FA-04 FISH PASSAGE TECHNICAL STUDIES PROGRAM INTERIM REPORT

SKAGIT RIVER HYDROELECTRIC PROJECT FERC NO. 553

Seattle City Light

Prepared by:
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March 2022
Initial Study Report

TABLE OF CONTENTS

List of Figures

List of Tables

List of Attachments

List of Acronyms and Abbreviations

2-D .....two-dimensional
AACE.....Association for the Advancement of Cost Engineering International
AWS.....Agency Work Session(s)
cfs.....cubic feet per second
City Light.....Seattle City Light
DCD .....Design Criteria Document
FERC.....Federal Energy Regulatory Commission
HSC.....habitat suitability criteria
ISR .....Initial Study Report
LP.....licensing participant
LSPIV .....Large-Scale Particle Image Velocimetry
NMFS.....National Marine Fisheries Service
NPS .....National Park Service
O&M.....operations and maintenance
Project .....Skagit River Hydroelectric Project
RSP .....Revised Study Plan
SfM .....Structure from Motion
SPD .....Study Plan Determination
UAV.....unmanned aerial vehicle
USACE .....U.S. Army Corps of Engineers
USFWS .....U.S. Fish and Wildlife Service
USR.....Updated Study Report
WDFW.....Washington Department of Fish and Wildlife

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1.0 INTRODUCTION

The FA-04 Fish Passage Technical Studies Program (Fish Passage Study) is being conducted in support of the relicensing of the Skagit River Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) No. 553, as identified in the Revised Study Plan (RSP) submitted by Seattle City Light on April 7, 2021 (City Light 2021). On June 9, 2021, City Light filed a "Notice of Certain Agreements on Study Plans for the Skagit Relicensing" (June 9, 2021 Notice)[1] that detailed additional modifications to the RSP agreed to between City Light and supporting licensing participants (LP) (which include the Swinomish Indian Tribal Community, Upper Skagit Indian Tribe, National Marine Fisheries Service [NMFS], National Park Service [NPS], U.S. Fish and Wildlife Service [USFWS], Washington State Department of Ecology, and Washington Department of Fish and Wildlife [WDFW]). The June 9, 2021 Notice included agreed to modifications to the Fish Passage Study.

In its July 16, 2021 Study Plan Determination (SPD), FERC approved the Fish Passage Study with modifications. Specifically, FERC did not require City Light to convene an expert panel to review and provide opinions on the study results.[2]

This interim report on the 2021 study efforts is being filed with FERC as part of City Light's Initial Study Report (ISR). City Light will perform additional work for this study in 2022 and include a report in the Updated Study Report (USR) in March 2023.

[1] Referred to by FERC in its July 16, 2021 Study Plan Determination as the "updated RSP."

[2] City Light will continue discussions with LPs about if/when to engage an expert panel. As of February 15, 2022, City Light has not convened an expert panel and does not intend to do so unless LPs specifically request it during future study stages.

2.0 STUDY GOALS AND OBJECTIVES

This Fish Passage Study addresses the following two elements:

(1) An assessment of upstream passage potential for a selected group of target fish species under varying flow regimes at two existing features in the Gorge bypass reach, defined as the 2.5-mile section of the Skagit River from Gorge Dam to the Gorge Powerhouse (i.e., Fish Passage Assessment of Existing Features in the Gorge Bypass Reach); and

(2) An assessment to determine the feasibility of providing upstream and downstream passage for target fish species at the Project developments, including conceptual designs and preliminary cost estimates for selected alternatives (i.e., Fish Passage Facilities Alternatives Assessment).

These elements will be addressed concurrently under a two-year study schedule to be completed by March 2023. A summary of progress to date for each study element is provided herein. Each element of the study has unique goals and objectives, as discussed in the following sections.

2.1 Fish Passage Assessment of Existing Features in the Gorge Bypass Reach

The purpose of the Fish Passage Assessment of Existing Features in the Gorge Bypass Reach[3] is to characterize fish passage potential in the Gorge bypass reach. This study element will evaluate potential ranges of flow under which two existing features in the Gorge bypass reach may be passable by the target species under consideration. These features, termed Existing Feature 1 and Existing Feature 2, are located approximately 10,000 feet and 7,600 feet downstream of Gorge Dam, respectively. City Light identified five target species for fish passage evaluation in the Gorge bypass reach: steelhead (*Oncorhynchus mykiss*); Chinook (*O. tshawytscha*), Coho (*O. kisutch*), and Sockeye (*O. nerka*) salmon; and Bull Trout (*Salvelinus confluentus*).

2.2 Fish Passage Facilities Alternatives Assessment

The purpose of the Fish Passage Facilities Alternatives Assessment is to investigate biological, physical, operational, and engineering factors, and using those factors, determine the feasibility of providing safe, timely, and effective fish passage at any or all of the three Project developments. In the RSP, City Light (2021) identified five target species for fish passage evaluation: steelhead; Chinook, Coho, and Sockeye salmon; and Bull Trout. However, as discussed in Section 2.4 of this study report, the June 9, 2021 Notice identified several additional species to be evaluated under other relicensing studies to investigate species presence and passage flows in the Gorge bypass reach. During meetings and workshops conducted for this study to date, LPs requested that these additional species also should be considered for passage at the Project developments.

Following the collection of existing biological, physical, and operational criteria for fish passage, this element of the study will include the development of concept-level upstream and downstream passage facilities that may involve alternatives at the Ross, Diablo, or Gorge developments and/or for the system of all three developments as a whole. Alternatives will be reviewed by LPs, who will provide input on the study for all phases of data collection and conceptual fish passage

[3] Previously referred to as the Fish Passage Barrier Assessment in the Fish Passage Study RSP (City Light 2021).

alternative development. Planning-level concepts will consider both volitional (non-directive) and directive fish passage strategies where applicable. Upstream and downstream passage concepts will be configured to accommodate unique physical, operational, and site constraints of the existing facilities and the overall Project reach. All concepts will be developed consistent with the engineering principles, criteria, and guidelines contained in NMFS (2011), WDFW (2000a, 2000b), and Bell (1991), to the extent practicable. Other factors affecting technical viability, Project modifications, and/or potential biological limitations of each alternative will be identified. Upon completion of concept-level fish passage facility options, planning-level opinions of probable construction costs appropriate to reconnaissance level investigations will be completed consistent with the Association for the Advancement of Cost Engineering International (AACE) Cost Estimate Classification System, Class 5 standardized guidelines (AACE 2003). The goal of the engineering assessment for fish passage options is to determine if specific conceptual scenarios are constructable, if they are able to perform at a customary standard set by the fisheries management agencies, and at what cost, within the standards of accuracy provided in AACE (2003).

When available, this element of the Fish Passage Study will integrate into the conceptual design process the results of the FA-07 Reservoir Tributary Habitat Assessment (City Light 2022b) and, as appropriate, results of other studies conducted during relicensing. The purpose will be to identify constraints and assess benefits and risks of providing fish passage and access to habitats upstream of the Project dams, consistent with the approach recommended in Anderson et al. (2014).

2.3 Fish Passage Study June 9, 2021 Notice Commitments

The June 9, 2021 Notice identified four additional commitments related to the Fish Passage Study:

- City Light will identify fish passage flow windows at any partial potential impediments, which will be partially identified through use of the Bypass Hydraulic Model being developed as part of the FA-05 Skagit River Gorge Bypass Reach Hydraulic and Instream Flow Model Development Study (Bypass Instream Flow Model Development Study).
- City Light will provide an opportunity for LPs to identify alternatives and provide input on the fish passage feasibility study.
- City Light will assess overall feasibility of fish passage alternatives but without providing a feasibility engineering design (akin to a 30 percent engineering design level) for fish passage alternatives.
- City Light will modify the Fish Passage Study to clarify that the expert panel serves in an advisory capacity only and only for such study products for which review is requested. Protocols for requesting expert panel review, performance of reviews, and responses to reviews will be agreed to during the course of the study. NMFS will not accept unsolicited expert panel advisory opinions.[4]

[4] In its SPD for the Skagit Project, FERC (2021) did "not recommend that City Light be required to convene an expert panel to review and provide opinions on the study results." However, City Light will continue discussions with LPs about when/if to engage an expert panel.

2.4 June 9, 2021 Notice Commitments Under Other Studies Being Addressed as Part of Fish Passage Study

Although not FA-04 Fish Passage Study commitments in the June 9, 2021 Notice, City Light agreed to address fish passage at the Gorge Dam plunge pool and study the passage, incidental or targeted, of several additional fish species for both elements of the study in consideration of the following commitments made under the FA-05 Bypass Instream Flow Model Development Study:

- City Light will, to the extent necessary, evaluate downstream and upstream fish passage at the Gorge Dam plunge pool.
- City Light clarified that the FA-05 study plan will allow for passage consideration of the following additional species for flow analysis of existing features in the Gorge bypass reach:
  - Pink Salmon (*Oncorhynchus gorbuscha*).
  - Chum Salmon (*O. keta*).
  - Sea-Run Cutthroat (*O. clarki clarki*).
  - Pacific Lamprey (*Entosphenus tridentatus*).
- City Light agreed to consider the following species as present in the Gorge bypass reach:
  - Pacific Lamprey (*Entosphenus tridentatus*).
  - Salish Sucker (*Catostomus catostomus*).
  - Dolly Varden (*Salvelinus malma*).

During technical workshops and meetings conducted for the Fish Passage Study in 2021, LPs referenced these commitments for the FA-05 Bypass Instream Flow Model Development Study and requested that City Light consider the same list of additional species for the Fish Passage Study. In response, City Light agreed that, in addition to those species originally considered for passage evaluation in the RSP, the study also will consider the species in the FA-05 commitments listed above. Therefore, both elements of the Fish Passage Study will consider the following species for targeted or incidental passage:

- Steelhead
- Chinook Salmon
- Pink Salmon
- Chum Salmon
- Bull Trout
- Sea-run Cutthroat Trout
- Coho Salmon
- Sockeye Salmon
- Pacific Lamprey
- Dolly Varden
- Salish Sucker[5]

[5] Upstream and downstream passage for Salish Sucker will be considered incidental to passage for other species as specific biological passage criteria and abundance in the Skagit River are unknown.

3.0 STUDY AREA

The Fish Passage Study area encompasses the Project from the Gorge Powerhouse to the upstream end of Ross Lake, thereby including all of the Gorge, Diablo, and Ross developments (Figure 3.0-1 and Figure 3.0-2). The study area also includes portions of the Gorge bypass reach below Gorge Dam that are outside the Project Boundary as defined under the current license.

