DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, PORTLAND DISTRICT
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Dear Fish Facility Design Work Group:

The U.S. Army Corps of Engineers, Portland District (Corps) draft 60% Engineering Documentation Report, "Juvenile PIT Tag Detection Prototype for Precision Increase,"A is available for your review and comment.

This Engineering Documentation Report is part of the Corps' effort to increase passive integrated transponder (PIT) detection at Bonneville Dam, and thus improve the precision of juvenile fish survival estimates calculated from detections of PIT-tagged fish passing Bonneville Dam. This effort is consistent with Conservation Recommendation 9 of the National Marine Fisheries Service 2019 Columbia River System Biological Opinion.

Your review of this draft report is very important. The comment period is now open. You may send your written comments to Ida Royer at 503-808-4776 or ida.m.royer@usace.army.mil by August 15, 2019. Thank you for your continued participation in the Fish Facility Design Work Group.

Sincerely,

Amy C. Gibbons
Chief, Environmental Resources Branch

US Army Corps of Engineers ®
Portland District

Engineering Documentation Report

Bonneville Lock and Dam

Juvenile PIT Tag Detection Prototype for Precision Increase

Columbia River, Oregon-Washington

July 2019

60% Review

EXECUTIVE SUMMARY

To be completed at next milestone.

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G-001 Detection Location Map

PERTINENT PROJECT DATA

PROJECT DESCRIPTION

Stream	Columbia River (river mile 146.1)
Location	Bonneville, Oregon
Owner	U.S. Army Corps of Engineers
Project Authorization	Rivers and Harbors Act of 1935
Authorized Purposes	Power, Navigation
Other Uses	Fisheries, Recreation

LAKE/RIVER ELEVATIONS (elevation above sea level in feet)

Maximum Controlled Flood Pool	90.0
Maximum Spillway Design Operating Pool	82.5
Maximum Regulated Pool	77.0
Minimum Pool	69.5
Normal Operating Range	71.5 - 76.5
Maximum 24-Hour Fluctuation at Stevenson Gage	4.0
Maximum Flood Tailwater (spillway design flood)	51.5
Maximum Operating Tailwater	33.1
Standard Project Flood Tailwater	48.9
Minimum Tailwater	7.0
Base (100-year) Flood El. (at project site tailwater)	39.8

POWERHOUSES

First Powerhouse (Oregon)	
Length	1,027 feet
Number of Main Units	10
Nameplate Capacity [2 @ 43 megawatts (MW), 8 @ 54 MW]	518 MW
Overload Capacity (2 @ 47 MW, 8 @ 60 MW)	574 MW
Station Service Units (1 @ 4 MW)	4 MW
Hydraulic Capacity	136,000 cfs

Second Powerhouse (Washington)	
Length (including service bay & erection bay)	985.5 feet
Number of Main Units	8
Nameplate Capacity (8 @ 66.5 MW)	532 MW
Overload Capacity (8 @ 76.5 MW)	612 MW
Fish Water Units (2 @ 13.1 MW)	26.2 MW
Hydraulic Capacity	152,000 cfs

SPILLWAY

Capacity at Pool Elevation (El. 87.5)	1,600,000 cfs

FISH PASSAGE FACILITIES

Fish Ladders
Washington Shore
Cascades Island
Bradford Island
Juvenile Bypass System – Second Powerhouse
Downstream Migrant System – Second Powerhouse
Upstream Migrant System

ACRONYMS AND ABBREVIATIONS

B1	Bonneville First Powerhouse
B2	Bonneville Second Powerhouse
CC	Corner Collector
cfm	cubic feet (foot) per minute
cfs	cubic feet (foot) per second
CRSO	Columbia River System Operation
DSM	Downstream Migrant
EDR	Engineering Documentation Report
El.	elevation
EM	Engineer Manual
FFDRWG	Fish Facilities Design and Review Work Group
FGE	fish guidance efficiency
fps	feet (foot) per second
ft.	feet (foot)
ft-c	foot-candle(s)
I.D.	inside diameter
ITS	Ice and Trash Sluiceway
JBS	Juvenile Bypass System
LED	light-emitting diode
MSL	mean sea level
MW	Mega watts
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
O.D.	outside diameter
O&M	operation and maintenance
PDT	Product Development Team
PH1	Bonneville First Powerhouse
PH2	Bonneville Second Powerhouse
PIT	passive integrated transponder
psi	pounds per square inch
PSMFC	Pacific States Marine Fisheries Commission
RM	river mile(s)
SMF	Smolt Monitoring Facility
STS	submersible traveling screen
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
VBS	vertical barrier screen

1. INTRODUCTION

1.1. PURPOSE AND SCOPE

The purposes of this Engineering Documentation Report (EDR) are to document engineering investigations and provide a recommended alternative for an effective, low cost method for increasing system survival estimates through installation of additional juvenile fish PIT tag detection at Bonneville Dam. This report will assess the feasibility of installing additional juvenile fish PIT tag detection at one or more of the potential locations at Bonneville Dam:

- First Powerhouse Ice & Trash Sluiceway (B1 ITS)
- Spillway Bays
- Second Powerhouse Corner Collector (B2CC)
- Second Powerhouse JBS Outfall Piers
- Downstream

1.2. BACKGROUND

Currently, juvenile fish PIT tag detection is only performed in two locations at the Bonneville Project. One is in the Second Powerhouse Corner Collector (B2CC) channel (High Flow PIT Tag Detection system). The second is in the Second Powerhouse juvenile bypass system (JBS) transportation pipe (Full Flow PIT Tag Detection system) downstream near the Smolt Monitoring Facility. Juveniles passing through the First Powerhouse and the spillway do not encounter any PIT tag detection. See Plate G-001.

Estimating survival of juvenile salmonids through the Federal Columbia River Power System (from Lower Granite to Bonneville) is included in Terms and Condition #1 in the 2019 Biological Opinion. Estimation of this metric is dependent on detection of PIT-tagged fish at Bonneville Dam, which currently depends on PIT-tagged fish passing the JBS or the B2CC.

In recent years the amount of water passing through the spillway has increased due to court orders and stakeholder agreements. This has reduced the proportion of water, and thus the numbers of fish, passing through Powerhouse 1 (PH1) and Powerhouse 2 (PH2). As a result, the ability to detect PIT-tagged fish and precisely estimate system survival has been reduced. Regional stakeholders have consequently requested that the Action Agencies increase detection capability at Bonneville Dam. Conservation Recommendation #9 of the 2019 Biological Opinion likewise directed the Action Agencies to "evaluate alternative means of detecting PIT tags at Bonneville Dam…."

Advancement in PIT Tag technology (antennas, tags, transceivers, etc.) is credited to R&D efforts by Biomark (vendor), NOAA and PSMFC.

