Goals and Objectives - §5.9(b)(1) — *Describe the goals and objectives of each study proposal and the information to be obtained*

The U. S. Bureau of Reclamation (USBR) and Ochoco Irrigation District currently manage Bowman Dam operations primarily for irrigation storage, recreation and fish and wildlife. With the potential of hydroelectric development there is the potential for entrainment of fish through the proposed hydro-turbines. This potential entrainment is a resource issue requiring further analysis.

The proposed study would analyze the seasonal water-year rule-curve, as well as the annual variation associated with the range of low runoff years and high runoff years and how this affects the depth of the pool over the intake structure and the effects on the rates of entrainment. ODFW suspects that as pool elevation decreases entrainment may be more likely (ODFW 1996).

Additional specific concerns include determining what time of year oxygen and other water quality parameters might limit fish access to the outlet intake which might to some degree decrease entrainment potential. ODFW recommends seasonal temperature, pH and oxygen profiles be compiled to investigate this potential.

ODFW recommends that OID conduct an analysis of annual variation of the reservoir water level for mean, dry, and wet years. ODFW recommends modeling how future operational changes that may be contemplated will affect the reservoir rule curves for filling and discharging. Changes due to natural variation of the hydrograph and changes to the operating rule curve for the project may affect reservoir water quality, elevation, magnitude and condition and of entrained fish.

The proposed Project turbine configuration includes installing two vertical Francis turbines. It is unclear what the operational head range of the project would be. ODFW recommends that the report include an analysis of the operational range of head, including a generation exceedance curve. The report should also include an analysis of the magnitude of fish passage at various pool elevations (and head), turbine efficiency, and the predicted effects on fish.

The proposed Project will use the dams' existing deep-water intake. Resident fish that have acclimated to those depths and abruptly pass downstream through the existing intake would likely experience mortality due to sudden pressure changes, as the rapid transit time does not allow sufficient time for fish to make adjustments in swim bladder volume to accommodate pressure changes (Cada 1990). Fish that are not acclimated to depths may survive passage at a higher rate, which raises concern regarding survival of non-native fish species and hatchery-raised trout impacting anadromous fish present in the system, once they are entrained through the intake.

3.2 Relevant Resources Management Goals - §5.9(b)(2) — *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

ODFW has multiple resource management goals derived from Oregon statute and adopted rules that guide our recommendations in hydro licensing processes. Permeating each of these policies is the goal of protecting and restoring native fish and wildlife populations for use and enjoyment by present and future generations. Key directives to ODFW for implementing fish and wildlife management strategies include; avoidance of impacts to these populations, protection of genetic diversity, and protection and restoration of natural habitats on which these populations are dependent.

Oregon's fish screen law (Oregon Revised Statute 498.306) may require the owner or operator of a diversion located in waters in which native and naturally spawning fish are currently present to address fish screen requirements.

3.3 Background and Existing Information - §5.9(b)(4) — *Describe existing information concerning the subject of the study proposal, and the need for additional information.*

The proposed project would utilize the USBR's Bowman Dam, which is operated for irrigation storage and flood control. The dam is an earth-fill structure with a height of 245 feet, crest length of 800 feet, and a spillway consisting of an uncontrolled-crest inlet structure, discharge chute, and stilling basin. The

outlet has a 120-foot deep intake structure with an 11-foot diameter circular tunnel upstream from the gate chamber, an 11-foot, modified horseshoe tunnel downstream from the gate chamber, and a stilling basin shared with the spillway. While the outlet is located at a depth of 120 feet, this elevation is not constant. Intake depth may be 120 feet at full pool, but when the pool elevation is reduced, which occurs often, the depth of the outlet is reduced as well.

The proposed Project turbine configuration includes installing two vertical Francis turbines. It is unclear what the operational head range of the project would be. ODFW recommends that the report include an analysis of the operational range of head, including a generation exceedance curve. The report should also include an analysis of the magnitude of fish passage at various pool elevations (and head), turbine efficiency, and the predicted effects on fish.

The proposed Project will use the dams' existing deep-water intake. Resident fish that have acclimated to those depths and abruptly pass downstream through the existing intake would likely experience mortality due to sudden pressure changes, as the rapid transit time does not allow sufficient time for fish to make adjustments in swim bladder volume to accommodate pressure changes (Cada 1990). Fish that are not acclimated to depths may survive passage at a higher rate, which raises concern regarding survival of non-native fish species and hatchery-raised trout impacting anadromous fish present in the system, once they are entrained through the intake.

As a part of an earlier desktop study for a previous Bowman dam hydropower application (Kleinschmidt 2012), data when graphed, shows larger fish have a better chance of survival. This point relates directly back to ODFW's concerns about non-native and hatchery-raised fish being passed through the intake and surviving in the river, below Bowman Dam. ODFW knows this currently occurs and does not want to have a situation created that would increase the number of these undesirable fish species where they would negatively impact re-introduction and establishment of anadromous fish in the Crooked River.

As previously mentioned, while some data is available from the Kleinschmidt desktop study, there is a need to address a number of variables that were omitted or not considered as a part of the study. Additionally it is important that the information collected as part of this study be paired with the results of the Study 2: Prineville Reservoir Fish Entrainment Study, which will provide field data obtained via, e.g. screw trap sampling or other sampling methods relative the turbine strike potential impacts. .