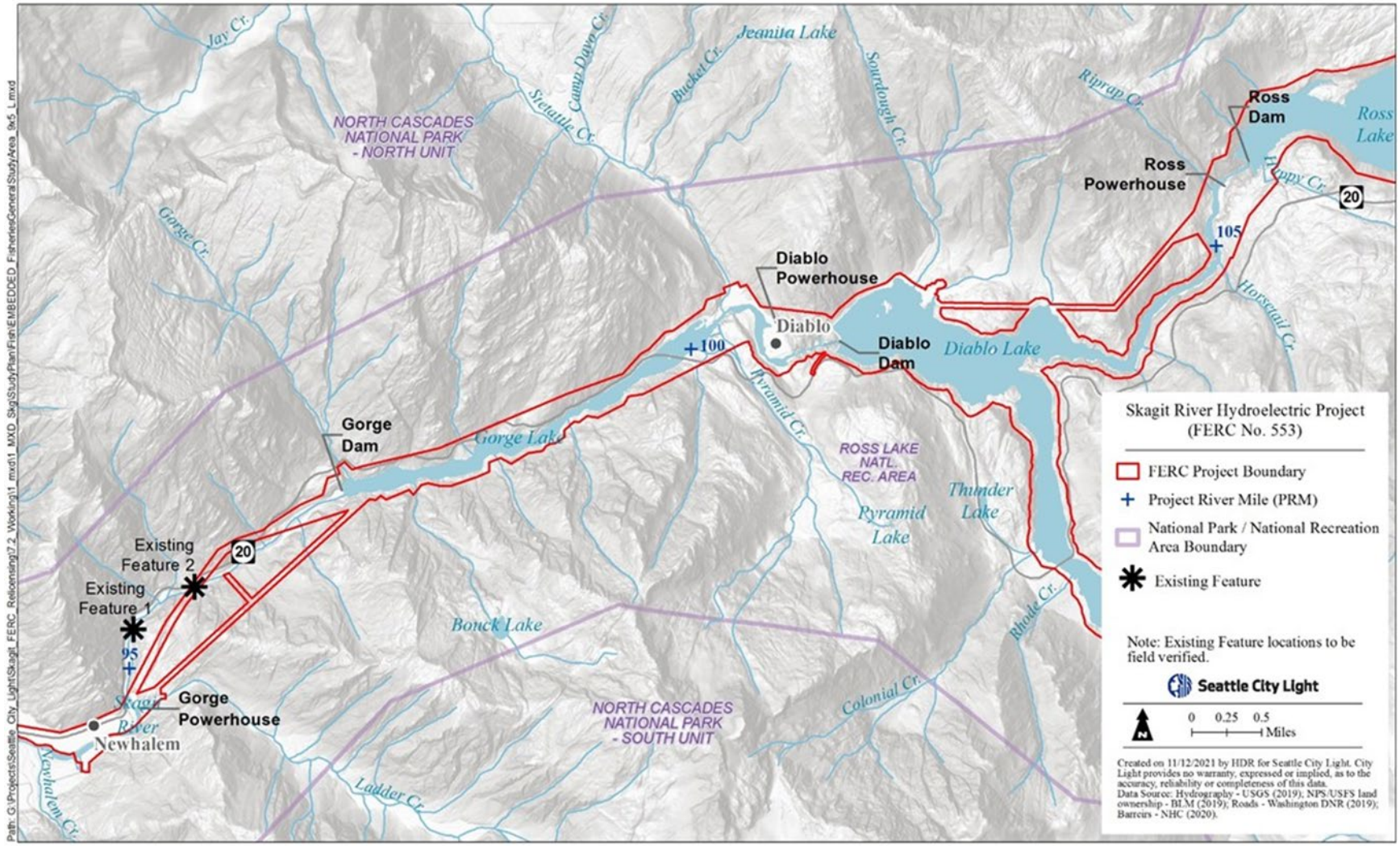

Figure 3.0-1. Study area for the Fish Passage Study.

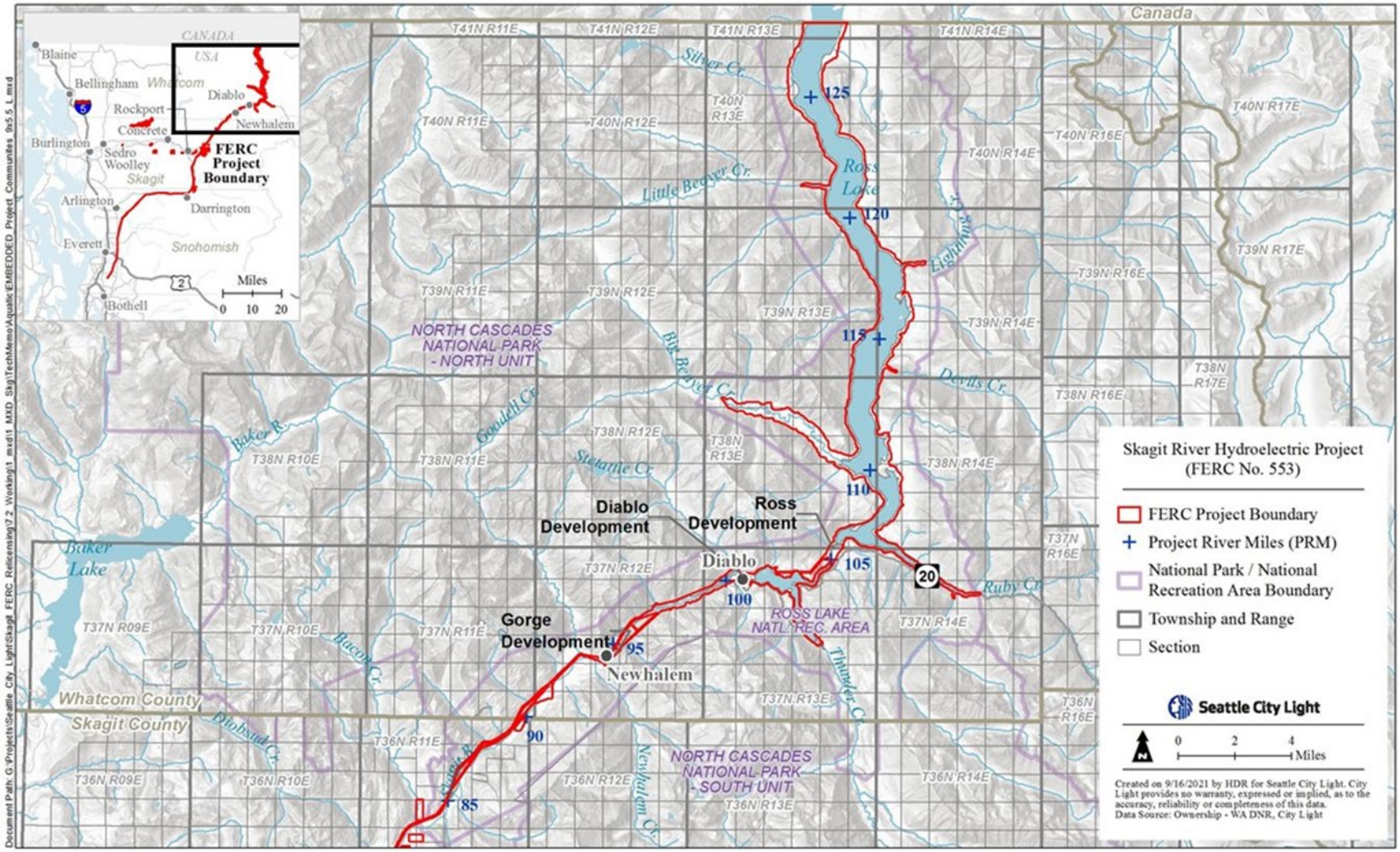

Figure 3.0-2. Project showing all developments to the Canadian border.

4.0 METHODS

4.1 Methods Common to Both Fish Passage Study Elements

City Light included resource agency fish passage engineers to execute each element of the study. Coordination has included the execution of technical workshops with LPs and the establishment of bi-weekly meetings with fish passage experts from agencies and Indian Tribes, as well as interested LPs, to discuss study progress, solicit input, and establish a more frequent series of engagements to maintain consistent communication and collaboration among LPs, City Light, and the study team. A summary of coordination opportunities and discussions completed to date is presented in Section 5.1 of this study report. For both elements of this study (data collection and meeting/report summary activities) the cutoff date for this report was January 2022.

City Light hosted technical workshops with interested LPs throughout 2021 to inform the development of conceptual design criteria for fish passage and to discuss ongoing study progress. The dates and content of each technical workshop are summarized in Section 5.1.3 of this study report.

An additional method common to both study elements is the participation of the study team on a site visit to the Project study area and nearby similar facilities. These site visits took place to familiarize the study team with on-site conditions and to better inform the execution of both study plan elements. Site visits are summarized in Section 5.3.1 of this study report.

4.2 Methods Specific to the Fish Passage Assessment of Existing Features in the Gorge Bypass Reach

This element of the Fish Passage Study is closely linked to and coordinated with the FA-05 Bypass Instream Flow Model Development Study because one objective of this element of the Fish Passage Study is to identify ranges of river flows that may provide adequate hydraulic conditions for target species to ascend the Gorge bypass reach to the base of Gorge Dam. As defined in Section 2.6.2 of the Fish Passage Study RSP (City Light 2021), one of the initial steps of this assessment included a field investigation to characterize and document the physical structure of two existing features in the Gorge bypass reach, Existing Feature 1 and 2, that have been identified as potential impediments to passage. These field investigations were completed in the summer of 2021, and data is summarized in Section 5.2.1 of this study report. In 2022, the study team will synthesize data collected during these investigations and perform a multi-faceted fish passage assessment of the existing features. This assessment will include outputs from the Bypass Hydraulic Model to estimate the flow range(s) under which upstream passage of the target species would be possible. The study team will conduct this assessment by reviewing physical data, including observations of several target fish species presence in the Gorge bypass reach, and compare this information to known factors that influence fish passage for those species.

As described in Section 2.6.3 of the RSP (City Light 2021), results from data synthesis and the Bypass Hydraulic Model will be used to compare simulated flow depth, velocity, and distance to adjacent holding areas with a target fish's swimming speeds and anticipated time to exhaustion (endurance). Pathways and corresponding ranges of flow that appear to allow for upstream navigation and those that do not will be reported. In addition to the Bypass Hydraulic Model, fish passage potential at existing features will consider visual observation of the Gorge bypass reach,

which will be accomplished through review of the physical data (e.g., velocity and depth) obtained from channel transects, time-lapse camera photography, aerial photogrammetry taken by unmanned aerial vehicle (UAV), Structure from Motion (SfM) orthomosaic development, and Large-Scale Particle Image Velocimetry (LSPIV) analysis.[6]

4.3 Methods Specific to the Fish Passage Facilities Alternatives Assessment

As described in Section 2.6.1 of the Fish Passage Study RSP (City Light 2021), the study team is implementing a three-stage process for assessing the feasibility of upstream and downstream fish passage at the Project, including the development of:

(1) Fish passage conceptual design criteria;

(2) Fish passage concept-level designs; and

(3) A fish passage feasibility assessment.

The methods associated with each of the three stages are described in detail below.

4.3.1 Fish Passage Conceptual Design Criteria

City Light considered LP input from technical workshops for the overall Fish Passage Study and assembled existing biological, physical, and operational data for each Project development to draft a Preliminary Draft Fish Passage Facilities Alternatives Assessment Conceptual Design Criteria Document (DCD) and a Revised Draft DCD that considered LP comments and feedback and included additional metrics and data. Following Technical Workshop 3 in December 2021, the study team finalized the DCD, and submitted the Final DCD (Attachment F) to LPs in February 2022. Upon finalization of the DCD, the study team proceeded to the next stage of this study element—fish passage concept-level designs. The various meetings and technical workshops will continue until the completion of the Fish Passage Study.

4.3.2 Fish Passage Concept Development

In early 2022, the study team will proceed with developing concept-level upstream and downstream fish passage alternatives and their estimated costs. The study team will develop functional site layouts, process descriptions and diagrams, facility sizing, general design parameters, expected fish capture and survival efficiencies, and opinions of probable costs for select fish passage alternatives. Generally, the work undertaken to develop the Fish Passage Concept Development Report will include the following:

- Complete concept-level facility layouts and configurations of fish passage and auxiliary structures for each alternative in accordance with the requirements contained in the DCD, including necessary construction requirements (e.g., cofferdams), modifications to existing Project structures, and features needed for fish passage operations and maintenance (O&M) purposes (e.g., permanent access facilities);

[6] Implementation of Large-Scale Particle Image Velocimetry (LSPIV) was included as a supplemental study methodology after development of the RSP and added voluntarily by City Light. The results of the LSPIV analysis indicate that no useful information will be generated to support the Fish Passage Study.

- Prepare a list of potential facility operational changes that may be associated with construction or operations of the fish passage facilities;
- Develop an estimate of reasonably expected performance of the facilities consistent with site characteristics identified in the DCD and/or prepare a list of additional information needed to provide such estimates;
- Develop site layouts and constructability to the level consistent with generally accepted engineering practice for planning/reconnaissance level studies (e.g., U.S. Bureau of Reclamation 2012; U.S. Army Corps of Engineers [USACE] 2000; USACE 1999; AACE 2003);
- Prepare an estimate for the annual O&M costs associated with each fish passage concept alternative;
- Hold Technical Workshops 4 and 5 to review progress during the concept development work; and
- Prepare draft and final Fish Passage Concept Development reports.