1.3. PROJECT AUTHORIZATION

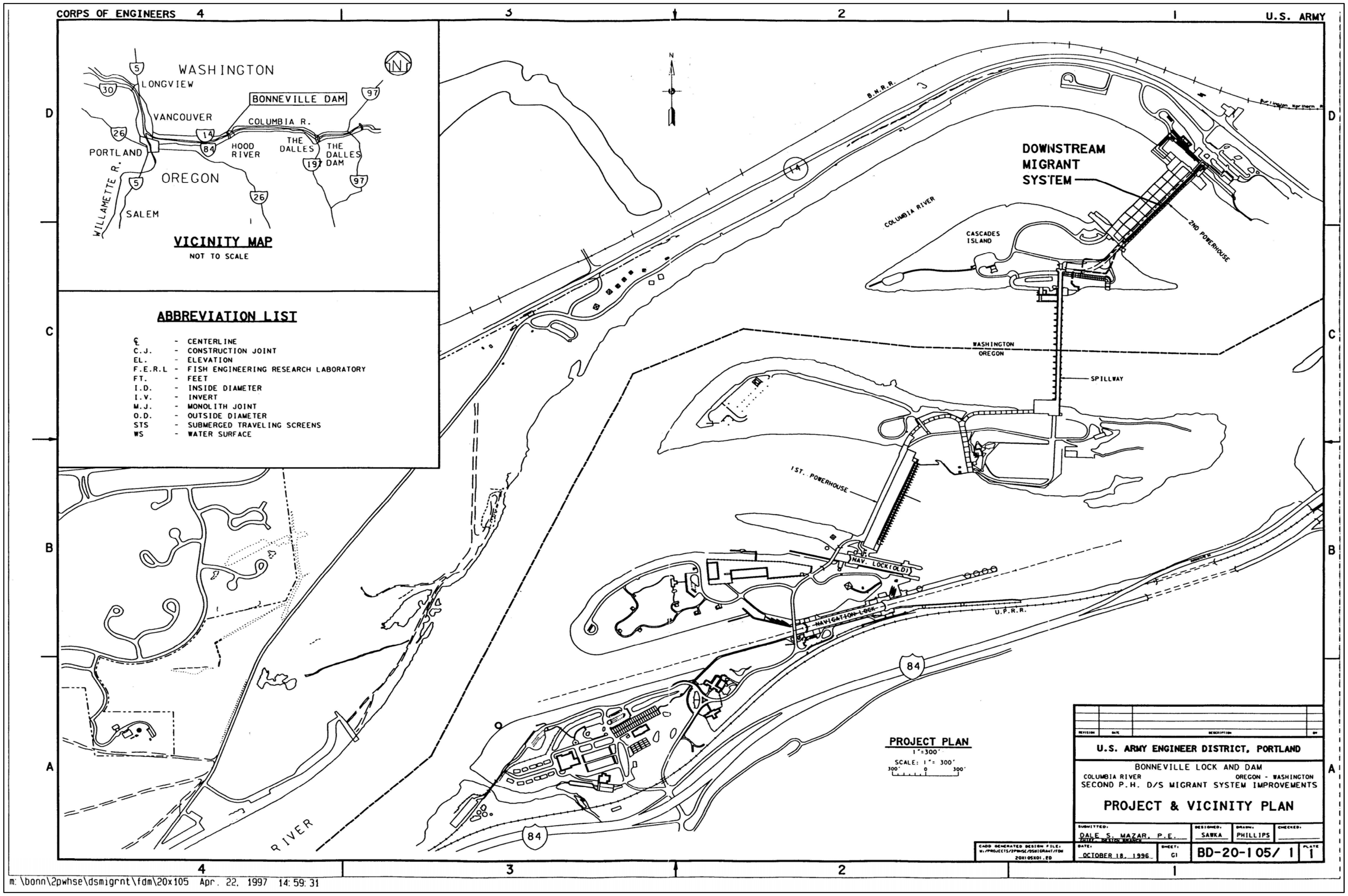
The Bonneville Project began with the National Recovery Act, 30 September 1933, and was formally authorized by Congress in the Rivers and Harbors Act of 30 August 1935. Authority for the completion, maintenance, and operations of Bonneville Dam was provided in Public Law 329, 75th Congress, 20 August 1937. This act provided the authority for the construction of additional hydroelectric generation facilities (Bonneville second powerhouse) when requested by the Administrator of Bonneville Power Administration. Letters dated 21 January 1965 and 2 February 1965 from the Administrator developed the need for the construction of Bonneville second powerhouse. Construction started on the second powerhouse in 1974 with units 11 through 18 and two fishway units, and was completed in 1982.

The Energy and Water Development Appropriation Bill, 1995, directs the U.S. Army Corps of Engineers (USACE) to use additional appropriations to aggressively improve effectiveness and efficiency of the bypass systems, reduce predator mortality, and enhance passage conditions.

1.4. Project Location

The Bonneville Project is located on the Columbia River approximately 42 miles east of Portland, Oregon at river mile (RM) 146 *(Figure 1-1).*

Figure 1-1. Bonneville Project and Vicinity



2. DESCRIPTION OF PROJECT FEATURES

Currently, juvenile fish PIT tag detection is only performed in two locations at Bonneville Dam. One is in the B2CC channel (High Flow PIT Tag Detection system). The second is in the PH2 JBS transportation pipe (Full Flow PIT Tag Detection system) downstream near the Smolt Monitoring Facility (SMF). See Plate G-001.

2.1.1. High Flow PIT Tag Detection System (B2CC)

Juvenile fish passing B2 at the surface are diverted into the B2CC and travel downstream at (low turbulence) high velocities to the outfall. PIT Tag detection is provided by a single full channel pass-thru antenna.

2.1.2. Full Flow PIT Tag Detection System (B2 JBS Transportation Pipe)

Juvenile fish passing B2 at deeper elevations are diverted up the VBS slot by STS's and through orifices. These orifices pass the fish into the collection channel. These fish then pass through the DSM facility and on into the JBS transportation pipe. This pipe carries them downstream to the SMF and outfalls. PIT tag detection is provide through four (redundant) pass-thru antennas prior to the SMF.

3. PROBLEM STATEMENT

Estimating survival of juvenile salmonids through the Federal Columbia River Power System (from Lower Granite to Bonneville) has been a key component of the NOAA Fisheries Biological Opinions, and is included in Term and Condition #1 in the 2019 Biological Opinion. Estimation of this metric is dependent on detection of PIT-tagged fish at Bonneville Dam. Currently, detection of PIT-tagged fish requires passage through either the JBS or the B2CC. In recent years the relative proportion of water passing through the spillway has increased due to court-ordered spill or a spill agreement, increasing the number of fish passing the spillway and decreasing the number passing via PH1 or PH2. As both the JBS and B2CC are located at PH2, this has resulted in reduced numbers of fish passing these routes, thereby reducing the overall detection of PIT-tagged fish at Bonneville Dam and subsequently the ability to precisely estimate system survival.

The goal of this study is to increase the overall number of PIT-tagged fish detected passing Bonneville Dam. The relative benefits of each passage route location and PIT tag antenna type must be weighed against cost, technical complexity, and other factors.

4. CONSTRAINTS AND CRITERIA

Constraints limit which alternatives receive further consideration and evaluation. The constraints for this study are:

- The prototype must fit within the existing infrastructure. The existing water channel profiles will be maintained.
- The prototype cannot hinder fish passage during operation by obstructing a passage route.
- The prototype cannot affect hydraulics such that it impacts fish passage, the integrity of the dam structure, or operations required for safety, passing debris, or regular and continued maintenance.
- The prototype must be based on technology that either exists or could exist by the time of construction.

The following criteria will be used for analyzing the various alternatives.

- **Detection Delta** – This criteria is comprised of two parts. The first is project location (or fish passage route), the second is the estimated detection efficiency of the antenna identified to be placed in that location (efficiency numbers where provided by NOAA/PSMFC/Biomark). These two factors are multiplied together to generate Detection Delta.
- **Cost** – Cost only considers construction. Depending on the antenna type, if pre-assembled off-site by Pacific States Marine Fisheries Commission (PSMFC) then the cost of the antenna would be paid for by BPA and not be included.
- **O&M Burden** – Post-construction operations and maintenance (O&M) costs are those incurred by Corps personnel at Bonneville Project only. Maintenance of the antennas themselves is done by PSMFC and funded by BPA as agreed upon under the Corps-BPA MOU.
- **Constructability** – Considerations for constructability include the amount of concrete drilling/additions, facility outages required, Project support needed, etc.
- **Reliability/Durability –** Reliability is concerned with the antenna, transceiver system, cabling, and anything else associated with the data collection system itself (and not the supporting infrastructure); as well as how durable the antenna is expected to be with the anticipated debris load at the specific location.
- **Secondary Biological Uses –** This criteria involves biological benefits not associated with an increase in PIT detection at a location for survival estimation. Secondary uses of the antenna at a location would include gaining fish use information of a passage route that previously did not have PIT detection, adult fallback information, and both juvenile and adult fish use of a year-round surface passage route.