3.4 Project Nexus - §5.9(b)(5) — *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

ODFW has multiple resource management goals derived from Oregon statute and adopted rules that guide our recommendations in hydro licensing processes. Permeating each of these policies is the goal of protecting and restoring native fish and wildlife populations for use and enjoyment by present and future generations. Key directives to ODFW for implementing fish and wildlife management strategies include; avoidance of impacts to these populations, protection of genetic diversity, and protection and restoration of natural habitats on which these populations are dependent.

3.5 Proposed Methodology - §5.8(b)(6) — *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field seasons(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

While a desk analysis of existing data used at some project developments, including one collected as part of an earlier Bowman Dam Hydropower FERC application (Symbiotics LLC. - FERC No 11925) are

available, it is not one that ODFW believes is fully comprehensive and inclusive of the all necessary information to fully inform the turbine strike analysis effects.

The report should analyze the seasonal water-year rule-curve, as well as the annual variation associated with the range of low runoff years and high runoff years and how this affects the depth of the pool over the intake structure and the effects on the rates of entrainment. ODFW suspects that as pool elevation decreases entrainment may be more likely (ODFW 1996).

3.6 Level of Effort and Cost - §5.9(b)(7) — *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

The study would be done during first year of the TLP study period. Two analysts would be expected to work for approximately 30 days on the analysis and report preparation. The total cost for conducting the analysis and preparing the report is estimated to be approximately $20,000

Study 4 Crooked River Tailwater Benthic Invertebrate Study

4.1 Goals and Objectives - §5.9(b)(1) — *Describe the goals and objectives of each study proposal and the information to be obtained*

It is anticipated project construction may result in elevated sediment and turbidity levels in the Crooked River below Bowman Dam, despite efforts by OID to isolate the work area and contain sediment. Fine sediment in deposits or in suspension can reduce primary production and invertebrate abundance and thus can affect the availability of food within a stream (Cordone and Kelley 1961). The high densities of redband trout in this reach and extremely high combined biomass of redband trout and mountain whitefish is largely a result of the productive and diverse macroinvertebrate community.

The objectives of the study would be to collect information on the benthic invertebrate community in the Crooked River downstream of Bowman dam in respect to their habitat use and potential vulnerability to ramping and flow fluctuations associated with e propose hydropower operations. This study would complement the proposed Study 7 regarding flow ramping and flow fluctuation evaluations.

4.2 Relevant Resource Management Goals - §5.9(b)(2) — *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

ODFW's trout management policy identifies habitat protection, rehabilitation and enhancement as essential to maintaining wild trout production and are the primary management activities. It further states the productive capacity of waters will be maintained or enhanced so no net loss of natural production occurs (OAR 635-500-0105 and 0115.). Maintaining an adequate prey base is essential to meeting these goals and objectives.

ODFW has multiple resource management goals derived from Oregon statute and adopted rules that guide our recommendations in hydro licensing processes. Permeating each of these policies is the goal of protecting and restoring native fish and wildlife populations for use and enjoyment by present and future generations. Key directives to ODFW for implementing fish and wildlife management strategies include; avoidance of impacts to these populations, protection of genetic diversity, and protection and restoration of natural habitats on which these populations are dependent.

4.3 Background and Existing Information - §5.9(b)(4) — *Describe existing information concerning the subject of the study proposal, and the need for additional information.*

Flow fluctuations generated from ramping at hydroelectric facilities for operational purposes can cause increased velocities and shear stress, bedload mobilization, and scour, all of which can contribute to decreases in species abundance, richness, and diversity. Decreases in invertebrate community measures can result from the initial physical disturbance causing increased macroinvertebrate drift, but can also result from changes in the community structure caused by response to chronic flow fluctuations. Over time, species that are more vulnerable to stranding and desiccation from lateral water surface changes or those more susceptible to entrainment during increased flows may be replaced by more tolerant species, thus altering community indices.

4.4 Project Nexus - §5.9(b)(5) — ***Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.***

Studies of benthic invertebrates have been used to evaluate aspects of ecosystem management including ecological integrity, ecosystem stability and aquatic system function (Reice and Wohlenberg 1993). The information on will be used to help inform the potential impacts of ramping rate considerations for the proposed Project.

4.5 Proposed Methodology - §5.8(b)(6) — ***Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field seasons(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.***

Preferably the study would be done over a three year period prior to construction, however if necessary it could be scaled back to a two year study period.

Benthic invertebrate sampling is a critical component to evaluating habitat quality relative to fish productivity. Indices such as the proposed Hilsenhoff Biotic Index (Hilsenhoff 1988) have been successfully used because they incorporate a biological response to environmental conditions. Studies of benthic invertebrates have been used to evaluate aspects of ecosystem management including ecological integrity, ecosystem stability and aquatic system function (Reice and Wohlenberg 1993). This type of analysis is consistent with other fish protection analyses completed during licensing proceedings for hydroelectric projects that have the potential to adversely affect resident and anadromous salmonids and ESA-listed fish species.

4.6 Level of Effort and Cost

The study would be done over a two year period prior to construction. The study is estimated to require two employees for a period of 15- 20 days on the field investigations. Two analysts would be expected to work for approximately 5 - 10 days on the analysis and report preparation. The total cost for conducting the analysis and preparing the report is estimated to be approximately $20,000

Study 5. Evaluation of Fish Passage Options at Arthur R Bowman Dam.