4.3.3 Fish Passage Assessment

The study team has identified fish passage concepts that appear viable and that are consistent with the requirements of the DCD. The options for which concepts will be developed include those discussed during Technical Workshop 3 in December 2021, and further refined during subsequent Agency Work Session (AWS) meetings in January 2022. Each technical option for facilitating fish passage above Gorge Dam and/or Gorge Powerhouse will be evaluated in three ways:

(1) Its ability to be engineered, constructed, and operated in the context of site geology, existing Project and non-Project structures, site hydrology, reservoir and riverine operations, and safety requirements (i.e., technical feasibility);

(2) Its ability to operate without significantly interfering with existing Project and non-Project uses; and

(3) Its ability to meet customary performance standards established for similar facilities, such as facility collection efficiency, survival through the passage facility, and overall Project-wide passage effectiveness.

Habitat availability and quality upstream of the Project dams, based on the results of the FA-07 Reservoir Tributary Habitat Assessment (City Light 2022b), will also influence whether a passage alternative would benefit anadromous fish populations.

5.0 PRELIMINARY RESULTS

5.1 Preliminary Results Common to Both Fish Passage Study Elements

As presented in Section 4.1 of this study report, the data collection cutoff date for this study report was January 2022 for both elements of the Fish Passage Study. Relative to meetings and reporting, summaries are included for meetings and products completed to January 10, 2022. Meetings that will take place in 2022 are summarized as future milestones in Section 6.4 of this study report. Although common to both study elements, technical workshops and meetings that have taken place in 2021 have focused primarily on the Fish Passage Facilities Alternatives Assessment because the synthesis of data collected and the development of the Bypass Hydraulic Model that will be used to support the Fish Passage Assessment of Existing Features in the Gorge Bypass Reach is ongoing through early 2022 and concurrent with the development of this study report.

5.1.1 Collaboration with Licensing Participants

From the outset of this study, City Light has coordinated with LPs through several types of engagement opportunities to facilitate frequent communication and collaboration. Engagement opportunities have included review of the Preliminary and Revised draft DCDs, co-development of agendas for technical workshops, participation in technical workshops as defined in the RSP (City Light 2021), and participation in bi-weekly AWS with a technically based group of LPs (Figure 5.1-1). Feedback and shared information obtained from LPs during these collaborative engagements will continue to be incorporated into study reports through the duration of the Fish Passage Study.

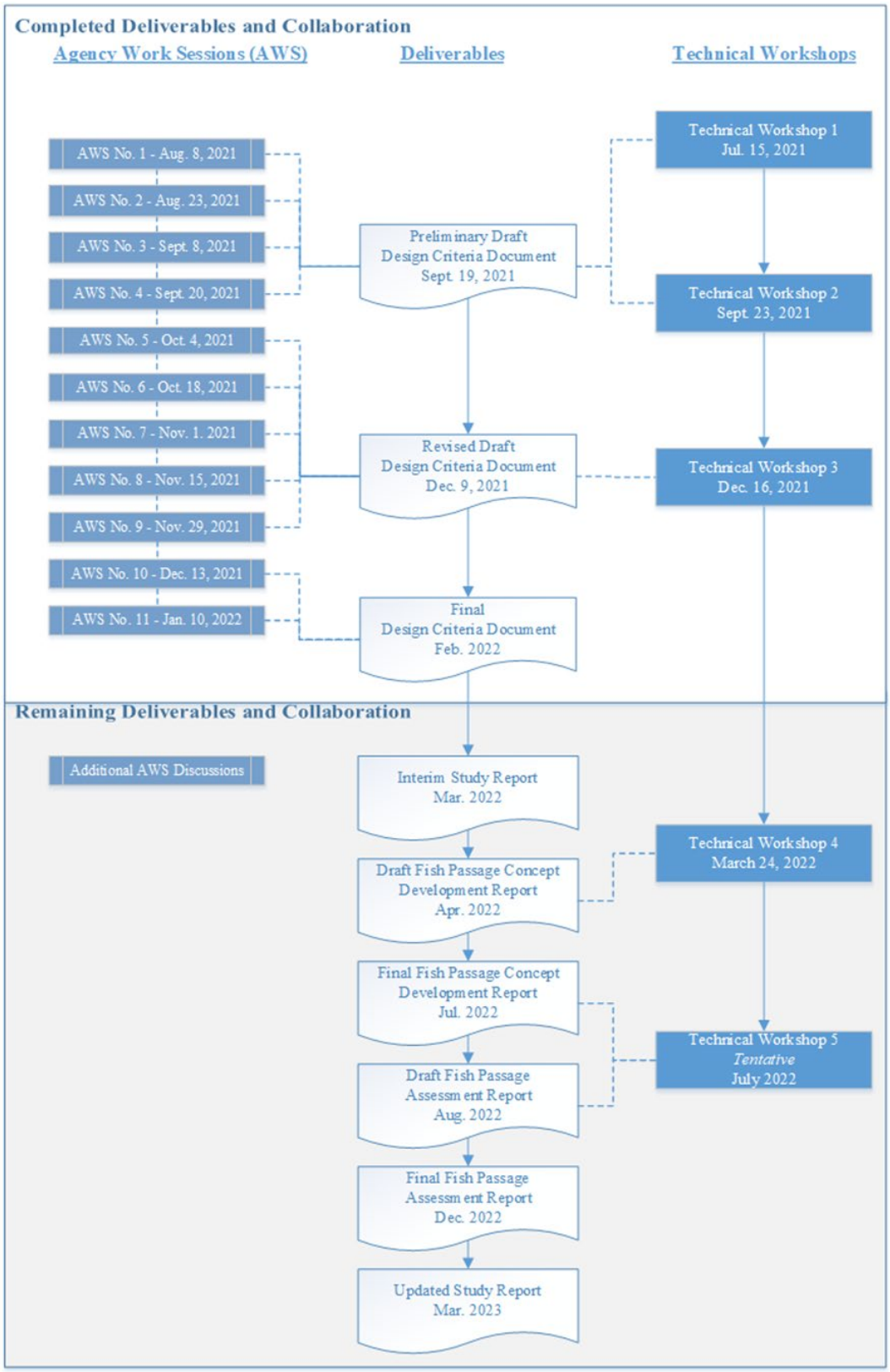

Figure 5.1-1. Summary of deliverables and LP collaboration process.

5.1.2 Review of Preliminary and Revised Draft DCD

The Preliminary Draft DCD was submitted to LPs prior to the Fish Passage Study Technical Workshop 2, held on September 23, 2021. Comments and information received following Technical Workshop 2 were considered and incorporated into the Revised Draft DCD. Comments received for the Preliminary Draft DCD that required additional discussion or clarification were discussed among a smaller group of fish passage experts and interested LPs during bi-weekly AWS that have been established as part of this study (see Section 5.1.4 of this study report).

The Revised Draft DCD was prepared with the information available at the time of its issue and was submitted to LPs in December 2021, prior to Technical Workshop 3. Feedback obtained from LPs during technical workshops and AWS discussions has been incorporated into the Final Draft, which was submitted to LPs in February 2022, and is attached to this study report (Attachment F).

5.1.3 Technical Workshops

From the initiation of the Fish Passage Study in June 2021 through January 2022, City Light has hosted three fish passage technical workshops. In advance of each technical workshop, City Light hosted an agenda-setting meeting with a small group of LPs (primarily those who attend the AWS) to ensure that the content of each workshop aligned with expectations and to capture any additional requested discussions or direction. Technical workshop agendas for the July, September, and December 2021 technical workshops (Technical Workshops 1, 2, and 3) are included in Attachments A – C of this study report.

In preparation for and during these technical workshops, the study team gathered and presented biological, physical, and operational information, including biological performance data, where available, for high-head dam fish passage facilities in the Pacific Northwest. The content of each technical workshop is summarized below.

5.1.3.1 Technical Workshop 1, July 15, 2021

Technical Workshop 1 agenda topics included the following:

- June 9, 2021 Notice on the Fish Passage Study.
- An overview of the RSP (City Light 2021) and detailed schedule.
- A list of target species to be selected for passage for each element of the study, with a request for concurrence.
- The development of the AWS as a mechanism to establish a frequent collaboration and communication channel.
- A discussion of the fish passage criteria to be applied to the Fish Passage Assessment of Existing Features in the Gorge Bypass Reach.
- A discussion on the status of the related FA-05 Bypass Hydraulic Model Development Study and how it will inform development of the Fish Passage Assessment of Existing Features in the Gorge Bypass Reach.

The agenda, presentation, and meeting notes (prepared by Triangle Associates) for Technical Workshop 1 are provided in Attachment A of this study report.

5.1.3.2 Technical Workshop 2, September 23, 2021

Prior to Technical Workshop 2, the study team prepared the first deliverable for the Fish Passage Study, the Preliminary Draft DCD. Technical Workshop 2 agenda topics included the following:

- An overview of the Preliminary Draft DCD, including content, data sources, and resulting considerations that may be used to formulate fish passage strategies and facility alternatives.
- A review of the DCD milestones, including a request for LP comments by October 7, 2021.
- A discussion of biological data obtained to date, primarily from publicly available information, and the identification of data gaps and potential data sources required to progress to the next stage of the Fish Passage Facilities Alternatives Assessment.
- A review of potential fish passage strategies and technologies that may be considered for future evaluation and alternatives assessment.
- Existing biological performance information at Pacific Northwest fish passage facilities and discussion on the development of performance criteria for Project requirements.

The agenda, presentation, and meeting notes (prepared by Triangle Associates) for Technical Workshop 2 are provided in Attachment B of this study report.

5.1.3.3 Technical Workshop 3, December 16, 2021

Prior to Technical Workshop 3, the study team prepared and submitted the Revised Draft DCD. Technical Workshop 3 agenda topics included the following:

- An overview of changes incorporated into the Revised Draft DCD, based on LP comments on the Preliminary Draft DCD.
- A proposed list of upstream and downstream passage options for each development as discussed with LPs during several AWS that took place in November 2021.
- A discussion, with the intention for concurrence on the list of fish passage options to be carried forward into the next stage of the Fish Passage Facilities Alternatives Assessment.

The agenda, presentation, and meeting notes (prepared by Triangle Associates) for Technical Workshop 3 are provided in Attachment C of this study report.

5.1.4 Agency Work Sessions

During the first Fish Passage Study technical workshop, held on July 15, 2021, the City Light introduced a new element of the study to increase LP engagement and the frequency at which LPs were consulted, informed, and participated in study discussions. The new element established bi-weekly AWS, consisting of discussions hosted by the City Light, and attended by a small group of fish passage experts and interested LPs from NMFS, USFWS, WDFW, the NPS, the Upper Skagit Indian Tribe, the Swinomish Indian Tribal Community, and the Skagit River System Cooperative.

The AWS provide a consistent forum for frequent collaboration among the AWS participants on all elements of the Fish Passage Study. This bi-weekly communication allows for a rigorous

assessment of the factors influencing the viability and potential effectiveness of fish passage at the Project developments and is an effective forum for the active involvement of resource agency and Tribal biologists and engineers who have specific fish passage or related experience or have co-management responsibilities for fish resources in the Skagit River basin. Meeting participants are encouraged to engage in these sessions as frequently as possible to provide insights and opinions regarding ongoing and future elements of the Fish Passage Study.

The inaugural AWS was held on August 8, 2021, and meetings have taken place every other week since the inception date through January 2022. Typical LP attendance includes one or two representations from each of the participating groups (i.e., NMFS, USFWS, WDFW, NPS, the Upper Skagit Indian Tribe, the Swinomish Indian Tribal Community, and the Skagit River System Cooperative). Summary notes for each AWS, which occurred virtually, are included as Attachment D of this study report, and a brief overview of the discussion content for each meeting held through January 10, 2022, is provided below.

5.1.4.1 AWS No. 1 (August 8, 2021)

Summary of Discussion Topics

- Allowed for participant introductions and background.
- Defined goals and objectives of AWS.
- Provided Fish Passage Study progress and schedule of future milestones.

Agreements and Outcomes

- The study team will provide a review of fish passage study development in detail in next meeting.
- Present outline for Preliminary Draft DCD in next meeting.
- Group agreed that meeting notes will be made available to LPs and posted to Triangle Associates' SharePoint site.
- Agendas for each subsequent meeting will be sent to LPs in advance of the next call.