5. ALTERNATIVES DEVELOPMENT

5.1. BIOLOGICAL CONSIDERATIONS

5.1.1. Biological Criteria

The most important biological criteria is to increase the number of PIT-tagged juvenile salmonids successfully detected passing through Bonneville Dam. This assumes that any detected fish is 'dedicated' to passing and could not turn and move back upstream, or later pass through another route. Additionally, if possible provide information on fish behavior (for adults or juveniles). This includes information on adult fallback behavior, or relative numbers of juvenile fish passing through routes that currently have no PIT detection.

5.1.2. Biological Considerations

Bonneville Dam is operated to provide maximum benefits to ESA-listed fish. These operations are outlined in the Fish Passage Plan. While juvenile salmonids pass downstream in the spring and summer, some adults pass year-round. Steelhead kelts are repeat spawners and return to the ocean after spawning in late winter – early spring. Both Chinook and steelhead can overshoot their natal streams, traveling above dams and then falling back when ready to move into their spawning grounds.

The PH1 ice-and-trash sluiceway is operated year-round, while some passage routes such as the spillway and PH2 corner collector (B2CC) are operated only during the juvenile fish passage season (1 April – 31 August). The B2CC often opens early (early March) to aid in the downstream migration of adult steelhead kelts. Turbines are operated as water demands allow, but due to fish-related considerations the turbine units at PH2 are operated first, followed by the units at PH1. Excess water above what can pass the turbine units are then passed via the spillway ('involuntary spill'). All of these operations contribute to how water, and thus fish, pass Bonneville Dam and the biological benefit of specific passage routes.

5.2. HYDRAULIC CONSIDERATIONS

5.2.1. Hydraulic Design Criteria

The hydraulic criteria the team used to evaluate the alternatives was based on how the presence of the prototype will effect dam safety and routine operations at the project as well as the prototype's anticipated modeling intensity.

Dam safety is unquestionably important. Jeopardizing the safe operation of the project puts downstream communities and invested entities at unnecessary risk. In addition, if the prototype requires the project to perform new operational procedures, those must be taken into account and minimized to reduce the burden on the project. Regardless of how effective the prototype is at fish detection, if it places the project into an unsafe or unstable state, that prototype is unacceptable.

As the alternatives are developed further, there may be a need to perform hydraulic **modeling** to ensure the prototype would not cause undesirable hydraulic effects. Such effects may reduce the hydraulic capabilities of the existing structures at the project and in turn negatively impact dam safety and fish passage. The extent and intensity to which this modeling is performed will depend on the alternative.

5.2.2. Hydraulic Considerations

Two additional hydraulic considerations outside of the hydraulic design criteria must be examined for each alternative to establish advantages and disadvantages.

One is that of which **flow regime** – laminar or turbulent – the water will be under when it passes near the PIT tag detection antenna. Laminar flow is a flow regime where fluid particles move in smooth layers relative to one another. Turbulent flow is a flow regime where the fluid particles rapidly mix as they move along due to random, three-dimensional velocity fluctuations. Which regime the flow is under will influence the overall efficiency of the antenna to detect PIT tags. Laminar flow is preferred because the fish retain their orientation in the water column as they pass near the antenna, providing the antenna an easy 'target' to detect and record the PIT tag as the fish passes. Turbulent flow does not allow fish to retain their orientation in the water column due to the random nature of the flow regime, causing them to 'tumble' past the antenna and reducing the chance of detecting and recording the PIT tag. Note that laminar flow does not mean every fish will be detected. Likewise, turbulent flow does not mean every fish will pass undetected. Rather the chance of detection is higher with laminar than turbulent flow.

The other is how the prototype will change the **geometry** of the structure it is attached to within the flow. The change in geometry could have a significant impact on the hydraulics of the structure; this is where hydraulic modeling would be able to provide further insight. For example, an antenna that sits atop one of the variable B1 ITS gates will cause a greater geometric change – and possible hydraulic change – than an antenna that is mounted flush within the walls of the B2CC.

REFERENCES:
NMFS Anadromous Salmonid Passage Facility Design, 2011.
Fox & McDonald, Introduction to Fluid Mechanics, 8th Ed., 2014.

5.3. STRUCTURAL CONSIDERATIONS

5.3.1. Structural Design Criteria

The team evaluated each antenna type and location within the dam and how the antenna would be installed or mounted. Due to the function and makeup of the proposed antennas, the overall impact to the dam's structural integrity is minimal and not considered a major factor in the alternatives analysis. The constraints stated in this report confine the following alternative solutions to fitting within the existing flow surfaces of the existing Bonneville Project.

5.3.2. Structural Considerations

The antennas and arrays considered in the report have very little impact to the structures at the Bonneville Project. Most systems are installed with concrete anchors, metal fasteners, or simply slide into existing gate slots. Concrete demolition, if needed, will be limited so as to preserve the structural integrity of the affected system. None of the alternatives, meeting the constraints set by this report, pose any great risk to the structural stability and function of the Bonneville Project.

5.4. ELECTRICAL CONSIDERATIONS

5.4.1. Electrical Design Criteria

Provide "clean" power source and isolated ground (where necessary) for transceiver system. Provide environmentally controlled location (room) for PSMFC data collection equipment (electronics). This can be provided by existing PIT Tag rooms where data collection capacity and logistics allow. The existing PIT Tag room at Bradford Island is being considered.

5.4.2. Electrical Considerations

Transceivers will most likely be installed outdoors. Sun/rain shield will be provided for outdoor transceiver panels. Installation of transceiver power/data transmission could be temporary (for prototype purposes) and made permanent at a later date.

5.5. MECHANICAL CONSIDERATIONS

5.5.1. Mechanical Design Criteria

The mechanical design will be in support of the data collection infrastructure in the form of HVAC design and any other mechanical needs the prototype and its installation needs.

5.5.2. Mechanical Considerations

Cooling may not be needed if alternatives use current PIT tag detection processing spaces. Mechanical changes may have to be made with regards to the ITS intakes for some of the alternatives.