5.1 Goals and Objectives - §5.9(b)(1) — ***Describe the goals and objectives of each study proposal and the information to be obtained***

This study would be designed to exam of options to meet the stated goal of "utilizing habitat above Bowman Dam to support reintroduced populations of steelhead trout and spring Chinook salmon." The evaluation of installation and operation of fish passage facilities at Bowman Dam is necessary as part of

OID's proposed Bowman dam hydroelectric Project. This study would identify the various options available for providing fish passage at Bowman Dam, including evaluating at a preliminary level the technical, financial, biological, and operational implications of each option. Engineering plans should be developed to safely accommodate fish passage both upstream and downstream at variable discharge flows and reservoir levels. Criteria used in designing passage facilities should be in compliance with specifications outlined by the National Marine Fisheries Service for streams inhabited by anadromous fish.

Anadromous fish access to the upper Crooked River and its tributaries has been blocked since construction of the Pelton-Round Butte Dam complex in 1958-1964 and Bowman Dam in 1961. The upper basin above Bowman dam currently supports native redband trout, and is has the capacity of supporting reintroduced anadromous salmonid fishes as well. Ongoing efforts to re-establish steelhead trout and spring Chinook salmon above the Pelton Round Butte Project combined with the providing of fish passage at the Opal Springs Hydroelectric Project (as of August of 2019) and other barriers on the mainstem Crooked River below Bowman Dam give both species access to Crooked River upstream as far as Bowman Dam. Fish passage at the dam could extend the ranges of both species into the upper Crooked River watershed.

5.2 Relevant Resources Management Goals - §5.9(b)(2) — *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

ODFW's Crooked River Basin Plan identifies reconnecting isolated and fragmented populations of redband trout by restoring and improving passage over manmade barriers as a goal (OAR 635-500-1850c). Prior to the construction of Bowman Dam, the upper Crooked River was inhabited by anadromous mid-Columbia spring Chinook Salmon (Onchorynchus tshawystcha) and summer steelhead (Onchorynchus mykiss irideus). These species persisted in the lower Crooked River until the construction of the Pelton-Round Butte Dam complex in 1958-1964. Through relicensing of this FERC project, the joint applicants are proposing the reintroduction of both chinook and steelhead into the Crooked River subbasin. The Basin Plan further states the goal of restoring anadromous and migratory resident migratory fish to their historic range in the Crooked River basin by improving upstream and downstream passage over artificial barriers OAR 635-500-1850b. The Basin Plan also directs evaluating passage over Ochoco and Bowman dams, if passage is restored successfully over Pelton, Round Butte and Opal Springs hydroelectric dams.

5.3 Background and Existing Information - §5.9(b)(4) — *Describe existing information concerning the subject of the study proposal, and the need for additional information.*

ODFW is not aware of any other information available pertaining to this study proposal other than comparable studies on other hydropower projects or potential passage projects. One example of a very similar study entitled "Evaluation of Fish Passage Options for Ochoco Dam" was completed in 2014 as part of the Upper Deschutes Basin Habitat Conservation Plan. (R2 Resource Consultant, Inc. and Biota Pacific Environmental Sciences, Inc. 2014)

5.4 Project Nexus - §5.9(b)(5) — *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

The State of Oregon recognizes the importance of passage to the continued persistence and viability of migratory resident and anadromous fish species (ORS 498.351 and 509.605). It is the policy of the State to provide for upstream and downstream passage for native migratory fish. Fish passage is required in all

waters of the state in which native migratory fish are currently or have been historically present. A person owning or operating an artificial obstruction may not construct or maintain any artificial obstruction across waters inhabited by native migratory fish (ORS509.585). This statute further directs ODFW to "direct its enforcement authority toward priority projects, emergencies and 'triggers'". In this case, the trigger is the conversion of an existing structure to include hydroelectric facilities (fundamental change in permit status). Given this mandate, the owner and or operator of the facility has three alternatives a) submit a proposal for fish passage to ODFW, b) apply to the Fish and Wildlife Commission for a waiver demonstrating alternatives to fish passage that provide a net benefit to native migratory fish or c) file for an exemption with the Commission under subsection 9 ORS 509.585.

The information resulting from this study can be used by the Applicant in respect to potential options and providing fish passage at Bowman dam and/or the option of applying to ODFW for a fish passage waiver. The information gathered from this study will ODFW to likewise assess the fish passage options for the proposed Project and help guide ODFW in advising and analyzing the merits of any proposed fish passage option that OID may pursued.

5.5 Proposed Methodology - §5.8(b)(6) — ***Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field seasons(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.***

Engineering plans should be developed to safely accommodate fish passage both upstream and downstream at variable discharge flows and reservoir levels. Criteria used in designing passage facilities should be in compliance with specifications outlined by the National Marine Fisheries Service for streams inhabited by anadromous fish.

This study would provide a preliminary evaluation of the various options and implications of providing fish passage past Bowman Dam, the ability of these options to function within the established operational regime for Bowman Dam, and an initial planning level opinion of probable capital and operational cost for the alternatives. Technical considerations would be based on: 1) limited examination of Bowman Dam and the Crooked River channel, 2) information provided by OID and BOR, and 3) comparison with similar fish passage systems in the region.