5.1.4.2 AWS No. 2 (August 23, 2021)

Summary of Discussion Topics

- Discussed data needs and linkages to development of fish passage strategies and conceptual designs.
- Discussed approach for filling data gaps.
- Discussed general strategy for developing passage strategies and concepts.
- Provided Fish Passage Study progress and schedule of future milestones.

Agreements

- The study team will provide list of data needs and distribute to LPs prior to next AWS call, for future discussion.
- The AWS members will serve as liaisons for the greater LP group, including co-managers.

- Linkages to how other studies will influence this study will continue to be refined and identified.

5.1.4.3 AWS No. 3 (September 8, 2021, delayed due to Labor Day holiday)

Summary of Discussion Topics

- Provided LPs with high-level request for information tracking table for data needs.
- Discussed development of table and provided a summary of data collected to date.
- Discussed need for more specific data on fish abundance, timing, peak migration timing, reservoir transit behavior, and survival of juvenile outmigrants.
- Discussed periodicity and information to be obtained from habitat suitability criteria (HSC) technical team under study FA-02 Instream Flow Model Development Study.
- Presented examples of how data is used to inform fish passage design.
- Provided Fish Passage Study progress and schedule of future milestones.

Agreements

- Subsequent meetings will continue to discuss data needs.
- Request for Information tracking table will include cultural resources.
- Lamprey will be added to periodicity considerations for passage.

5.1.4.4 AWS No. 4 (September 20, 2021)

Summary of Discussion Topics

- Continued discussion of Request for Information tracking table and data needs.
- Discussed refinement of target species list for passage considerations, and the preferred use of the word "target" versus "focal."
- Study team requested information for lamprey and Salish Sucker (*Catostomus* sp.) occurrence and periodicity in upper Skagit River.
- Provided Fish Passage Study progress and schedule of future milestones.

Agreements

- Progress on Preliminary DCD comments will be discussed at next AWS.
- The study team will update periodicity table per HSC refinements.

5.1.4.5 AWS No. 5 (October 4, 2021)

Summary of Discussion Topics

- Held high-level discussion on Preliminary DCD comments and reminder that comments are requested by October 7, 2021.
- Reviewed facilities assessment process and LP study request comments, and the need to review biological goals and engineering feasibility.

- Discussed the typical process for establishing fish passage programs at barriers (including high dams), which includes the establishment of goals and objectives, along with benefits, risks, and constraints per McClure et al. (2018); a range of alternatives can be developed following the establishment of these parameters. Provided Fish Passage Study progress and schedule of future milestones.

Agreements

- Next meeting agenda will focus on goal setting, including a brainstorming event to encourage LP participation using a web-based platform.
- Subsequent AWS will focus on a determination of goals, objectives, benefits, risks, and constraints for fish passage, as desired by LPs.

5.1.4.6 AWS No. 6 (October 18, 2021)

Summary of Discussion Topics

- Held brief discussion on NMFS' comments on Preliminary Draft DCD (received October 14, 2021), including request to LPs for information on fish sizes as requested by NMFS.
- Initiated discussion on goal setting, including refresher on general definitions of goals and how they are used to inform fish passage concepts and designs.
- Initiated brainstorming session was paused based on feedback from LPs. The consensus among AWS participants was that establishing biological, ecological, and fisheries resource management goals for fish passage is a co-manager, policy-level discussion that should not occur as part of the Fish Passage Study, but rather will be informed by concurrent studies and agency/Tribal discussions in the future, with consideration of recovery planning targets and current and future harvest objectives.
- Discussion on goals pivoted to discussion on fish passage strategies and proposed that future AWS be more technical in nature, focusing on brainstorming the range of fish passage options that may be considered throughout each of the three Project developments.
- Provided Fish Passage Study progress and schedule of future milestones.

Agreements

- Various LPs agreed to explore their data sources for information on Skagit River-specific fish sizes.
- This study will not establish biological goals and objectives for fisheries resource management but rather will consider biological requirements of target species within the anticipated operating environments of the Gorge, Diablo, and Ross developments. These factors will inform a range of upstream and downstream passage facility alternatives that may be evaluated as part of the study.

5.1.4.7 AWS No. 7 (November 1, 2021)

Summary of Discussion Topics

- Study team reiterated the request for Skagit River-specific data on fish weights.

- Held brief discussion of comments on Preliminary Draft DCD from USFWS (received October 21, 2021), and acknowledgement of receipt of comments from Upper Skagit Indian Tribe (received October 29, 2021).
- Initiated brainstorming session on upstream and downstream passage alternatives, constraints, and issues for the Gorge Dam.
- Brainstorming session focused on technical options, criteria, and design considerations for passage; however, potential fisheries management options were considered as applicable to how and where fish would be transported (e.g., reservoir transit and tributary collection strategies).
- LPs expressed desire for full range of all feasible passage considerations—everything should be considered now, and feasibility will determine which options might progress to the next stage of the Fish Passage Study.
- Provided Fish Passage Study progress and schedule of future milestones.

Agreements

- A comprehensive range of fish passage alternatives and strategies should be considered and documented at this stage; all options should be considered up front and eliminated in subsequent stages as feasibility is assessed.
- LPs will explore data on Skagit River-specific fish sizes.
- Diablo Dam fish passage alternatives will be discussed during the next AWS.

5.1.4.8 AWS No. 8 (November 15, 2021)

Summary of Discussion Topics

- Study team reiterated the request for Skagit River-specific data on fish weights.
- Held brief discussion of comments on Preliminary Draft DCD and preparation of comment response matrix that will be provided with the Revised Draft DCD.
- Initiated brainstorming session on upstream and downstream passage alternatives, constraints, and issues for the Diablo Dam.
- Brainstorming session focused on technical options, criteria, and design considerations for passage, and included volitional and non-volitional options (e.g., trap and haul), as well as tributary collections.
- Identified initial constraints for several options that will be considered in future AWS and technical workshop discussions.
- Provided Fish Passage Study progress and schedule of future milestones.

Agreements

- A comprehensive range of fish passage alternatives and strategies should be considered and documented at this stage; all options should be considered up front and eliminated in subsequent stages as feasibility is assessed.
- Study team will prepare next meeting's agenda to include:

- Review results of alternatives setting exercise and discussion for the Diablo Development.
- Fish Passage Options brainstorming exercise and discussion for the Ross Development.

5.1.4.9 AWS No. 9 (November 29, 2021)

Summary of Discussion Topics

- Study team reiterated the request for Skagit River-specific data on fish weights.
- Held brief discussion of comments on Preliminary Draft DCD and preparation of comment response matrix that will be provided with the Revised Draft DCD.
- Reviewed results of the Diablo Dam fish passage options discussed during previous AWS.
- Initiated brainstorming session on upstream and downstream passage alternatives, constraints, and issues for the Ross Dam.
- Brainstorming session focused on physical conditions, technical options, criteria, and design considerations for passage, and included volitional and non-volitional options (e.g., trap and haul), as well as tributary collections.
- Identified initial constraints for several options that will be considered in future AWS and technical workshop discussions.
- Provided Fish Passage Study progress and schedule of future milestones.

Agreements

- A comprehensive range of fish passage alternatives and strategies should be considered and documented at this stage; all options should be considered up front and eliminated in subsequent stages as feasibility is assessed.
- Study team will prepare next meeting's agenda to include:
  - Review results of alternatives setting exercise and discussion for the Ross Development.
  - Discuss factors that influence the technical feasibility of fish passage options and inform alternative selection.
  - Discuss methods for option development and selection that will be discussed in more detail during Technical Workshop No. 3.

5.1.4.10 AWS No. 10 (December 13, 2021)

Summary of Discussion Topics

- Study team reiterated the request for Skagit River-specific data on fish weights.
- Held brief discussion of Revised Draft DCD, submitted to LPs on December 9, 2021, and requested comments on the DCD by January 6, 2022.
- Reviewed brainstorming session for fish passage options at Ross Development as discussed during the previous AWS meeting.
- Discussed factors that influence the technical feasibility of fish passage options and inform alternative selection.

- Discussed methods for option development and selection that will be discussed in more detail during Technical Workshop No. 3.
- Provided Fish Passage Study progress and schedule of future milestones.

Agreements

- A comprehensive range of fish passage alternatives and strategies should be considered and documented at this stage; all options should be considered up front and eliminated in subsequent stages as feasibility is assessed.
- Study team will prepare next meeting's agenda to include:
  - Discussion of Revised Draft DCD comments received to date.
  - Review of fish passage options and discussions from Workshop 3, held December 16, 2021.
  - Refine fish passage options to be carried into Stage 2 of the Fish Passage Facilities Alternatives Assessment.

5.1.4.11 AWS Discussion No. 11 (January 10, 2022)

Summary of Discussion Topics

- Held brief discussion of comments received to date on Revised Draft DCD and stated that a revised comment response matrix will be provided with the Final Draft.
- Reviewed fish passage options discussed during Workshop 3, held December 16, 2021.
- Presented reformulation of fish passage options, including Options 1A, 1B, and 1C, and held discussion on each option. Requested concurrence from LPs on recommended list of options to advance to next stage of the Fish Passage Facilities Alternatives Assessment.
- Discussed options not recommended to advance to the next stage of the study, and rationale for elimination.
- Provided Fish Passage Study progress and schedule of future milestones.

Agreements

- Options 1A–C are to move forward and be evaluated as part of the Concept Development Report (Stage 2 of the Fish Passage Facilities Alternatives Assessment).
- Options and technologies that were eliminated from further consideration will be documented with explanations in the Final DCD.
- Study team will prepare next meeting's agenda to include:
  - Review of fish passage options selected for advancement to Stage 2 of the Fish Passage Facilities Alternatives Assessment, per previous AWS meeting.
  - Review of outline and schedule for Stage 2 deliverable – Concept Development Report.
  - Progress report on Fish Passage Assessment of Existing Features in Bypass Reach.

5.2 Fish Passage Assessment of Existing Features in the Gorge Bypass Reach

This assessment will occur following the completion of the Bypass Hydraulic Model, which is currently underway as part of the FA-05 Bypass Instream Flow Model Development Study. The status of commitments on the June 9, 2021 Notice for this element of the study is summarized below.

Although this element of the Fish Passage Study has not yet been initiated, data to inform this assessment was collected in 2021 as part of the FA-05 Bypass Instream Flow Model Development Study. A memorandum summarizing data collected in 2021 is included in Attachment B of City Light's FA-05 Bypass Instream Flow Model Development Study report (City Light 2022b), and is briefly summarized below. As described in Section 4.2 of this study report, for this study element, the study team will consider, among many other factors, the results of Bypass Hydraulic Model that is currently under development for the Gorge bypass reach as well as visual observation of the Gorge bypass reach, which will be accomplished through the review of time-lapse camera photography, aerial photogrammetry taken by UAV, SfM orthomosaic development, and LSPIV analysis.

5.2.1 Data Collection

From May-July 2021, members of the study team for the FA-05 Bypass Instream Flow Model Development Study collected hydraulic data for the Skagit River between the Gorge Dam and Gorge Powerhouse. In addition, from July 26-30, 2021, members of the Fish Passage Study and Bypass Instream Flow Model Development Study participated in a week-long field investigation to collect data to inform the development of the Bypass Hydraulic Model that will be used to assess instream flows and evaluate fish passage potential. Controlled spillway releases were chosen in consultation with LPs and coordinated with Gorge Dam operators from July 26-29, 2021, and discharge measurements were made at baseflow conditions (i.e., no spill from Gorge Dam) on July 30, 2021. Data from the July 26-30, 2021 field investigations was collected during controlled flow releases from Gorge Dam of approximately 50, 250, 500, and 1,200 cubic feet per second (cfs) (i.e., calibration flows for the Bypass Hydraulic Model). These flows were discussed with LPs, and concurrence was received during pre-field preparations and technical workshops conducted for the FA-05 Bypass Instream Flow Model Development Study. A brief summary of the data collected during these field investigations is provided below, and more information is available in Attachment B of the FA-05 Bypass Instream Flow Model Development Study report (City Light 2022a).