6. ALTERNATIVES

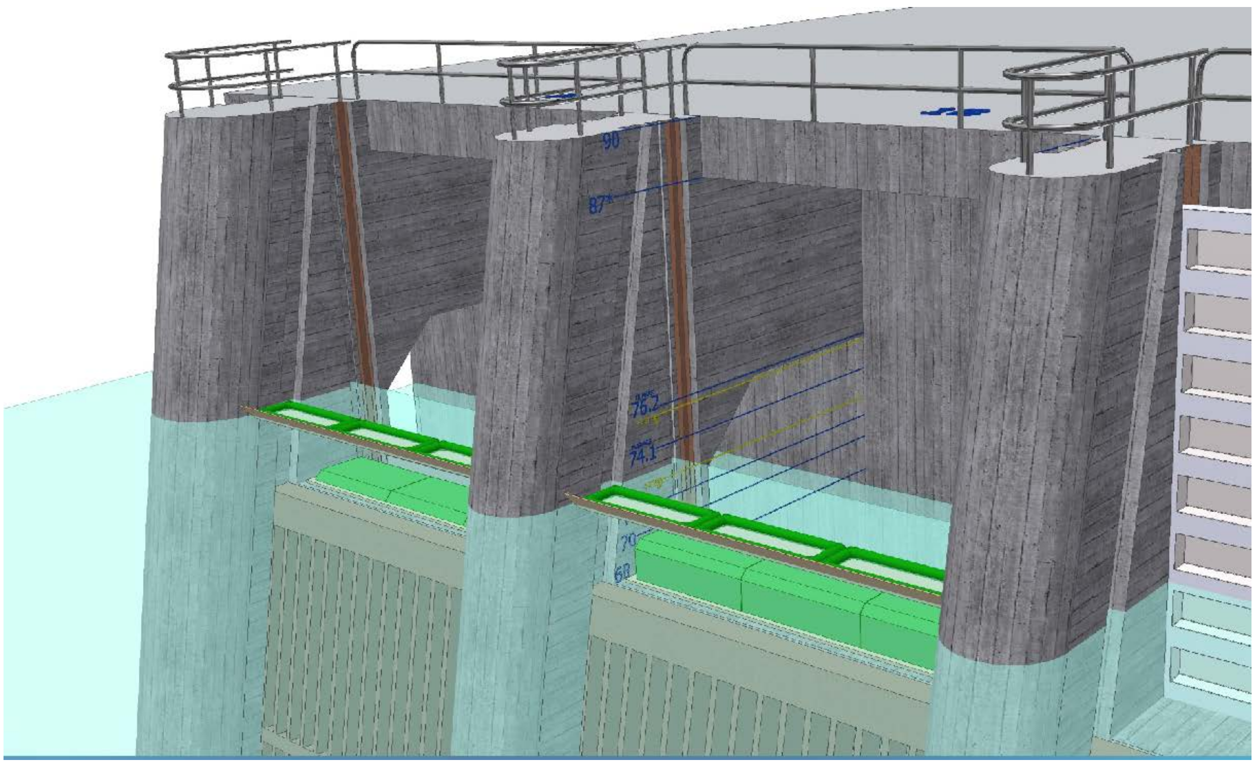
Ten alternatives were identified as potential solutions for increasing the overall number of PIT-tagged fish detected passing Bonneville Dam. These alternatives are described below.

6.1. ALTERNATIVE 1 – B1 ITS FIXED ENTRANCE GATE (FLAT PLATE ANTENNA)

6.1.1. General Description

There are two ITS bays with fixed entrance gates (Bays 1A and 1B) used to pass ice & trash as well as juvenile fish. PSMFC is currently developing a conceptual design for a prototype flat plate antenna that could be installed in either Bays 1A or 1B (Figure 6-1). See Plate G-001 for location.

Figure 6-1. B1 ITS Fixed Gate Flat Plate Antenna



6.1.2. Structural Design Components

Installation of this style of flat plate antenna would require a caisson or cofferdam to dewater the area. The flat plate would likely be installed directly to the concrete immediately downstream of the turbine intake trashracks. Post-installed concrete anchors would be the feasible means of mounting the flat antenna to the concrete.

6.1.3. Electrical Design Components

Transceiver and associated electronics will be provided by PSMFC and installed by a Gov't contractor. Gov't will provide transceiver power and fiber optics for PIT tag data transmission to PSMFC data collection electronics.

6.1.4. Mechanical Design Components

None. It is assumed that the transmission of the PIT tag data to existing collection electronics will not necessitate any extra cooling. No other mechanical impacts for this alternative.

6.1.5. Advantages

Hydraulics: Flat plate has low hydraulic profile; expect relatively low modeling effort. Laminar flow expected over antennas

6.1.6. Disadvantages

Electrical: Antenna read range might not capture fish for higher forebay elevations.

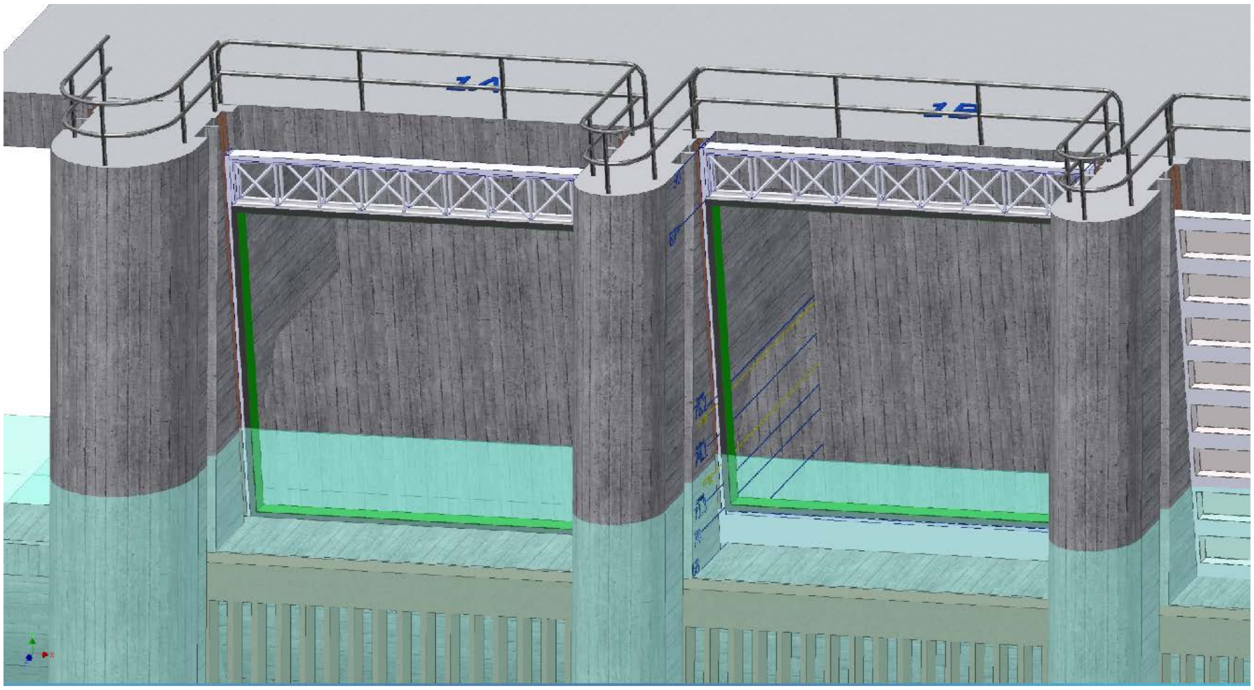
Biological: Only provides detection in one of five bays.

6.2. ALTERNATIVE 2 – B1 ITS FIXED ENTRANCE GATE (PASS-THRU ANTENNA)

6.2.1. General Description

There are two ITS bays with fixed entrance gates (Bays 1A and 1B) used to pass ice & trash as well as juvenile fish. An antenna for either of these gates would consist of a modular pass-thru type antenna placed in the gate slot above the entrance gate (Figure 6-2). See Plate G-001 for location.

Figure 6-2. B1 ITS Fixed Gate Pass-Thru Antenna



6.2.2. Structural Design Components

Since the pass-through antenna array will be delivered in a modular form, there is likely no structural considerations for this alternatives because the array assembly will be set into the existing gate slot.

6.2.3. Electrical Design Components

Transceiver and associated electronics will be provided by PSMFC and installed by a Gov't contractor. Gov't will provide transceiver power and fiber optics for PIT tag data transmission to PSMFC data collection electronics.

6.2.4. Mechanical Design Components

None. It is assumed that the transmission of the PIT tag data to existing collection electronics will not necessitate any extra cooling. No other mechanical impacts for this alternative.

6.2.5. Advantages

Hydraulics: pass-through antenna would be flush with gate slots. No expected change in hydraulics, minimal modeling. Laminar flow expected over antennas.