This type of analysis is consistent with other fish protection analyses completed during licensing proceedings for hydroelectric projects that have the potential to adversely affect resident and anadromous salmonids and ESA-listed fish species.

5.6 Level of Cost and Effort

The evaluation of fish passage options at Arthur R Bowman Dam study analysis report preparation is estimated at $30,000. Two analysts would be expected to work for approximately 10-12 days on the analysis. Additionally, two analysts would be expected to work for approximately 7 – 14 days on the field investigations and two analysts would be expected to work for approximately two days incorporating agency comments into the final report.

The evaluation of anadromous fish habitat above Bowman Dam study would be completed during the 2020 study season with the draft report available for comment by the federal agencies and ODFW prior to December 31, 2020.

Study 6. Evaluation of Anadromous Fish Habitat above Bowman Dam

6.1 Goals and Objectives - §5.9(b)(1) — *Describe the goals and objectives of each study proposal and the information to be obtained*

Information and analyses of salmonid fish spawning and rearing habitats along with riparian assessments, water quality, water temperature, and hydrological data above Bowman Dam would be reviewed and summarized. To the extent supported by the existing information, a summary of: 1) total area of habitat, and 2) the relative quality of habitat to produce summer steelhead trout and spring Chinook salmon, was prepared. Existing limitations and/or impairments to habitat described in existing documents, such as unscreened diversions and blockages to fish movement, would also be note

6.2 Relevant Resources Management Goals - §5.9(b)(2) — *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

ODFW's wildlife policy (ORS 496.012) establishes wildlife management policy to prevent serious depletion of any indigenous species and maintain all species of fish and wildlife at optimum levels. The wildlife diversity program's goal is to maintain Oregon's wildlife diversity by protecting and enhancing populations and habitats of native wildlife at self-sustaining levels throughout natural geographic ranges (OAR 635-100-0010). The Fish and Wildlife Habitat Mitigation Policy (OAR 635-415-0010) requires or recommends, depending upon the habitat protection and mitigation opportunities provided by specific statutes, mitigation for losses of fish and wildlife habitat resulting from development actions.

ODFW has multiple resource management goals derived from Oregon statute and adopted rules that guide our recommendations in hydro licensing processes. Permeating each of these policies is the goal of protecting and restoring native fish and wildlife populations for use and enjoyment by present and future generations. Key directives to ODFW for implementing fish and wildlife strategies include; avoidance of impacts to these populations, protection of genetic diversity, and protection and restoration of natural habitats on which these populations are dependent.

ODFW's Crooked River Basin Plan identifies reconnecting isolated and fragmented populations of redband trout by restoring and improving passage over manmade barriers as a goal (OAR 635-500-1850c). Prior to the construction of Bowman Dam, the upper Crooked River was inhabited by anadromous mid-Columbia spring Chinook Salmon (Onchorynchus tshawystcha) and summer steelhead (Onchorynchus mykiss irideus). These species persisted in the lower Crooked River until the construction of the Pelton-Round Butte Dam complex in 1958-1964. Through relicensing of this FERC project, the joint applicants are proposing the reintroduction of both chinook and steelhead into the Crooked River subbasin. The Basin Plan further states the goal of restoring anadromous and migratory resident migratory fish to their historic range in the Crooked River basin by improving upstream and downstream passage over artificial barriers OAR 635-500-1850b. The Basin Plan also directs evaluating passage over Ochoco and Bowman dams, if passage is restored successfully over Pelton, Round Butte and Opal Springs hydroelectric dams.

6.3 Background and Existing Information - §5.9(b)(4) — *Describe existing information concerning the subject of the study proposal, and the need for additional information.*

Anadromous fish access to the upper Crooked River and its tributaries has been blocked since construction of the Pelton-Round Butte Dam complex in 1958-1964 and Bowman Dam in 1961. The upper basin above Bowman dam currently supports native redband trout, and is has the capacity of supporting reintroduced anadromous salmonid fishes as well. Ongoing efforts to re-establish steelhead trout and spring Chinook salmon above the Pelton Round Butte Project combined with the providing of fish passage at the Opal Springs Hydroelectric Project (as of August of 2019) and other barriers on the

mainstem Crooked River below Bowman Dam give both species access to Crooked River upstream as far as Bowman Dam. Fish passage at the dam could extend the ranges of both species into the upper Crooked River watershed.

6.4 Project Nexus - §5.9(b)(5) — *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements*

The State of Oregon recognizes the importance of passage to the continued persistence and viability of migratory resident and anadromous fish species (ORS 498.351 and 509.605). It is the policy of the State to provide for upstream and downstream passage for native migratory fish. Fish passage is required in all waters of the state in which native migratory fish are currently or have been historically present. A person owning or operating an artificial obstruction may not construct or maintain any artificial obstruction across waters inhabited by native migratory fish (ORS509.585). This statute further directs ODFW to "direct its enforcement authority toward priority projects, emergencies and 'triggers'". In this case, the trigger is the conversion of an existing structure to include hydroelectric facilities (fundamental change in permit status). Given this mandate, the owner and or operator of the facility has three alternatives a) submit a proposal for fish passage to ODFW, b) apply to the Fish and Wildlife Commission for a waiver demonstrating alternatives to fish passage that provide a net benefit to native migratory fish or c) file for an exemption with the Commission under subsection 9 ORS 509.585.