5.2.1.1 Transect Measurements and Acoustic Doppler Current Profiler

Five measurement transects were established in the Gorge bypass reach to record depths and velocities during controlled releases from Gorge Dam from July 26-29, 2021. Measurements were made at all five transects for targeted flows of 1200, 500, 250, and 50 cfs during the July 26-29, 2021, spills. A summary of the measured flow depths, velocities, and discharges and instrumentation used at each transect for the controlled releases is presented in Attachment B of the FA-05 Bypass Instream Flow Model Development Study report (City Light 2022a). In areas that could not be waded during controlled flow releases, an acoustic Doppler current profiler was deployed to record velocities and depths.

5.2.1.2 Level-Logger Installation and Monitoring

Twelve level loggers were installed at Existing Features 1 and 2 in May 2021 and continuously recorded water stage and temperature. Water stage data from the full network of level loggers was recorded for the period May 28 – September 26, 2021, for calibration and validation of the Bypass Hydraulic Model and to support fish passage assessment under this study. The level logger recordings were downloaded monthly through late-September 2021 and were post-processed for quality control. Extreme flows in November 2021 damaged or destroyed more than half of the instruments, with consequent loss of much of the post-September 2021 data. This effectively terminated the data collection program, although water level data through early December 2021 were retrieved from some of the surviving data loggers.

Data collected from the loggers through late-September is sufficient to inform the development of the Bypass Hydraulic Model. Notably, stages were recorded for an unplanned spill in late June when a maximum discharge of approximately 7,400 cfs was achieved and for the planned releases in late July. Collection of water stage data during these spills addresses commitments made under the FA-05 Bypass Instream Flow Model Development Study in the June 9, 2021 Notice regarding the analysis of high flows for fish passage evaluation. Charts of the observed stages track well with spill records, and quality control measurements taken during monthly data downloads reveal high reliability. Refer to Attachment B of the FA-05 Bypass Instream Flow Model Development Study report (City Light 2022a) for more information.

5.2.1.3 UAV Imagery Flights

Oblique and nadir (downward facing) photographs and videos were taken with a UAV throughout the Gorge bypass reach during controlled spills (July 26-29, 2021). Still photographs were collected to visually document conditions at each spill and to measure two-dimensional (2-D) surface velocity vectors (magnitude and direction).

Structure from Motion Orthomosaic Development

SfM is a photogrammetric imaging technique for estimating three-dimensional structures (models) from 2-D image sequences. The primary inputs for the SfM processing completed in the Gorge bypass reach were overlapping photographs. These photos were taken with a drone at altitude during the controlled releases, primarily to develop orthomosaic images to be used during the Bypass Hydraulic Model calibration, but they will also be made available to other Skagit relicensing studies for a variety of applications. Refer to Attachment B of the FA-05 Bypass Instream Flow Model Development Study report (City Light 2022a) for more information.

Large-Scale Particle Image Velocimetry

The LSPIV method measures the surface flow velocities by video, recording the movement of tracer particles seeded onto the flow surface and analyzing the tracer movement in successive video frames. Although the RSP for the FA-05 Bypass Instream Flow Model Development Study did not propose to implement LSPIV as part of the original plan, study leads elected to conduct this analysis opportunistically as a supplemental tool to verify the Bypass Hydraulic Model. During field work conducted in the summer of 2021, the study team captured nearly 3,400 photographs of the Gorge bypass reach between Gorge Dam and Gorge Powerhouse from a UAV at altitude. Video footage at Existing Features 1 and 2 were recorded at each controlled spill in late

July, and clips from July 26, 2021 (1,200 cfs spill) were processed in LSPIV software to measure 2-D surface flow velocity vectors (velocity magnitude and direction).

Unfortunately, despite initial promising results, the application of LSPIV in this instance ultimately proved to be unsuccessful. Hydraulic conditions through Existing Features 1 and 2, including turbulent flow, frothy whitewater, and cascading flow, resulted in a low signal-to-noise ratio over much of the LSPIV measurement domain, with no means of assuring reliable and consistent surface velocity data suitable for the originally intended uses of supporting validation of the Bypass Hydraulic Model and evaluation of fish passage under the FA-04 Fish Passage Study.

Because the LSPIV method was not proposed as part of the original RSP, any opportunistic data obtained from this method was considered supplemental to the overall analysis, and not required to meet the objectives of the FA-05 Bypass Instream Flow Model Development Study or to inform passage flows under the Fish Passage Study. Therefore, the unsuccessful application of this method will have no effect on development of the Bypass Hydraulic Model, or the FA-04 Fish Passage Study.

5.2.1.4 Time-Lapse Still Photography

Monitoring cameras were installed on June 23, 2021, to capture photographs at Existing Features 1 and 2. From June 23 – October 2021, these cameras have continuously operated to capture images and document flow conditions at one-hour intervals; cameras continued to collect images through 2021. The study team has downloaded data approximately every four to six weeks since camera deployment. In addition to natural flow conditions, cameras documented conditions at and upstream of Existing Features 1 and 2 during several operational, maintenance, or minimum instream flow releases in the Gorge bypass reach, including:

- July 26-30, 2021: Hydraulic conditions through each existing feature were captured during a planned, controlled release at Gorge Dam, including planned flows of 50, 250, 500, and 1,200 cfs. Note that actual flows varied slightly from the planned flows.
- October 25-31, 2021: Conditions upstream of each existing feature were captured during a planned release to meet minimum instream flow requirements for Pink Salmon and Chum Salmon. During this period, spilled flows of up to approximately 3,200 cfs were observed.
- November 5-6, 2021: Hydraulic conditions through each existing feature were captured during a planned, controlled release at Gorge Dam, including flows up to of approximately 4,500 cfs.

A photo log of specific flow events is included as Attachment E of this study report. These photographs will supplement the Bypass Hydraulic Model data and inform the development of the Fish Passage Assessment of Existing Features in the Gorge Bypass Reach, to be drafted in spring 2022. Note that photographs from the October and November controlled releases are not included in the photo log because camera data could not be downloaded prior to the data collection cutoff date established for this study report (October 31, 2021).

5.2.2 Model Development and Calibration

The Fish Passage Study and the FA-05 Bypass Instream Flow Model Development Study are integrally linked, as data from one will inform the other. The Bypass Hydraulic Model is currently

being developed for a range of flows to generate hydraulic data to support this element of the Fish Passage Study. Data from the July 26-29, 2021, controlled releases and unplanned spills in late-June/early-July 2021 are currently being considered as part of model development.

As of November 2021, the FA-05 Bypass Instream Flow Model Development Study team has progressed to the stage of the Bypass Hydraulic Model calibration using data obtained during field studies completed in the spring and summer of 2021. Field work associated with data collection for the Bypass Hydraulic Model was included under the Fish Passage Study RSP because it will inform the assessment of passage through the Gorge bypass reach. The model calibration memorandum completed by the study team for the Bypass Instream Flow Model Development Study is included in Attachment B of the Bypass Instream Flow Model Development Study report (City Light 2022a). The model calibration memorandum reports the results of the three categories of data that were collected during field investigations in July 2021, including measurements at established transects, UAV-based still photos and videos, and the recordings on level loggers placed at Existing Features 1 and 2. A total of 644 depth and velocity measurements were collected at five established transects and the bridge immediately below Gorge Dam. Measured velocities ranged from near 0 at channel margins to over 7 feet per second, and depths up to 16 feet were observed.

5.2.3 Data Synthesis and Fish Passage Assessment

The study team has been coordinating with the FA-05 Bypass Instream Flow Model Development Study team throughout 2021 during data collection and preliminary analysis. The study team will initiate the Fish Passage Assessment of Existing Features in the Gorge Bypass Reach following the development of the Bypass Hydraulic Model and synthesis of data collected during 2021 field investigations. This assessment will begin in the first quarter of 2022.

5.3 Fish Passage Facilities Alternatives Assessment

As described in Section 4.3 of this study report, the study team is implementing a three-stage process for assessing the feasibility of upstream and downstream fish passage at the Project. The first stage includes the development of a DCD. The study team has completed the Preliminary, Revised, and Final drafts of the DCD; the Final Draft DCD is included as Attachment F. See Section 5.3.2 of this study for an overview of the DCD.

To date, this element of the Fish Passage Study was executed and informed by conducting site visits to specific locations within the study area, hosting meetings and technical workshops with interested and engaged LPs (previously discussed in Section 5.1.3 of this study report) and developing deliverables for the first stage of the fish passage assessment.

5.3.1 Site Visits

On August 16, 2021, the study team visited all three Project dams to become familiar with the physical structures and operations. On August 17, 2021, the team visited Puget Sound Energy's Lower Baker River Dam to observe the adult collection and sorting facilities, and the juvenile floating surface collector at both Upper and Lower Baker reservoirs.

5.3.2 Deliverables

5.3.2.1 Preliminary Fish Passage Conceptual Design Criteria Document

The study team initiated development of the Preliminary Draft DCD in July 2021. The content of the DCD aligned with the information presented in the RSP (City Light 2021) and considered relevant agreements from the June 9, 2021 Notice. The Preliminary Draft DCD was submitted to LPs for review and comment on September 17, 2021, approximately one week in advance of Technical Workshop 2. Comments were requested by October 7, 2021, with a final deadline of November 5, 2021, to allow for sufficient time to incorporate comments into the document prior to internal reporting deadlines. Comments were received from NMFS on October 14, 2021; from USFWS on October 21, 2021; from the Upper Skagit Indian Tribe on October 29, 2021; and from the Swinomish Indian Tribal Community on November 5, 2021. No comments from WDFW and other LPs were received.

5.3.2.2 Revised and Final Fish Passage Conceptual Design Criteria Document

The Preliminary Draft DCD was updated to reflect salient comments and requested information from those LPs that submitted comments prior to November 5, 2021. The updates resulted in a substantial edit to the document to incorporate more site-specific information at each Project development to better inform future feasibility assessments for fish passage technologies to be developed during later stages of the study. The resulting updated document, the Revised Draft DCD, was submitted to LPs on December 9, 2021, one week in advance of Technical Workshop 3.

Following submittal of the Revised Draft DCD, the study team received review comments from the USFWS, the Upper Skagit Indian Tribe, and the NPS. Responses were considered and incorporated into the Final DCD (Attachment F) and documented in a comment response matrix. Contents of the Final Draft DCD are briefly summarized below.

The Final DCD summarizes key physical, biological, and technical criteria that will be considered during development of conceptual fish passage facility design alternatives at the Project. The information presented in the final draft provides the foundation for the discussion of biological performance standards and the design basis to develop upstream and downstream passage alternatives to the concept level. The Final Draft DCD describes baseline conditions related to existing Project developments that may influence each fish passage strategy and alternative, including reservoir rule curves and operating limits, historical operations data, and biological and physical data for each reservoir, as currently available. The Final Draft DCD also provides a list of fish passage options that will be considered for further evaluation during the second stage of the Fish Passage Facilities Alternatives Assessment. The document also summarizes empirical performance data from existing fish passage facilities implemented elsewhere in the Pacific Northwest. Key elements of each section of the Final Draft DCD include:

- Section 1.0 introduces the Project and describes the genesis of the Fish Passage Study and the scope and purpose of the Final Draft DCD. Section 1.0 provides a list of the linked, concurrent relicensing studies, the results of which may influence future fish passage strategies and design. This section also summarizes the collaborative process to date for the study, including a summary of AWS and content.