6.2.6. Disadvantages

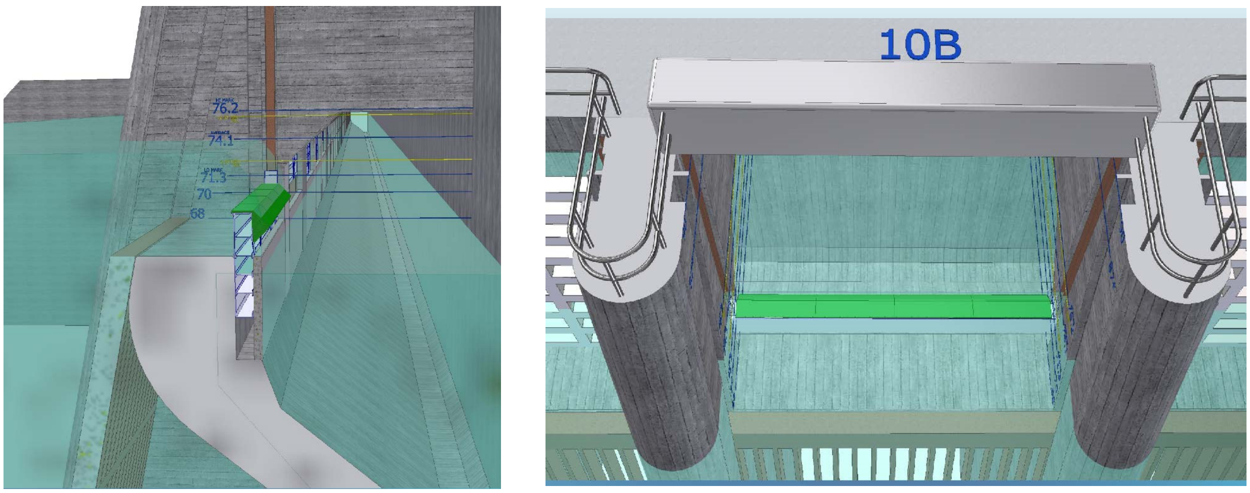
Project Operations: Antenna uses gate slot. Antenna would need to pulled and stored if gates were to be used.
Biological: Only provides detection in one of five bays.

6.3. ALTERNATIVE 3 – B1 ITS AUTOMATED ENTRANCE GATE (FLAT PLATE ANTENNA)

6.3.1. General Description

There are three ITS bays with automated entrance gates (Bays 3B, 6C and 10B) used to pass ice & trash as well as juvenile fish. An antenna for any of these gates would consist of a flat plate type antenna installed on the top of the gate (Figure 6-3). See Plate G-001 for location.

Figure 6-3. B1 ITS Automated Gate Flat Plate Antenna



SECTION VIEW

PLAN VIEW

6.3.2. Structural Design Components

Installation of this antenna type will likely involve mounting the antenna direct to the automatic gate using metal fasteners. Structural impact to the system is relatively low compared to other antenna designs/placements. This alternative is perhaps the simplest to accomplish due to the antenna's fixity on a moveable gate which can easily be brought out of the water for installation.

6.3.3. Electrical Design Components

Transceiver and associated electronics will be provided by PSMFC and installed by a Gov't contractor. Gov't will provide transceiver power and fiber optics for PIT tag data transmission to PSMFC data collection electronics. Antenna cable connections will have to be capable of extending/retracting to follow the gate travel. Protection of the cable will be a design concern. Controls for the automated gate will most likely need some modifications to maintain the desired head over the gate. This is a result of the additional height of the gate due to the antenna installation.

6.3.4. Mechanical Design Components

It is assumed that the transmission of the PIT tag data to existing collection electronics will not necessitate any extra cooling. The mechanical lifter for the gate elevation control may need to be adjusted to account for the addition of the antenna height.

6.3.5. Advantages

Hydraulics: Lower head than fixed gates, head relatively constant over range of operation levels, laminar flow expected over antennas.

6.3.6. Disadvantages

Hydraulics: Significant changes to weir (gate) crest – detailed modeling effort expected.
Project Operations: Antenna could accumulate debris.
Biological: Only provides detection in one of five bays.

6.4. Alternative 4 – B1 ITS Outfall (Pass-Thru Antenna)

6.4.1. General Description

PSMFC is currently looking into the feasibility of a conceptual design for a prototype pass-through antenna that could be installed in the outfall gate slot. It has been noted that Biomark feels this concept will not be feasible (performance wise) due to high flow and turbidity. This alternative would consist of an addition of a pass-thru antenna installed upstream of the outfall exit. A flush-mounted antenna array would be installed within the flume channel requiring concrete demolition in dry conditions. For this alternative, a 6” x 9” rectangular demolition of the concrete channel walls and floor would be required in order to properly in-set the array so that its face is flush with the existing channel walls. The affected wall sections would then need to be reinforced with buttressing or similar supports. See Figure 6-4 for photo of the outfall. See Plate G-001 for location.

Figure 6-4. B1 ITS Outfall Pass-Thru Antenna

6.4.2. Structural Design Components

This alternative consists of the installation of a flush-mounted antenna array along the ITS channel outfall would require concrete demolition in dry conditions. For this alternative, a 6” x 9” rectangular demolition of the concrete channel walls and floor would be required in order to properly in-set the array so that its face is flush with the existing channel walls. The affected wall sections would then need to be reinforced with buttressing or similar supports.

6.4.3. Electrical Design Components

Transceiver and associated electronics will be provided by PSMFC and installed by a Gov’t contractor. Gov’t will provide transceiver power and fiber optics for PIT tag data transmission to PSMFC data collection electronics.

6.4.4. Mechanical Design Components

None. It is assumed that the transmission of the PIT tag data to existing collection electronics will not necessitate any extra cooling. No other mechanical impacts for this alternative.

6.4.5. Advantages

Hydraulic: Antenna would be flush against walls/floor – no change in geometry.
Biological: Captures entirety of fish that utilize B1 ITS for downstream passage at one location.

6.4.6. Disadvantages

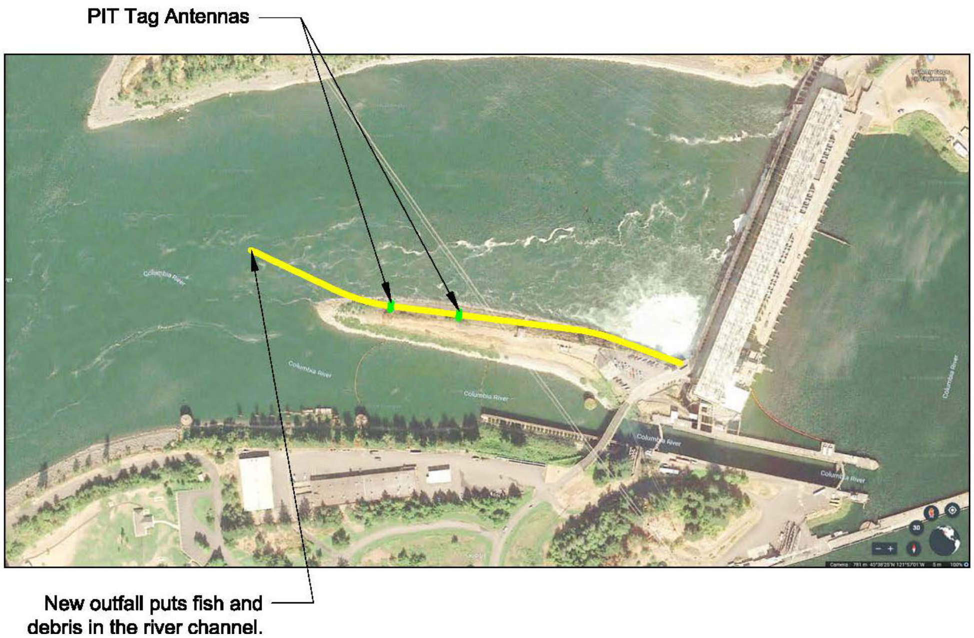
Hydraulics: Turbulent flow and likely high velocities (fish might pass too quickly for antenna to read). Some modeling expected. Poor detection efficiency due to turbulent flows.