The information resulting from this study can be used by the Applicant in respect to potential options and providing fish passage at Bowman dam and/or the option of applying to ODFW for a fish passage waiver. The information gathered from this study will ODFW to likewise assess the fish passage options for the proposed Project and help guide ODFW in advising and analyzing the merits of any proposed fish passage option that OID may pursued.

6.5 Proposed Methodology - §5.8(b)(6) — *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field seasons(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

The biological potential of the upper basin can be derived from available Federal, State, and local resource agency information and reports of habitat conditions for flowing waters upstream of Prineville Reservoir. Habitat assessments conducted by the USFS, by ODFW for their Deschutes River and Crooked River Fish Management Planning efforts, by the Northwest Power and Conservation Council in preparation of the Deschutes Subbasin Plan (NPCC 2004) and watershed assessments performed by the Crooked River Watershed Council (CRWC). Other potential information on exists on water quality, streamflow, water temperature, and fish passage data gathered from ODEQ, ODFW, the CRWC, US Geological Survey, Watershed Sciences, and Portland General Electric.

Information and analyses of salmonid fish spawning and rearing habitats along with riparian assessments, water quality, water temperature, and hydrological data above Bowman Dam would be reviewed and summarized. To the extent supported by the existing information, a summary of: 1) total area of habitat, and 2) the relative quality of habitat to produce summer steelhead trout and spring Chinook salmon, was prepared. Existing limitations and/or impairments to habitat described in existing documents, such as unscreened diversions and blockages to fish movement, would also be noted.

This type of analysis is consistent with other fish protection analyses completed during licensing proceedings for hydroelectric projects that have the potential to adversely affect resident and anadromous salmonids and ESA-listed fish species.

6.6 Level of Cost and Effort - §5.9(b)(7) — *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

The total cost for conducting the analysis and preparing the report is estimated to be approximately $35,000. Two analysts would be expected to work for approximately 30 days on the analysis. Additionally, two analysts would be expected to work for approximately 7 – 14 days on the field investigations and two analysts would be expected to work for approximately two days incorporating agency comments into the final report.

The evaluation of anadromous fish habitat above Bowman Dam study would be completed during the 2020 study season with the draft report available for comment by the federal agencies and ODFW prior to December 31, 2020.

Study 7. Ramping and Flow Fluctuations Evaluation/Study

7.1 Goals and Objectives - §5.9(b)(1) — *Describe the goals and objectives of each study proposal and the information to be obtained*

ODFW's objective for seeking this ramping rate information is to better predict the potential impacts of the Project operations on downstream macroinvertebrate and native fish populations and their habitat.

Hydroelectric facilities typically have the capability of increasing and decreasing flow levels downstream of the facilities. In general, the rate at which these changes occur is called the "ramp rate" or "ramping." From a fisheries perspective, ramping down the river flow has the potential to strand fish in areas of the channel that are relatively low-gradient, or where pockets or side channels exist in the river channel. Stranding is defined as the separation of fish from flowing water as a result of declining river stage from rapid decreases in flow ("down-ramping"). Smaller juvenile fish (less than about 50 mm long) are most vulnerable to potential stranding because of weak swimming ability and typical habitat preference. River channel configuration, channel substrate type, time of day, water temperature, and flow level before down-ramping (antecedent flow) are also key factors that determine stranding incidence. Artificial flow fluctuations from hydroelectric power operations can create a varial zone on the streambed where the biomass of algae and macroinvertebrates can be significantly reduced, especially if low-gradient riffle areas are dewatered frequently. Because macroinvertebrates are the primary food source for most riverine fish, extreme flow fluctuations can adversely affect fish growth in streams where the fish population is food-limited. Also, changes in flow that are too great or frequent can disrupt fish spawning success and dewater eggs incubating in the streambed gravels. Therefore, it is important to consider the season as well as the rate and magnitude of flow change when developing ramping regimes that minimize adverse impacts on fish.

The purpose of this study is to evaluate the potential for adverse fisheries and benthic macroinvertebrate impacts associated with current ramping regimes in each of the river reaches affected by the proposed hydroelectric Project. The objectives addressed by this set of studies are as follows:
• Describe the extent of potential flow fluctuations in terms of rate of stage change (ramp rate) and frequency in the riverine reaches of the Crooked River as affected by Project operations.
• Describe the physical extent of streambed habitat affected by proposed operations in the Crooked River reaches downstream of Bowman dam,
• Describe the potential for down-ramping to strand fish. Verify this with field observations in the river reaches downstream of Bowman dam.
• Characterize the potential impacts of Project ramping on fish resources.

The study would identify critical sites the river where there exists a high risk of juvenile salmonid (Redband Trout and Mountain Whitefish) stranding, such as near gravel and sand bars, shallow side channels and pools. It would determine stage-discharge relationships which provide the conversion of flow (always known and controlled within a hydroelectric facility) and stage (the underlying factor affecting fish stranding). The study would further determine lag time. This being the time a "parcel" of water takes to travel in the natural watercourse from either the intake or tailrace to each critical site. Several lag times should be determined at different flows. The study would determine stage attenuation. Commonly referred to as flow routing, stage attenuation refers to the damping (or smoothing) of flow and stage changes as water moves downstream. Stage attenuation would be determined for a range of flows.