- Section 2.0 summarizes the salient physical and operational considerations that will be used to describe the operating environment of potential fish passage strategies and facility concepts. This section provides an overview of each dam and reservoir, with aerial and profile illustrations; defines specific information on intakes, spillways, and reservoirs; and provides a general assessment of the availability of land to construct passage infrastructure along with existing access routes for each development.
- Section 3.0 describes biological considerations that influence the type, size, and complexity of fish passage strategies and facility concepts. This section provides a summary of known information on the fish species in the Skagit River that have been considered for passage, as well as existing information relative to abundance, life history, and migration timing for both upstream and downstream migrants. The target list of species considered for this assessment includes those species listed in the Fish Passage Study RSP, as well as several additional species requested for consideration by LPs (in the June 9, 2021 Notice) for the related FA-05 Bypass Instream Flow Model Development Study. Cumulatively, the species to be considered for passage under this study include Chinook Salmon, Coho Salmon, Sockeye Salmon, steelhead, Bull Trout, Chum Salmon, Pink Salmon, sea-run Cutthroat Trout, Dolly Varden, Pacific Lamprey, and Salish Sucker.[7]
- Section 4.0 lists the engineering principles and ecohydraulic design guidelines established by fisheries agencies such as NMFS and WDFW that will be used for fish facility concept formulation. These criteria relate to general passage guidelines for fishways; fish screening criteria, trapping, and holding guidelines; and debris rack criteria.
- Section 5.0 describes the process and integration of physical, operational, and biological factors to formulate site-specific design criteria unique to all Project developments for both upstream and downstream fish passage concept development. These include data to be provided from concurrent relicensing studies (e.g., FA-07 Reservoir Tributary Habitat Assessment; City Light 2022b), surface water residence times in each reservoir, surface hydraulics, intake forebay configuration, and biological factors related to target species swimming abilities, migration rates and periods, predation, foraging, and potential risks including entrainment and residualization.
- Section 6.0 provides an overview of typical regulatory performance standards and an overview of performance metrics at other Pacific Northwest fish passage facilities. This list was refined by NMFS during review of the Preliminary Draft DCD, and additional facilities were added.
- Section 7.0 describes the range of upstream and downstream fish passage strategies and potential technologies considered for future fish passage facility concept development. These passage technologies can be applied to each of the Project developments upon selection of preferred fish management strategies during future stages of the Fish Passage Study. Example technologies are described and include:
    - Upstream passage: trap and transport, fish ladders/fishways, and fish passes; and
    - Downstream passage: forebay collectors, head of reservoir collection, turbine passage, surface spill, bypass systems, and project operational changes.

[7] Upstream and downstream passage for Salish Sucker will be considered incidental to passage for other species as specific biological passage criteria are unknown.

- Section 8.0 summarizes the range of potential fish passage options identified by the study team and LPs during workshops and AWS meetings, and presents one alternative, with two sub-options, to advance to the next stage of the Fish Passage Facilities Alternatives Assessment.
- Section 9.0 provides a document conclusion and communicates the arc of the Fish Passage Study by presenting next steps to inform future, LP-led policy decisions that will be needed to move forward into the next stages of fish passage design following the completion of this study.

With completion of the Final DCD, the study team has now advanced to the second stage of this element of the study, which includes the development of fish passage alternatives and concept-level designs for selected fish passage options documented in the Final DCD.

6.0 SUMMARY

As summarized in Section 5.0 of this study report, progress has been made to inform both elements of the Fish Passage Study through 2021; however, the majority of the analyses for both assessments will take place in 2022. In addition, data gaps persist that will continue to be researched, in coordination with LPs, to better inform fish passage needs for the facilities assessment. Data gaps and next steps are summarized below, following a summary of each study element.

6.1 Fish Passage Study Elements Summary

The following section summarizes the information collected to date for each element of the Fish Passage Study and briefly describes next steps.

6.1.1 Fish Passage Assessment of Existing Features in the Gorge Bypass Reach

In spring and summer 2021, data was collected to provide physical information about the Gorge bypass reach to inform fish passage potential and provide input for the Bypass Hydraulic Model under the FA-05 Bypass Instream Flow Model Development Study. The study team will use the physical data collected during 2021, model data, and visual observations of the Gorge bypass reach and other factors, including known swimming and leaping abilities of the selected target species, to estimate ranges of flow conditions that may provide adequate fish passage to Gorge Dam. These factors will be used to develop the Fish Passage Assessment of Existing Features in the Gorge Bypass Reach, beginning in early 2022.

As illustrated in the photo log included with this study report (Attachment E of this study report), photos of Existing Features 1 and 2 exhibit a wide range of hydraulic depths, velocities, and levels of turbulence in the Gorge bypass reach throughout the observed flow conditions. The assessment will focus on defining potential ranges of flows that may provide adequate hydraulic conditions for passage of target species (i.e., further define and characterize the partial and temporal nature of each existing feature). Further assessment using a 2-D hydraulic model (Bypass Hydraulic Model) will facilitate the assessment of upstream passage potential of target species considered in the assessment (see Section 2.1 of this study report).

6.1.2 Fish Passage Facilities Alternatives Assessment

As discussed in Section 5.3 of this study report, the study team has completed the Preliminary, Revised, and Final versions of the DCD and has collaborated with LPs to collect and report biological data on target species. The study team continues to coordinate with other studies to refine target species periodicities and better inform run timing and abundance estimates. The study team collaborated with LPs, as part of workshops and AWS, to define a list of conceptual fish facility options for each fish passage strategy presented in the Revised Draft DCD. The Final DCD (Attachment F of this study report) identifies one alternative, with two sub-options, selected for the development of concept-level upstream and downstream passage alternatives in the Fish Passage Concept Development Report, to be developed in 2022. In Fish Passage Concept Development Report, the study team will develop functional site layouts, process descriptions and diagrams, facility sizing, general design parameters, expected fish capture and survival efficiencies, and opinions of probable costs for select fish passage alternatives. Based on the results

of the Fish Passage Concept Development Report, the study team will identify fish passage concepts that appear viable and document the results in the overall Fish Passage Assessment, to be prepared in summer 2022.

6.2 Status of June 9, 2021 Notice

The June 9, 2021 Notice listed four additional commitments directly related to the implementation of the Fish Passage Study, and four commitments made under the concurrent FA-05 Bypass Instream Flow Model Development Study that City Light agreed to consider under the Fish Passage Study. The status of each is summarized in Table 6.2-1.

Table 6.2-1. Status of Fish Passage Study modifications identified in the June 9, 2021 Notice and Relevant Commitments under FA-05 Bypass Instream Flow Model Development Study to be Considered for the Fish Passage Study.

Study Modifications Identified in the June 9, 2021 Notice: As Written	Status
FA-04 Commitments	
City Light will identify fish passage flow windows at any partial potential impediments, which will be partially identified through modeling in FA-05 (Bypass Hydraulic Model).	Modeling under the FA-05 Bypass Instream Flow Model Development Study is currently underway and the final calibrated model will be available in early 2022. The identification of passable flows for upstream adult migration of target species in the Gorge bypass reach will be included in the Fish Passage Assessment of Existing Features in the Gorge Bypass Reach, which will commence in spring of 2022, with a draft report by July 2022.
City Light will provide an opportunity for LPs to identify alternatives and provide input on the fish passage feasibility study.	City Light and the study team have and will continue to engage the LPs throughout the Fish Passage Study during bi-weekly AWS meetings, and monthly technical workshops of the Fish Passage Work Group. In addition, the study team has and will continue to provide the LPs an opportunity to review and comment on all deliverables defined in Section 2.7 of the RSP. Through these engagements, reviews, and discussions, City Light has provided and will continue to provide the LPs with opportunities to identify alternatives and contribute to the study.
City Light will assess overall feasibility of fish passage alternatives but without providing a feasibility engineering design (akin to a 30 percent engineering design level) for fish passage alternatives.	As reported in Section 2.6.1 of the RSP, concepts will be developed to a level consistent with generally accepted engineering practice for appraisal/reconnaissance level studies (e.g., U. S. Bureau of Reclamation 2012; U.S. Army Corps of Engineers (USACE) 2000; USACE 1999; AACE 2003). City Light will not provide 30 percent engineering designs for any alternative under the Fish Passage Facilities Alternatives Assessment.
City Light will modify FA-04 to clarify that the expert panel serves in an advisory capacity only and only for such study products for which review is requested. Protocols for requesting expert panel review, performance of reviews, and responses to reviews will be agreed to during the course of the study. The National	As of this writing (March 2022), City Light and LPs have not convened an expert panel and do not intend to do so unless LPs specifically request it during future study stages. The rationale for this decision is based upon the NMFS statements in the June 9, 2021 Notice and FERC's SPD (2021) for the Skagit Project, which states:

Study Modifications Identified in the June 9, 2021 Notice: As Written	Status
Marine Fisheries Service ("NMFS") will not accept unsolicited expert panel advisory opinions.	*Regarding City Light's proposal to convene an expert panel to review and evaluate study reports, there is no need for such a requirement. City Light's proposed fish passage study is consistent with accepted practices for evaluating fish passage feasibility and developing passage alternatives within the context of a hydroelectric licensing proceeding (section 5.9(b)(6)).* *Commission staff and stakeholders, including federal agencies and Indian Tribes, will have the opportunity to review the study results and decide if it was completed as required by the study plan determination, and to determine whether it provides the information necessary to inform a licensing decision. Therefore, we do not recommend that City Light be required to convene an expert panel to review and provide opinions on the study results.*
Relevant Study Commitments under FA-05 to be Considered under FA-04	
City Light will allow for consideration of the following additional species for flows analysis of potential partial fish barrier passage: ▪ Pink Salmon ▪ Chum Salmon ▪ Sea-run Cutthroat ▪ Pacific Lamprey	These additional species will be considered for fish passage, targeted or incidental, under both elements of the Fish Passage Study.[1]
City Light will consider the following species as present in the Gorge bypass reach: ▪ Pacific Lamprey ▪ Salish Sucker ▪ Dolly Varden	In response to LP requests during AWS meetings and FA-04 Workshops, City Light will consider incidental passage of Salish Sucker and Dolly Varden for both elements of the Fish Passage Study.[1]
City Light will address downstream and upstream passage at the plunge pool in the Gorge bypass reach to the extent necessary.	As part of stage 2 of the Fish Passage Facilities Alternatives Assessment (Concept Development Report), City Light will evaluate passage options in the plunge pool as related to potential upstream passage facilities, as applicable, at Gorge Dam.
Relative to a comment on the reliance of professional judgment on the outcomes of the passage flow assessment, City Light and the LPs recognize that there is a need for further dialogue about the use of best professional judgment for decision-making and the establishment of objective criteria for evaluating studies as well as implementation of the studies.	City Light has been collaborating with LPs throughout the study in workshops and bi-weekly AWS meetings. This commitment has been incorporated into the study implementation effort.

1 The complete list of species to be evaluated under the Fish Passage Study includes: steelhead, Coho Salmon, Chinook Salmon, Sockeye Salmon, Pink Salmon, Chum Salmon, Pacific Lamprey, Bull Trout, Dolly Varden, Salish Sucker, and Sea-run Cutthroat Trout.

6.3 Next Steps

During the second year of the Fish Passage Study, City Light and its consultant team will continue to advance both elements of the study by addressing data needs and performing assessments as outlined in the RSP and the June 9, 2021 Notice. Next steps include continued facilitation of bi-weekly AWS meetings, attending workshops, and fulfillment of the deliverable schedule. As stated in Section 2.6.1.3 of the RSP, following these next steps, and upon completion of this study, City Light will identify, in consultation with LPs, next steps and additional information to support future fisheries management goals and objectives should a passage program be implemented at the Project. Post-study "next steps" and potential information needs are summarized in Section 6.3.3 of this study report.

6.3.1 Standing Action Items and Upcoming Activities

City Light will continue to progress through the commitments made for this study. Standing action items and upcoming activities are detailed as follows:

- Continue bi-weekly AWS with interested LPs to review progress, solicit input, and discuss feedback on each stage of the study.
- Participate in monthly working group sessions, as determined necessary by the study team.
- Work with LPs to narrow the list of conceptual fish passage alternatives for all fish passage strategies to those that are likely feasible to progress to stages two and three of the Fish Passage Facilities Alternatives Assessment.
- In spring 2022, initiate the development of the Fish Passage Assessment of Existing Features in the Gorge Bypass Reach, using the Bypass Hydraulic Model developed under the FA-05 Bypass Instream Flow Model Development Study. In this assessment, as noted in the June 9, 2021 Notice, the study team will identify fish passage flow windows at existing features.
- Continue to track linked concurrent relicensing studies to ensure that the most current data is synthesized into the next stages of the Fish Passage Study.
- Continue to advance the deliverable for stage two of the Fish Passage Facilities Alternatives Assessment, as defined in Section 4.3.2 of this study report.