6.5. Alternative 5 – B1 ITS Outfall Extension (Pass-thru Antenna)

6.5.1. General Description

Similar to the existing B2CC, the ITS outfall extension would effectively extend the ITS channel several hundred feet (1000ft – 1200ft) along the north bank of the southern spillway island. This increase in channel length would be needed to allow the water to reach a more laminar flow, improving array detection efficiency. The channel flume would likely be designed with pier and beam style foundation with equally spaced struts along its length (similar to B2CC flume). A rough estimate for cost of this alternative is between $5 – 7M. This alternative fails to meet the constraint for fitting within the existing infrastructure and is thereby eliminated. See Figure 6-5 for conceptual layout.

Figure 6-5. B1 ITS Outfall Extension

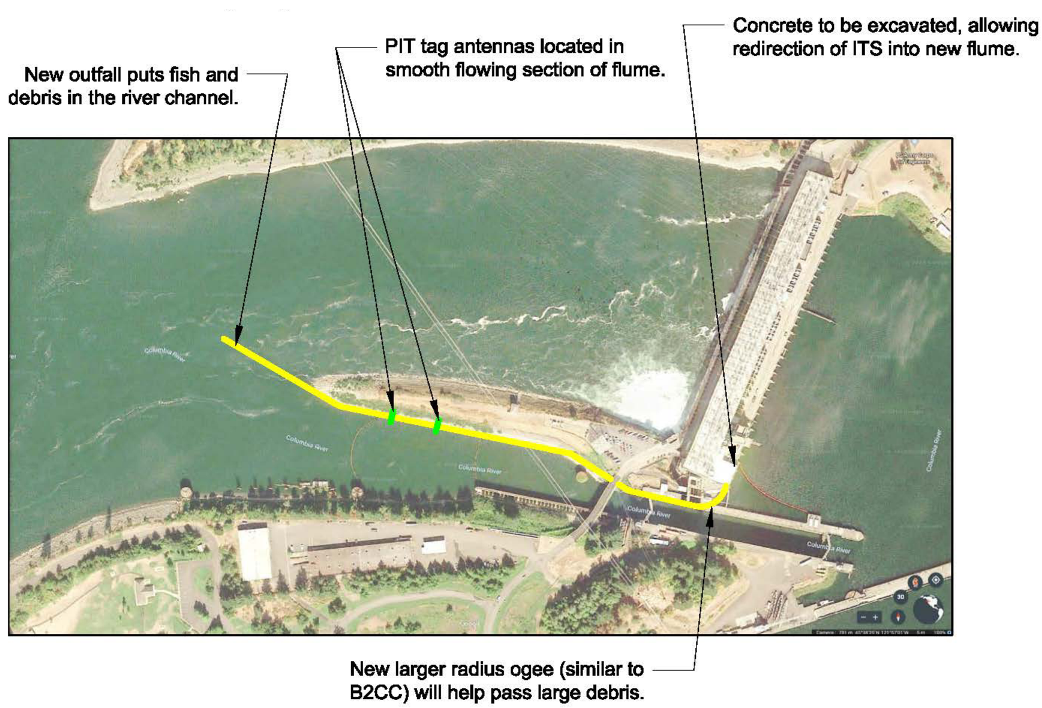


6.6. Alternative 6 – B1 ITS Outfall Reroute (Pass-thru Antenna)

6.6.1. General Description

For details of this alternative see above Alternative 5. This alternative fails to meet the constraint for fitting within the existing infrastructure and is thereby eliminated. See Figure 6-6 for conceptual layout.

Figure 6-6. B1 ITS Outfall Reroute/Extension

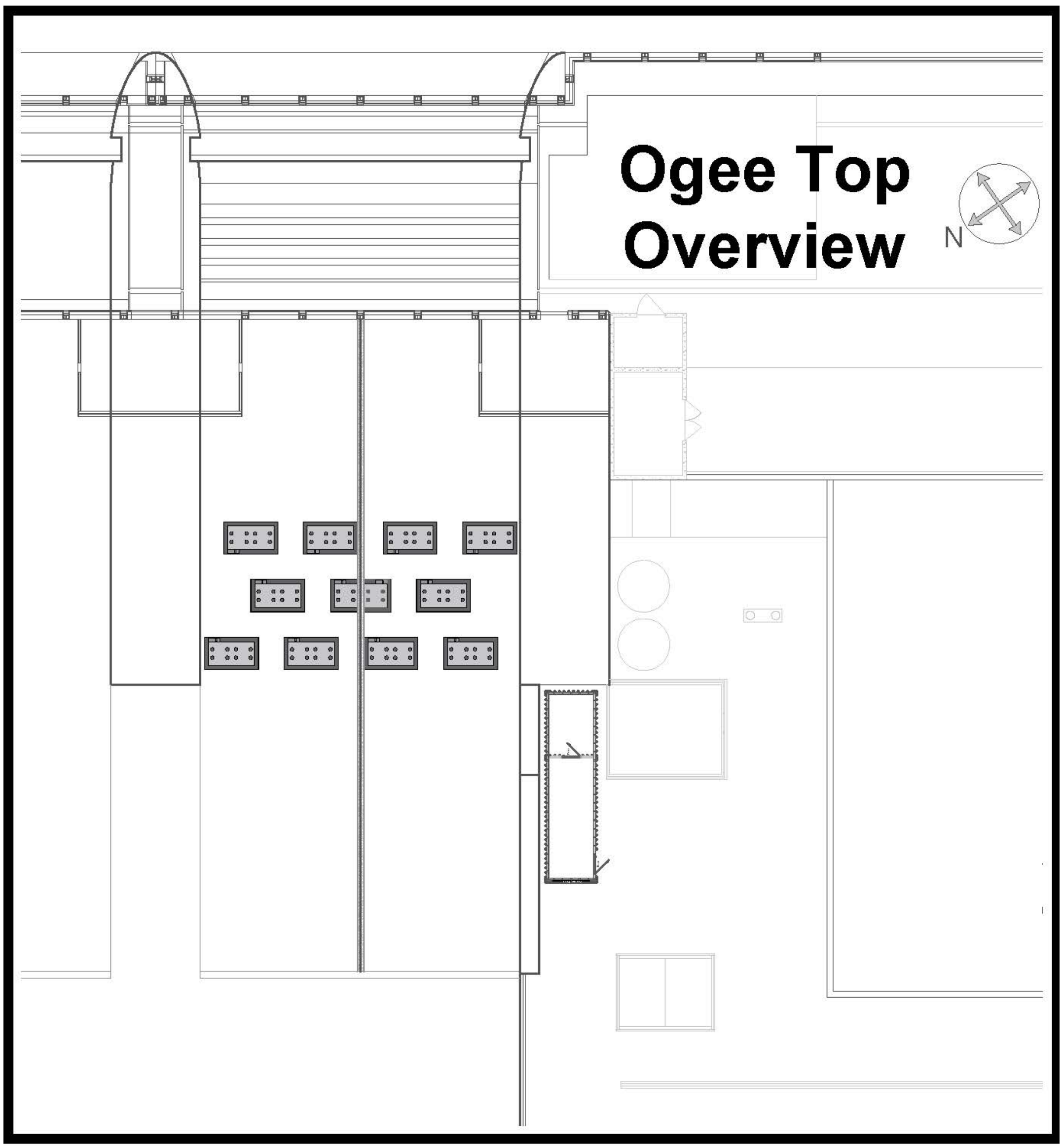


6.7. ALTERNATIVE 7 – SPILLWAY BAY (FLAT PLATE ARRAY)

6.7.1. General Description

This alternative is based upon a system currently being installed at Lower Granite Dam. This design involves the excavation of the ogee surface profile approximately 2 feet in depth. The individual antennas are mounted to the new lower demolished surface and concrete is placed back (around the antennas) to restore the original ogee profile. The cost of the Lower Granite array is approximately $5.8M. It consists of and antenna array embedded in the ogee concrete (Figure 6-7). See Plate G-001 for location.