7.2 Relevant Resources Management Goals - §5.9(b)(2) — *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

This investigation is intended to provide baseline information that, together with environmental data and results of other past and ongoing studies, can be used to assess effects of Project operations on fish resources and to help formulate recommendations for protection, mitigation, and enhancement measures consistent with agency and tribal management goals.

ODFW's wildlife policy (ORS 496.012) establishes wildlife management policy to prevent serious depletion of any indigenous species and maintain all species of fish and wildlife at optimum levels. The wildlife diversity program's goal is to maintain Oregon's wildlife diversity by protecting and enhancing populations and habitats of native wildlife at self-sustaining levels throughout natural geographic ranges (OAR 635-100-0010). The Fish and Wildlife Habitat Mitigation Policy (OAR 635-415-0010) requires or recommends, depending upon the habitat protection and mitigation opportunities provided by specific statutes, mitigation for losses of fish and wildlife habitat resulting from development actions.

Additionally, ODFW has multiple resource management goals derived from Oregon statute and adopted rules that guide our recommendations in hydro licensing processes. Permeating each of these policies is the goal of protecting and restoring native fish and wildlife populations for use and enjoyment by present and future generations. Key directives to ODFW for implementing fish and wildlife strategies include; avoidance of impacts to these populations, protection of genetic diversity, and protection and restoration of natural habitats on which these populations are dependent.

7.3 *Background and Existing Information*

Quickly increasing or reducing reservoir releases for potential hydropower operations can impact downstream fish and wildlife populations. Changes to reservoir releases should be designed towards a more gradual release schedule that provides more opportunity for an appropriate downstream fish response.

The rate of change of streamflow over a specified time when diversion is started, stopped, or changed is referred to as the ramping rate. Ramping rate is a concern for fish protection because rapid decrease in flow can strand fish on gravel bars, trap fish in disconnected channels or pools, and dewater fish eggs. In some river systems drops in flow, even as little as 1 inch of water surface elevation per hour, can impact fish populations. Other effects, including depletion of aquatic invertebrates on which fish feed, behavioral responses to changes in flow, and impacts to water quality may also reduce fish production but are not as well understood. The impacts of flow fluctuation may be reduced by specifying the ramping rate and times during the day and year when those ramping rates would apply. Usually, ramping recommendations are in inches or tenths of a foot per hour of water elevation (stage) change.

Ramping transects are evaluated to determine the maximum rate of flow change to meet interim ramping rates, so that engineers have specific design criteria to work with. Some of the data needed (channel shape and stage-discharge) is similar to that collected for part of PHABSIM studies.

7.4 Project Nexus - §5.9(b)(5) — *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

ODFW's objective for seeking this water flow information is to better predict the potential impacts of the Project on downstream macroinvertebrates and fish habitat and insure the necessary ramp release rates are adopted as part of the operational conditions.

7.5 Proposed Methodology - §5.8(b)(6) — *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field seasons(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

The ramping rate study framework summarized below is provided to give OID guidance for designing the flow ramping. Study:

1. *Identify critical sites*. Critical sites are described as areas in a river where there exists a high risk of juvenile salmon stranding, such as near gravel and sand bars, shallow side channels and pools.
2. *Determine stage-discharge relationships*. Stage-discharge relationships provide the conversion of flow (always known and controlled within a hydroelectric facility) and stage (the underlying factor affecting fish stranding).
3. *Determine lag time*. The lag time is the time a "parcel" of water takes to travel in the natural watercourse from the intake to the tailrace. Lag time scan also be determined from either the intake or tailrace to each critical site. Several lag times should be determined at different flows.
4. *Determine stage attenuation*. Commonly referred to as flow routing, stage attenuation refers to the damping (or smoothing) of flow and stage changes as water moves downstream. Stage attenuation should be determined for a range of flows.
5. Identify aquatic species and life stages that are potentially vulnerable to rapid flow changes and their periods-of-occurrence.
6. Use stream cross sections and corresponding stage-discharge relationships from instream flow studies to quantify the varial zone and impact zone (for alternative scenarios) between various flow increments.
7. Conduct field observations of actual down-ramp events to determine the lag time of flow change events and any attenuation in the rate-of-change of stage between the powerhouse and Copco reservoir.
8. Conduct concurrent observations of fish stranding incidence and fish condition during actual down-ramp events.

The ramping studies needs to be conducted in consultation with the Oregon Department of Fish and Wildlife, United States Fish and Wildlife Service, and Oregon Department of Environmental Quality to ensure critical site selection and study methodology meets their satisfaction.

This type of analysis is consistent with other fish protection analyses completed during licensing proceedings for hydroelectric projects that have the potential to adversely affect resident and anadromous salmonids and ESA-listed fish species.

7.6 Level of Effort and Cost - §5.9(b)(7) — *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

The total cost for conducting the analysis and preparing the report is estimated to be approximately $30,000. Two analysts would be expected to work for approximately 10-12 days on various alternatives and costs for downstream fish passage protection. Additionally, two analysts would be expected to work for approximately 5-7 days on the preliminary conceptual design of the preferred alternative for structural measures for downstream fish protection, and two analysts would be expected to work for approximately two days incorporating agency comments into the final report.