6.3.2 Data Needs to Meet Objectives of the Fish Passage Study RSP

The following data are required to meet the objectives of the RSP for each element of the Fish Passage Study. Data will be provided by concurrent relicensing studies in 2022.

6.3.2.1 Fish Passage Assessment of Existing Features in the Gorge Bypass Reach

Relative to the Fish Passage Assessment of Existing Features in the Gorge Bypass Reach, the following information is required to complete the objectives of the RSP, and will be provided in early 2022:

- Fish size range for each target species and life history; and
- Completed and calibrated 2-D Bypass Hydraulic Model prepared as part of the FA-05 Bypass Instream Flow Model Development Study.

6.3.2.2 Fish Passage Facilities Alternatives Assessment

In June 2021, the City Light consultant team submitted a Request for Information to LPs in an effort to collect data to inform this element of the study. Although some information has been provided as of this writing (March 2022), the following information will be required to meet the objectives of the RSP:

- Target fish passage potential, distribution, occurrence, and run timing for the Gorge bypass reach. This information will inform the feasibility of establishing upstream collection facilities at Gorge Dam.
- Final determination of run timing for target species, to be informed by on-going discussions as part of the HSC working group.
- Desired range of run abundance for each target species, both upstream and downstream, at each of the Project developments to inform the accurate sizing of facilities and associated infrastructure.

6.3.3 Potential Post-Study Information Needs

The Fish Passage Study will not be the only source of data required to inform future decisions pertaining to whether and how a fish passage program should be implemented. Additional data will be required to support the successful implementation of a fish passage program and to validate assessments of technical feasibility made under this study. City Light intends to work in collaboration with LPs following completion of this study to identify additional information needs. As stated in Section 2.6.1 of the RSP for this study, "based on the outcome of the technical fish passage study, City Light, in consultation with LPs, will identify any next steps or additional studies that may be needed in accordance with planning recommendations put forward in Anderson et al., (2014) and potential additional information as identified in the NMFS-04 Feasibility Analysis of Fish Passage study request (Sections 3.4.5 and 3.4.7)."

6.4 Remaining Deliverables and Workshop Schedule

A provisional schedule for conducting the remaining elements of the Fish Passage Study is as follows:

- Fish Passage Assessment of Existing Features in the Gorge Bypass Reach: Using hydraulic data obtained from the FA-05 Bypass Instream Flow Model Development Study, assess the extent to which two existing channel features constitute passage barriers to upstream passage of one or more of the target species: spring/summer 2022.
- Draft Fish Passage Concept Development Report: April 2022.
- Technical Workshop 4: March 2022.
- Final Fish Passage Concept Development Report: July 2022.
- Technical Workshop 5: July 2022 (optional workshop, to be determined).
- Fish Passage Assessment Report: July 2022 to December 2022.
- Draft Fish Passage Assessment Report: August 2022.
- Final Fish Passage Assessment Report: December 2022.

- USR: March 2023.

7.0 VARIANCES FROM FERC-APPROVED STUDY PLAN AND PROPOSED MODIFICATIONS

The study team has made two minor variances to the methods established for the Fish Passage Study in the RSP. Variances relate to the development of an expert advisory panel and study plan schedule modifications.

7.1 Fish Passage Independent Expert Panel

Per Section 2.1 of the RSP, City Light proposed to form a three-member Fish Passage Independent Expert Panel (Expert Panel), which would be available to review reports and provide advisory opinions. The makeup of the Expert Panel was to be determined in collaboration with LPs. As of January 2022, however, City Light and LPs have not convened the Expert Panel and do not intend to do so unless LPs specifically request it during future study stages. This variance does not affect the ability of the study to meet the objectives of the RSP.

7.2 Schedule Modification

The RSP originally termed the first element of the Fish Passage Study as the Fish Passage Barrier Assessment. During the course of this study, this element was renamed to the Fish Passage Assessment of Existing Features in the Gorge Bypass Reach in response to comments from LPs during agenda setting for Technical Workshop 1. In addition, the RSP indicated that this assessment would be provided in the ISR. Although a progress report on this study element is provided in Sections 5.2 and 6.1.1 of this study report, the Bypass Hydraulic Model required to complete this assessment will not be completed until early 2022. Therefore, this assessment is currently proposed to be developed as a stand-alone document in spring/summer 2022.

8.0 REFERENCES

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FISH PASSAGE TECHNICAL STUDIES INTERIM REPORT

ATTACHMENT A

FA-04 FISH PASSAGE STUDY WORKSHOP NO. 1 MEETING MATERIALS

Seattle City Light

MEETING AGENDA

Skagit Hydroelectric Project Relicensing Meeting

FA-04 Fish Passage Workshop No. 1

July 15, 2021, 1:00pm – 4:30pm

WebEx Meeting: [LINK]

Conference Call: +1-510-338-9438 USA

Access code: 1824858219

(Meeting ID: 1824 85 8219)

MEETING PURPOSE

The intent of this workshop is to present an overview of key study milestones, discuss opportunities for feedback and collaboration with the LPs, contrast the different data needs and methods for two interrelated fish passage assessments, and to begin discussing preliminary criteria and considerations. Specific objectives include:

- **Study Plan Milestones** - Review key study plan components and milestones, determine details for the study plan schedule in relation to ILP milestones.
- **Fish Passage Facilities Assessment** – Discuss general approach assessment methodology, data requirements, and concept development activities.
- **Fish Passage Assessment of Existing Features in the Bypass Reach** – Summarize approach, key criteria influencing the assessment of fish passage in the bypass reach, data needs/acquisition.

AGENDA

1:00 – 1:10 pm (15 min)	**Introductions** – *Facilitator* • Roll Call and Introductions
1:10 – 1:20 pm (10 min)	**Meeting Objectives and Agenda Overview** – *Mike Garello (HDR)* • Review Meeting Objectives and Agenda Topics
1:20 – 2:25 pm (65 min)	**Study Plan Overview, Schedule, and Milestones -** *Mike Garello (HDR)* **1. Study Schedule Overview and Discussion** Presentation of process diagram showing two separate assessments on similar timelines. Show interrelation between FA-04 and other concurrent studies via. Gantt Chart. i. **Fish Passage Facilities Assessment** - Provide summary of key deliverables, content, and anticipated release dates. ii. **Fish Passage Assessment of Existing Features in the Bypass Reach** - Provide summary of key deliverables, content, and anticipated release dates. Review relationship to concurrent studies.

	2. Dialogue and engagement within the study schedule: i. **On-going Communication**- Expectations and protocols for LPs and Study Team throughout FA-04 implementation. Review distribution lists, format for questions and feedback, etc. ii. **Interim work products** - Distribution and review of interim reports and work products and how feedback will be used, use of SharePoint site. iii. **Workshops** - Determine quantity, coordination, and content of potential workshop (including invitation list, time prior to workshops, agenda development, notes, and action items, etc.) iv. **Participation of NMFS, USFWS, and WDFW in study implementation -** determine individuals (such as Logan Negherbon, NMFS, Jared McKee, USFWS, Duncan Pfeifer, WDFW, Kevin Lautz, WDFW) that may participate and the frequency of engagement (such as workshop agenda formulation – to be facilitated by Triangle, bi-weekly progress meetings) **v. Timing of formation and involvement of Expert Panel**
2:25 – 2:35pm (10 min)	***Break***
2:35 – 3:00 pm (25 min)	**Focal Species for Fish Passage Assessments** – *Mike Garello (HDR)* Summary of key species used for assessment and concept development. • Table for species considered for Fish Passage Facilities Assessment • Table for species considered for Fish Passage Assessment of Existing Features in the Bypass Reach
2:55 – 3:40pm (45 min)	**Fish Passage Facilities Assessment –** *Mike Garello (HDR)* Overview of this study plan that has two distinct assessments. Summary of key differences between the two different assessment types and how data requirements, data gaps, and key considerations/assumptions can influence study conclusions. **1. Objectives and outcomes** **2. Data requirements** **3. Assessment methodology**
3:40 – 4:20pm (40 min)	**Fish Passage Assessment of Existing Features in the Bypass Reach -** *Mike Garello (HDR)* Objective: Initial performance thresholds for biometric comparison. **i. Assessment methodology** • Objectives and outcomes

	• Data requirements • Assessment methodology **ii. Data Collection** • Strategies for site inspection and visual observation • Collection of flow magnitude, depth, elevation, and velocity data **iii. Range of Observable Discharges**
4:20 – 4:30pm [Last 10 minutes]	**Schedule, Action Items, Next Steps** – *Facilitator and meeting participants* • Review action items • Next steps **(**discuss if a site visit is warranted?)
[End time]	**Meeting Adjourned**

FA-04 FISH PASSAGE TECHNICAL STUDIES

Workshop 1

7/15/2021

INTRODUCTIONS

- Roll Call
- Introductions

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WORKSHOP OVERVIEW AND OBJECTIVES

MEETING OBJECTIVES

- Objectives
  - Study Plan Milestones – Review key study plan elements, schedules, and milestone dates
  - Communication and Feedback – Discuss opportunities for LP engagement and input
  - Fish Passage Assessments – Discuss approach, methods, and initial data requirements influencing the initial efforts required for two different Fish Passage Study elements.

MEETING AGENDA

Schedule	Topic
1:00 to 1:10	Introductions
1:10 to 1:20	Meeting Objectives and Agenda Overview
1:20 to 2:25	Study Plan Overview, Schedule, and Milestones
2:25 – 2:35	Break
2:35 – 3:00	Focal Species for Fish Passage Assessments
3:00 – 3:40	Fish Passage Facilities Assessment
3:40 to 4:20	Fish Passage Assessment of Existing Features in the Bypass Reach
4:20 to 4:30	Schedule, Action Items, Next Steps
4:30	Meeting Adjourned

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STUDY PLAN OVERVIEW AND MILESTONES

STUDY PLAN OVERVIEW, SCHEDULE, AND MILESTONES

- Schedule and Process Overview
- Key Milestones
- Key Content of Reports
- Opportunities for Engagement and Communication