Figure 6-7. Spillway Ogee Flat Plate Antenna Array



6.7.2. Structural Design Components

Modification/demolition of the concrete surface profile of the ogees in Spillbays 1 and 18 is to be expected. In order to execute this installation safely, the system must be isolated from spilling and tailwater, so a caisson or cofferdam will be required to complete construction. This dewatering mechanism likely would be retained for future repair to the antenna system.

6.7.3. Electrical Design Components

Transceiver and associated electronics will be provided by PSMFC and installed by a Gov't contractor. Gov't will provide transceiver power and fiber optics for PIT tag data transmission to PSMFC data collection electronics.

6.7.4. Mechanical Design Components

None. It is assumed that the transmission of the PIT tag data to existing collection electronics will not necessitate any extra cooling. No other mechanical impacts for this alternative.

6.7.5. Advantages

Biological: Potential for capturing some PIT tag data not available in the past.

6.7.6. Disadvantages

Hydraulics: Constructing on ogee face may cause dam safety issues, turbulent flow is present, large tailwater fluctuations occur (coupled with small antenna read range), possible change in spill pattern, large modeling effort expected.
Biological: Only provides detection in one of eighteen bays.
Electrical: Space required to locate necessary electrical equipment is only available at Bays 1 and 18. Not feasible to utilize any other bays for detection.

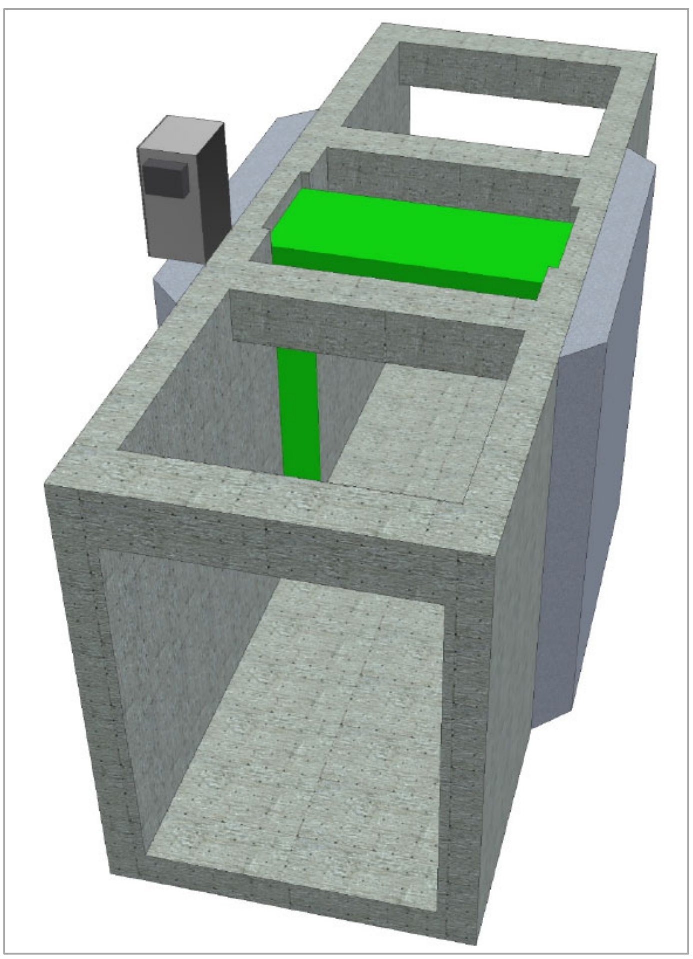
6.8. Alternative 8 – B2CC Channel (Additional Pass-thru Antenna)

6.8.1. General Description

This alternative would consist of an additional pass-thru antenna installed in the B2CC channel downstream from the existing antenna. An additional antenna would increase the detection efficiency of the CC system by providing redundancy (Figure 6-8 and 6-8a). A second flush-mounted antenna array would be installed towards the exit of the B2CC flume requiring concrete demolition in dry conditions. For this alternative, a 6” x 9” rectangular demolition of the concrete channel walls and floor would be required in order to properly in-set the array so that its face is flush with the existing channel walls. The affected wall sections would then need to be reinforced with buttressing or similar supports. See Plate G-001 for location.

Figure 6-8. B2CC Additional Pass-Thru Antenna

Figure 6-9a. B2CC Additional Pass-Thru Antenna Concept



6.8.2. Structural Design Components

Similar to Alternative 4, the installation of a flush-mounted antenna array along the B2CC would require concrete demolition in dry conditions. For this alternative, a 6” x 9” rectangular demolition of the concrete channel walls and floor would be required in order to properly in-set the array so that its face is flush with the existing channel walls. The affected wall sections would then need to be reinforced with buttressing or similar supports. See Figure 6-8a for a concept drawing of the modifications needed to the flume.

6.8.3. Electrical Design Components

Transceiver power and data transmission will be provided from the existing room. There would be no need for an additional electronics room. Transceiver and associated electronics would be provided by PSMFC and installed by a Gov’t contractor. Antenna design would utilize the new NOAA flat cable design.

6.8.4. Mechanical Design Components

None. It is assumed that the transmission of the PIT data to existing collection electronics will not necessitate any extra cooling. No other mechanical impacts for this alternative.

6.8.5. Advantages

Hydraulics: Antenna would be flush against walls/floor – no change in geometry, models already established. Laminar flow expected through antenna.
Biological: Provides redundancy for increase in detection efficiency

6.8.6. Disadvantages

Biological: does not provide potential for detection of additional passage routes (i.e. spillway or B1).

6.9. ALTERNATIVE 9 – JBS OUTFALL PIERS (FIN-TYPE ANTENNA?)

6.9.1. General Description

PSMFC/NOAA investigated this for conceptual design and found little opportunity for antenna placement (Figure 6-9). This alternative will not be investigated any further. See Plate G-001 for location.

Figure 6-10. JBS Outfall Piers

6.10. Alternative 10 – Downstream PIT Tag Barge Antenna Array

6.10.1. General Description

The barge alternative would be provided a self-contained unit. It consists of a fin type antenna array with complete electronics (transceiver, wireless communications, photovoltaic power supply, etc). An automated motor is provided to lift the antenna array out of the water due to debris loading (Figure 6-10). See Plate G-001 for anticipated location.

Figure 6-11. Barge Antenna Array

6.10.2. Structural Design Components

There are no structural design considerations for this alternative. The entire barge structure would be designed and constructed by others.

6.10.3. Electrical Design Components

All electrical equipment would be provided in whole as part of the barge. Data transmission of PIT tag information would be done via wireless communications.

6.10.4. Mechanical Design Components

No additional mechanical equipment would be needed to support the barge or the processing of the PIT tag data. All mechanical equipment would be provided in whole as part of the barge.

6.10.5. Advantages

Potential for capturing some PIT tag data not available in the past.

6.10.6. Disadvantages

Hydraulics: Likely turbulent flow.

Biological: Number of juvenile fish using a specific barge location for passage is unknown.