The ramp rate analysis would be completed during the first study season of the Traditional Licensing Process with the draft report available for comment by the NMFS, FWS, and ODFW prior to December 31, 2020,

ODFW has proposed ramp rate guidelines for the hydropower release as a means of protecting the aquatic resources in the Crooked River below the proposed Project. However, a site specific study as prosed in this study would allow more give assurance that all the aquatic resources are being adequately protected in respect to the up ramping and down ramping schedule for proposed Project.

Study 8. Surveys for Sensitive Wildlife

8.1 Goals and Objectives - §5.9(b)(1) — *Describe the goals and objectives of each study proposal and the information to be obtained*

Updated sensitive wildlife surveys should be done for the following species: greater sage grouse (Centocercus urophasianus), pygmy rabbit (Brachylagus idahoensis), mountain quail (Oreotyx pictus), western burrowing owl (Speotyto cunicularia), willow flycatcher ((Epidonax traillii), loggerhead shrike (Lanius ludovicianus), western toad (Bufo boreas) and Columbia Spotted Frog (Rana lutieventris) be included in this list.

Additionally, surveys for bald eagle (Haliaeetus leucocephalus) and golden eagle (Aquila chrysaetos) need updating. Both species are afforded protective measures through the Eagle Protection Act. OID should consult with biologists from ODFW, BOR and the USFWS to determine the location of bald and golden eagle nest and roost sites in the project vicinity. Specific protective guidelines are in place that regulates activity near these sites.

The project has the potential to have short term impacts from construction and long term impacts from operation on sensitive wildlife species. These include noise and human activity associated with project construction and operation. This could alter behavioral patterns and migration routes and jeopardize nesting success of avian species in the vicinity. Some wildlife may be displaced from their habitats during construction of the powerhouse and burial of transmission lines. Overhead transmission lines pose a risk of electrocution to perching birds and collision to birds in flight. OID should survey to identify sensitive wildlife species that may be impacted by the project.

8.2 Relevant Resource Management Goals - §5.9(b)(2) — *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

ODFW's wildlife policy (ORS 496.012) establishes wildlife management policy to prevent serious depletion of any indigenous species and maintain all species of fish and wildlife at optimum levels. The wildlife diversity program's goal is to maintain Oregon's wildlife diversity by protecting and enhancing

populations and habitats of native wildlife at self-sustaining levels throughout natural geographic ranges (OAR 635-100-0010). The Fish and Wildlife Habitat Mitigation Policy (OAR 635-415-0010) requires or recommends, depending upon the habitat protection and mitigation opportunities provided by specific statutes, mitigation for losses of fish and wildlife habitat resulting from development actions.

8.3 Background and Existing Information - §5.9(b)(4) — *Describe existing information concerning the subject of the study proposal, and the need for additional information.*

There is information available from previous surveys done by previous Bowman Dam Hydroelectric Project applicants. This information along with information available from ODFW, BLM, USFWS and BOR should be used as a basis for informing the updated surveys and information that needs to be collected via this study. As these previous surveys are a number of years old it is important that updated information be collected in respect to informing the potential impact of the proposed Project actives on the various species. In particular updated information is necessary on the current status of breeding activities sand nesting sites for golden eagles, bald eagles and other raptors in the vicinity of the Project.

8.4 Project Nexus - §5.9(b)(5) — *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

Documenting presence or absence of sensitive wildlife species and level of utilization is essential to developing appropriate mitigation measures addressing potential project impacts.

The project has the potential to have short term impacts from construction and long term impacts from operation on sensitive wildlife species. These include noise and human activity associated with project construction and operation. This could alter behavioral patterns and migration routes and jeopardize nesting success of avian species in the vicinity. Overhead transmission lines pose a risk of electrocution to perching birds and collision to birds in flight. OID should survey to identify sensitive wildlife species that may be impacted by the project

8.5 Proposed Methodology §5.8(b)(6) — *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field seasons(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

Proposed study methods involve two observers documenting diurnal wildlife use, specifically sensitive species, in the project area for a minimum of 15 hours. ODFW recommends the survey period total 30 hours, with 15 hours occurring during the April-May avian nesting and amphibian breeding periods and 15 hours or survey during the proposed construction period November-February. Rather than random observations, it is suggested OID consult with ODFW to develop a systematic approach.

Emlen transects are an accepted practice frequently used to document presence and density of avian species (Emlen 1977). The applicant should further consult with ODFW and USFWS for help in designing effective survey protocols for amphibians and the other identified species.

This type of analysis is consistent with other sensitive wildlife species protection analyses completed during licensing proceedings for hydroelectric projects that have the potential to adversely affect state and federal sensitive wildlife species and ESA-listed wildlife species.

8.6 Level of Effort and Cost - §5.9(b)(7) — *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

Proposed study methods involve two observers documenting diurnal wildlife use, specifically sensitive species, in the project area for a minimum of 15 hours. ODFW recommends this survey period a minimum of total 40 hours, with 15 hours occurring during the March - May avian nesting and amphibian breeding periods and 15 hours of survey during November-February. The total cost for conducting the analysis and preparing the report is estimated to be approximately $30,000. Two analysts would be expected to work for approximately 20 – 30 days on various surveys and 10 days for pre-survey work and post survey report preparation.

The sensitive wildlife species surveys would be completed during the first study season of the TLP with the draft report available for comment by the federal agencies and ODFW prior to December 31, 2020.