7. ALTERNATIVES EVALUATION

7.1. EVALUATION OF ALTERNATIVES

To be completed at next milestone

Table 7-1. Alternatives Evaluation Matrix

Decision Matrix											
			Weight: 1 - 2 (1 = Least Important, 2 = Most Important)								
			2.0		1.6	1.0	1.1	1.5	1.3		
Criteria			Detection Delta		Cost	O&M Burden	Constructability	Reliability/Durability	Secondary Biological Uses	Remarks	TOTALS (sum of ratings x weights)
			Antenna Location	Antenna Efficiency							
Antenna Location/Description		Alternative No.	Rating: 1 - 5 (1 = Poor, 5 = Outstanding)								
B1	ITS Fixed Gate (Flat Plate)	1	2	65%	2	4	2	3	5		23.0
	ITS Fixed Gate (Pass-Thru)	2	2	50%	2	1	4	2	5		20.1
	ITS Auto Gate (Flat Plate)	3	3	90%	4	4	4	2	5		**29.7**
	ITS Outfall (Pass-thru)	4	5	20%	3	4	2	4	5		**25.5**
	Extend ITS Channel/Outfall (Pass-thru)	5								Doesn't meet contraint for staying within the existing infrastructure	
	Reroute/Extend ITS Channel/Outfall (Pass-thru)	6								Doesn't meet contraint for staying within the existing infrastructure	
Spillway	Bay 1 or Bay 18 (Flat Plate array)	7	4	5%	1	4	1	4	3		17.0
B2	B2CC (Pass-thru)	8	2	99%	2	4	3	5	1		23.3
Downstream	JBS Oufall Piers (Fin Array)	9	1	50%	1	5	1	1	1		11.5
	PIT barge in tailrace (Fin Array)	10	2	4%	5	5	5	1	1		21.5

7.2. PRELIMINARY COST ESTIMATES

The cost estimate for each Alternative is a Class 5 Rough Order Magnitude (ROM) estimate derived from a combination of sources such as Historical data, Quotes from Manufacturer, Engineering estimates from Structural, Mechanical, and Electrical Engineers The Class 5 construction cost estimate will include 20% contingency for all Alternatives.

The Class 5 construction cost estimate includes the cost associated with providing the required infrastructure and installation of the antenna system. This estimate does not includes the system programming, calibrating and final testing for a complete and functional system.

A Class 3 cost estimate will be provided for the Recommend Alternative and the Next Best Alternative, including the Total Project Cost Summary (TPCS).

7.3. Alternative Selection

To be completed at next milestone.

7.4. REGIONAL COORDINATION

Regional review of this EDR has been conducted through the Fish Facility Design Review Work Group (FFDRWG). FFDRWG review is part of the Corps' Proposed Action and 2019 Biological Opinion for the Columbia River System Operation (CRSO). The FFDRWG is comprised of representatives from federal, state, and tribal partners who work closely with the USACE to provide input to engineering and design of fish facility modifications and improvements at Corps-operated CRSO facilities. The FFDRWG has been briefed of progress throughout the study. Notes from FFRDWG meetings can be found online at http://pweb.crohms.org/tmt/documents/FPOM/2010/FFDRWG/FFDRWG.html. Comments received from the 60% and Draft Final EDR as well as responses are included in Appendix C (if necessary).

At the 06 June 2019 FFDRWG meeting a FFRWG member requested that the Corps consider biological information gained by the addition of additional passage routes as a consideration in the decision-making process. This request was incorporated into the decision matrix under the criteria 'Other Biological Uses'.

8. RECOMMENDATIONS

To be completed at next milestone.

APPENDIX A – HYDRAULIC DESIGN

To be completed at next milestone

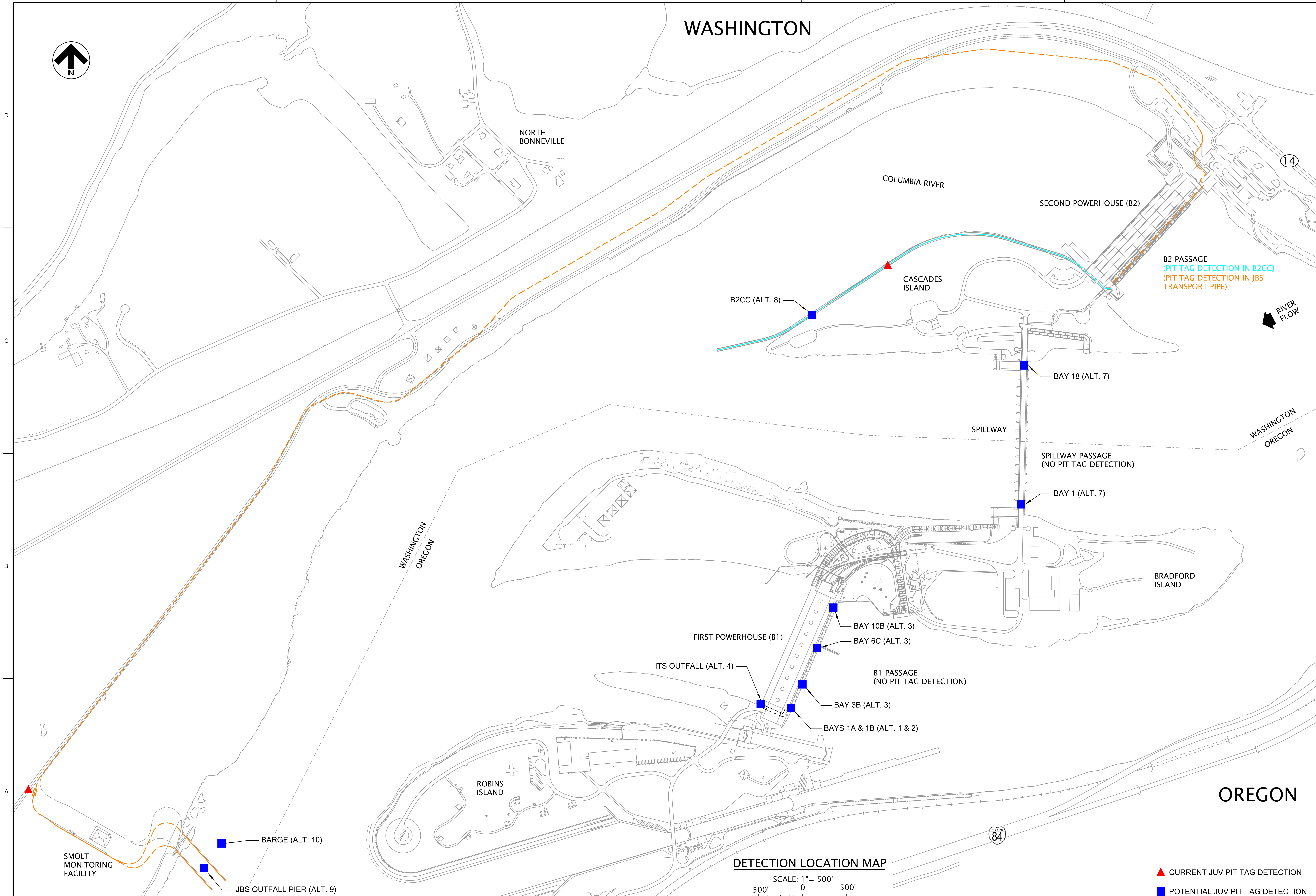
APPENDIX B – COST ESTIMATE

To be completed at next milestone

APPENDIX C – REGIONAL COORDINATION

To be completed at next milestone

PLATES



DETECTION LOCATION MAP

SCALE: 1"= 500'

500' 0 500'

US Army Corps of Engineers®
PORTLAND DISTRICT

60% REVIEW

MARK	DESCRIPTION	DATE	APPR.

U.S. ARMY CORPS OF ENGINEERS
PORTLAND DISTRICT
PORTLAND, OREGON

DESIGNED BY: B. BANNISTER
DATE:
DWN BY: G2ECDBDB
CKD BY: CKD BY
SOLICITATION NO.:
SUBMITTED BY: BILL FORTUNY, P.E.
CONTRACT NO.:
PLOT SCALE: 1:1
PLOT DATE: 7/25/2019
DRAWING NUMBER: DRAWING NUMBER
SIZE: ANSI D
FILE NAME: PLATE_G-001.dgn

BONNEVILLE LOCK AND DAM
JUVENILE FISH PASSAGE
PIT TAG DETECTION SYSTEM
PRECISION INCREASE PROTOTYPE

DETECTION LOCATION MAP

SHEET IDENTIFICATION
G-001