Final Comments

ODFW supports comments submitted by the Oregon Department of Environmental Quality in regard to OID's PAD for Arthur R. Bowman FERC No. 11925. Proposed studies to assess and monitor water quality parameters will provide important information to assess native fish populations and potential project impacts.

The ODFW appreciates the opportunity to comment on OID's PAD regarding the proposal to develop hydroelectric facilities on Bowman Dam. ODFW looks forward to working with OID to identify and address potential impacts of the project on fish and wildlife resources. We look forward to subsequent consultation to further develop study proposals and methodologies and evaluate appropriate mitigation measures.

As ODFW's hydropower coordinator for this project, correspondence with ODFW should be directed to my attention. I will ensure appropriate ODFW staff will be included in consultation, review and meetings. However, to facilitate our coordination, please send copies of draft and final study proposals, reports and applications to Ken Homolka, ODFW Statewide Hydropower Program Leader, and Brett Hodgson, District Fish Biologist for the Upper Deschutes Watershed District.

Ken Homolka
Hydropower Program Leader
Oregon Department of Fish and Wildlife
4034 Fairview Industrial Dr. SE
Salem, Oregon 97302-1142
503-947-6090
ken.homolka@state.or.us

Brett Hodgson
Deschutes District Fish Biologist
Oregon Department of Fish and Wildlife
61374 Parrell Road, Bend, OR 97702
541-388-6009
brett.l.hodgson@state.or.us

Sincerely,

Ted Wise
East Region Hydropower Coordinator
Oregon Department of Fish and Wildlife
61374 Parrell Road, Bend, OR 97702
541-6334-1115
ted.g.wise@state.or.us

cc. FERC Washington D.C.
Smita Mehta, ODEQ, Bend, OR
Chris Stine, ODEQ, Eugene, OR
Mary Grainey OWRD, Salem, OR
Peter Lickwar, USFWS Bend, OR
Scot Carlon, NOAA, Portland, OR
Greg Garnet, BOR Bend, OR

Literature Citation

Cada, G. F. 1990. A review of studies relating to the effects of propeller type turbine passage on fish early life stages. North American Journal of Fisheries Management 10(4):418-426.

Cordone, **A.** J., and Kelley, D. W. (1961). The influences of inorganic sediment on the aquatic life ofstreams. *California Fish and Game* **47,** 189-228.

EA Engineering, Science and Technology 1991. Radio tracking studies of adult spring Chinook salmon migration behavior in the McKenzie River, Oregon. Prepared for the Eugene Water and Electric Board, Eugene, Oregon

John T. Emlen. Estimating Breeding Season Bird Densities from Transect Counts. *The Auk: Ornithological Advances*, Volume 94, Issue 3, 1 July 1977, Pages 455–468, https://doi.org/10.1093/auk/94.3.455

Fedorenko, A.Y. 1989 Information related to adult injuries at Puntledge powerplant tailrace and any measures considered to ameliorate damages. Draft prepared for the Department of Fisheries and Oceans, Vancouver British Columbia 7pp

Hilsenhoff, W. L. 1988. Rapid field assessment of organic pollution with a family-level biotic index. Journal of the North American Benthological Society 7: 65-68.

Hunter, M.A. 1992. Hydropower flow fluctuations and salmonids: a review of the biological effects, mechanical causes, and options for mitigation. State of Washington Department of Fisheries Technical Report No. 119. Olympia. 46 pp.

Kleinschmidt Associates, 2012. Analysis of Turbine Passage Survival Crooked River Project. Draft prepared for Portland General Electric Company. Portland, Oregon

NPCC. 2004. Deschutes Subbasin Plan. Portland, OR: Northwest Power and Conservation Council.

Oregon Department and Fish and Wildlife 1985. Report on the identifiable loss of salmonid fish at the Winchester hydroelectric project in 1984. Oregon Department of Fish and Wildlife Special Projects Report Portland.

Porter, T, and B. Hodgson. 2016. Effects of a modified flow regime on the fish populations of the Crooked River below Bowman Dam. Oregon Department of Fish and Wildlife, Salem, OR.

Reice, S.R. and M. Wohlenberg. 1993. Monitoring freshwater benthic macroinvertebrates and benthic processes: measures for assessment of ecosystem health. In*: Freshwater biomonitoring and benthic macroinvertebrates* (Eds. D.M. Rosenberg & V.H. Resh). Chapman and Hall, New York, Pp.287-305.

R2 Resource Consultants, Inc., Biota Pacific Environmental Sciences, Inc. 2014. Deschutes Basin Habitat Conservation Plan Draft Study Report Study 14-2: Evaluation of Fish Passage Options for Ochoco Dam Prepared for Deschutes Basin Board of Control, and City of Prineville.

Smokoroski, K. 2010. Effects of Experimental Ramping Rate on the Invertebrate Community of a Regulated River. 2010 invited proceedings article by Karen Smokorowski from the November 2008

Colorado River Science and Resource Management Symposium. Study from the Magpie River in Ontario, Canada. Smokorowski USGS SIR 2010-5135 Magpie River.pdf

Stillwater Sciences 2005. Fish Entrainment Risk at Hydroelectric Facilities. January 19, 2005. Prepared for Eugene Water & Electric Board, Eugene, Oregon by Stillwater Sciences, Arcata California