FA-04 FISH PASSAGE STUDY OVERVIEW

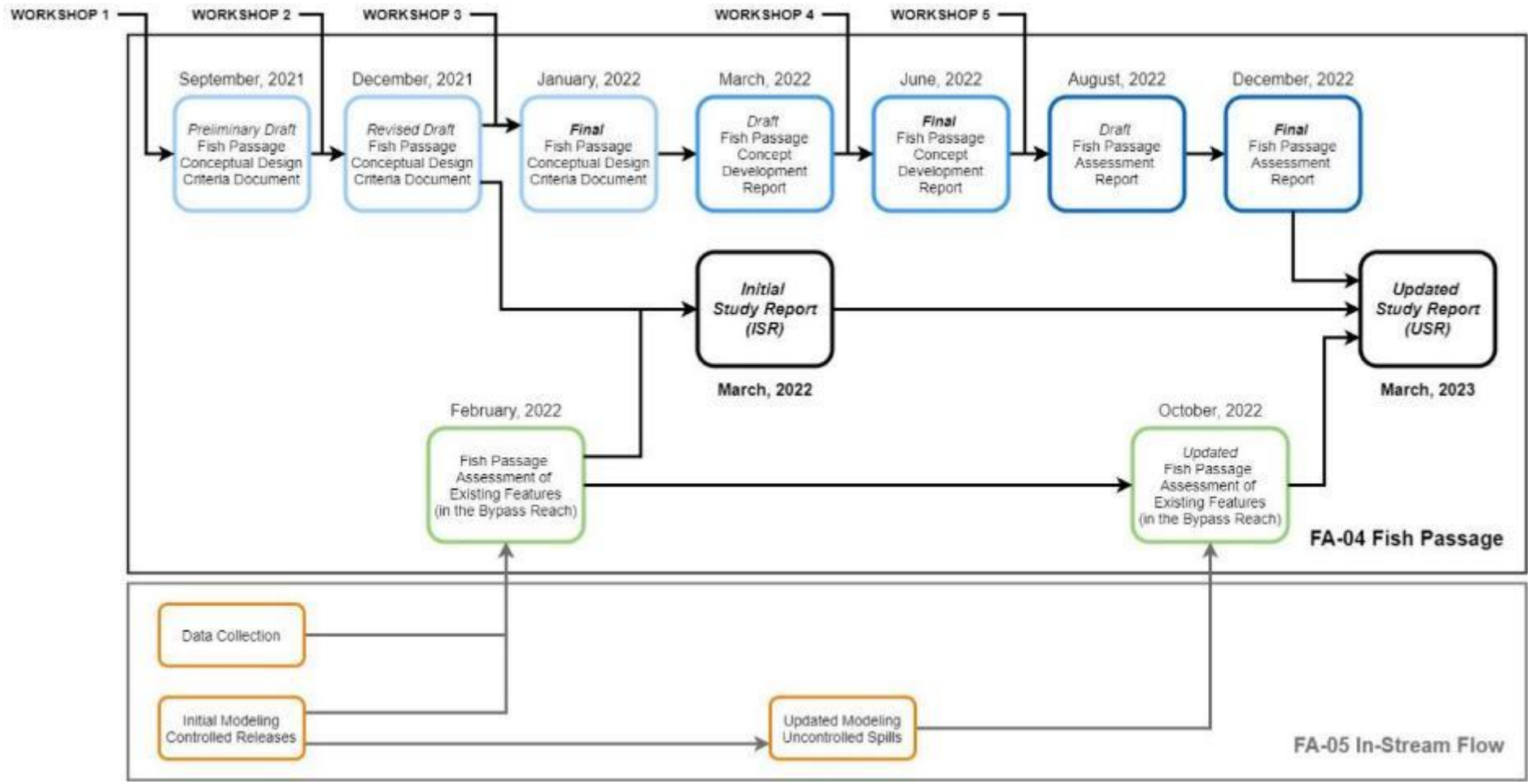
Fish Passage Facilities Assessment

- Establish Fish Passage Goals, Objectives, and Performance Expectations
- Formulation of Potential Fish Passage Strategies and Facilities
- Assessment of Technical Feasibility
- Capital and Lifecycle Costs

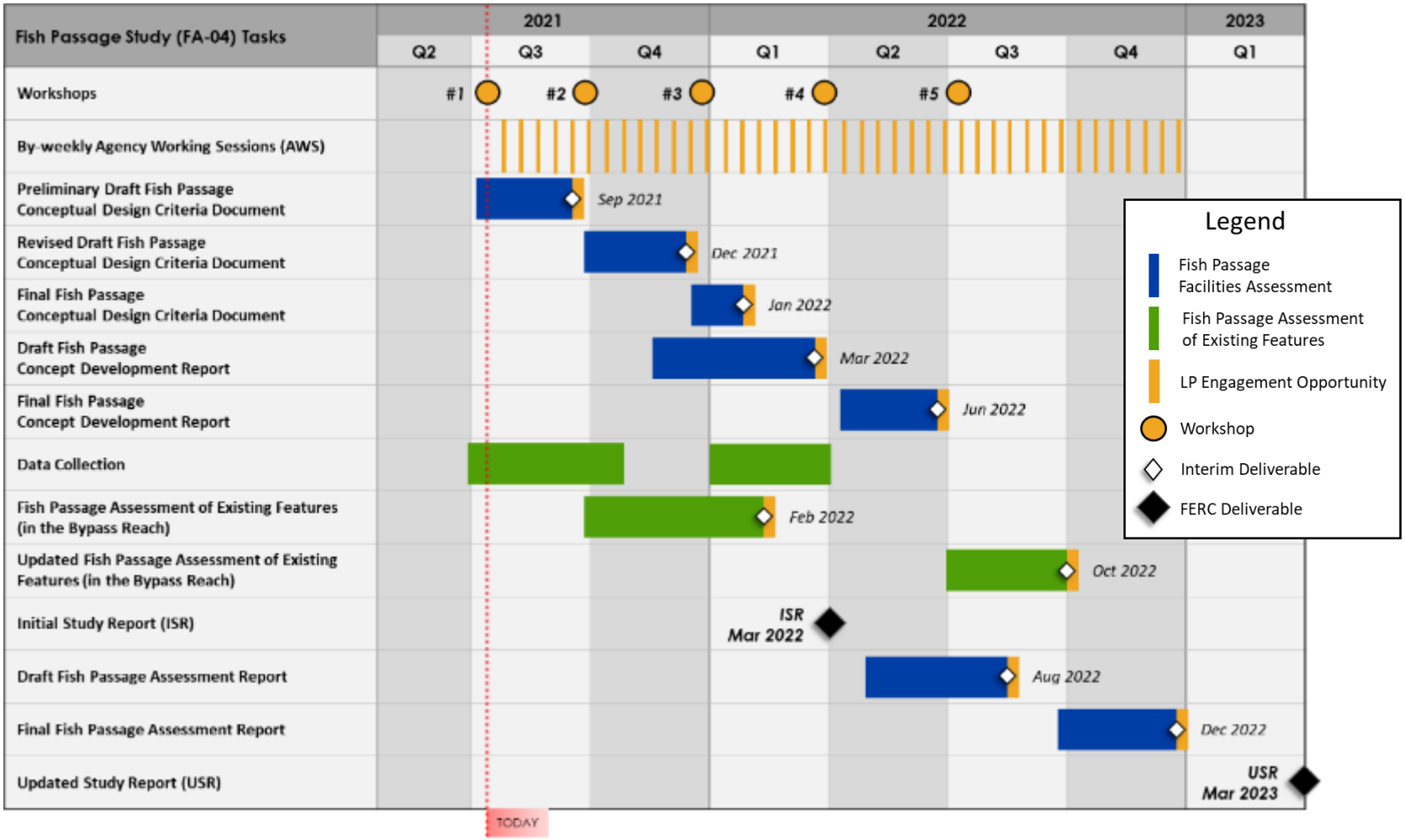
Fish Passage Assessment of Existing Features in the Bypass Reach

- Site Inspection and Survey
- Data Collection
- Hydrodynamic Modeling of Existing Features
- Biometric Comparison of Ecohydraulic Factors Influencing Fish Passage
- Identification of Flow Ranges that may Limit or Promote Fish Passage

PROCESS OVERVIEW



SCHEDULE OVERVIEW



WORKSHOPS

- Purpose – full and active involvement of Licensing Participants

1) Review study plan, people, and processes
2) Review and establish preliminary design criteria and information needs
3) Finalization of design criteria and approval of concept alternatives
4) Draft fish passage concepts
5) Final fish passage concepts

BI-WEEKLY AGENCY WORKING SESSION

- Purpose – Subject matter experts from resource agencies provide more frequent feedback on interim study progress, methods, and outcomes

1) Participation of NMFS, USFWS, and WDFW in study implementation
    1) Logan Negherbon, NMFS
    2) Jared McKee, USFWS
    3) Duncan Pfeifer, WDFW
    4) Kevin Lautz, WDFW
2) Participate in bi-weekly working sessions with consulting team

INTERIM DELIVERABLES AND REPORTS

- Purpose – Provide LPs with an opportunity to exchange information and obtain feedback at interim milestones during study implementation.

1) Provide progress level documentation of study work products at key decision points

2) Obtain more frequent feedback from Licensing Participants

FISH PASSAGE FACILITIES ASSESSMENT – KEY MILESTONES

Milestone	Anticipated Schedule
Fish Passage Facilities Assessment	
Fish Passage Conceptual Design Criteria Report	
Preliminary Draft Report	September 2021
Revised Draft Report	December 2021
Final Report	January 2022
Initial Study Report	March 2022
Fish Passage Concept Development Report	
Draft Report	March 2022
Final Report	June 2022
Fish Passage Assessment Report	
Draft Report	August 2022
Final Report	December 2022
Updated Study Report (USF, Fish Passage Study Sections)	March 2023

FISH PASSAGE FACILITIES ASSESSMENT – WORKSHOP 1 – JULY 15, 2021

- Review study plan objectives, schedule, and major milestones
- Discuss key focal species for two different fish passage assessments
- Discuss the approach to completing the Fish Passage Facilities Assessment
- Discuss the approach to completing the Fish Passage Assessment of Existing Features in the Bypass Reach

FISH PASSAGE FACILITIES ASSESSMENT – KEY DELIVERABLES

Fish Passage Facilities Design Criteria Report
Preliminary Draft (9/17/2021)**, Revised Draft** (12/1/2021)**, Final** (1/21/2022)

- Maps and Drawings of Existing Facilities
- Reservoir rule curves and operating limits, historical operations data, debris accumulation information, and data on thermal regimes of the reservoirs
- List of conceptual alternatives to be evaluated
- Performance of PNW passage facilities at high-head dams
- Biological and Technical Performance Goals
- Technical Design Criteria

FISH PASSAGE FACILITIES ASSESSMENT – WORKSHOP 2 – (SEPT 2021)

- Review Comments on Preliminary draft Fish Passage Conceptual Design Criteria Document (this is distributed in advance)
- Discuss the design basis and criteria needed to develop upstream and downstream passage alternatives to the concept level
- Identify information needed to proceed to the next phase of study
- Update progress made gathering biological performance information on Pacific Northwest fish passage facilities
- Discuss factors:
  - Estimated adult and juvenile run sizes;
  - Adult and juvenile run timing;
  - Upstream and downstream passage efficiency requirements; and
  - Other design criteria necessary to assist with the layout and configuration of concept-level alternatives

FISH PASSAGE FACILITIES ASSESSMENT – KEY DELIVERABLES

Fish Passage Facilities Concept Development Report
Draft (3/18/2022)**, Final** (6/17/2022)

- Concept-level facility layouts and configurations of fish passage and auxiliary structures for each alternative
- List of potential facility operational changes that may be associated with each alternative
- Estimate of reasonably expected performance of the facilities
- Site layouts and constructability
- Estimated annual O&M costs fore each alternative
- Order of magnitude Opinions of Probable Construction Costs for each alternative

FISH PASSAGE FACILITIES ASSESSMENT – WORKSHOP 3 – (DEC 2021)

- Review comments on Draft Fish Passage Conceptual Design Criteria Document
- Review revised list of potential fish passage concept alternatives

FISH PASSAGE FACILITIES ASSESSMENT – WORKSHOP 4 – (MARCH 2022) AND 5 (TBD)

- Review progress during the concept development work
- Present Draft and Final Fish Passage Concepts
  - Concept-level facility layouts and configurations
  - List of potential facility operational changes
  - Estimates of reasonably expected performance of the facilities
  - Estimated O&M Costs
  - Order of magnitude Opinions of Probable Construction Costs for alternatives

FISH PASSAGE FACILITIES ASSESSMENT – KEY DELIVERABLES

Fish Passage Assessment Report
Draft (8/19/2022)**, Final** (12/16/2022)

- Identify fish passage concepts that appear viable and consistent with design criteria
- Evaluate each technical option for facilitating fish passage:
- (1) its ability to be engineered, constructed, and operated (i.e., technical feasibility);
- (2) its ability to operate without significantly interfering with existing Project and non-Project uses;
- (3) the facility's ability to meet customary performance standards established for similar facilities.
- Identify any next steps or additional studies that may be needed

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – KEY MILESTONES

Milestone	Schedule
Fish Passage Assessment of Existing Features in the Bypass Reach	
Field Investigation of Existing Features	June 2021 – December 2021
Fish Passage Assessment of Existing Features	February 2022
Initial Study Report	March 2022
Potential Observation of Uncontrolled Spill Events	October 2021 – December 2021
Additional Modeling	January 2022 – March 2022
Updated Fish Passage Assessment of Existing Features	October 2022
Updated Study Report (USF, Fish Passage Study Sections)	March 2023

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – KEY DELIVERABLES

Fish Passage Assessment of Existing Features in the Bypass Reach
Initial Report (February 2022)**, Updated Report** (March 2023)

- Site Inspection and Survey
- Data Collection
- Hydrodynamic Modeling of Existing Features
- Biometric Comparison of Ecohydraulic Factors Influencing Fish Passage
- Identification of Flow Ranges that may Limit or Promote Fish Passage

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BREAK

10 minutes

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FOCAL SPECIES FOR FISH PASSAGE ASSESSMENTS

FOCAL SPECIES FOR FA-04 FISH PASSAGE STUDY

- Fish Passage Facilities Assessment
  - Requires information on all anadromous and resident populations
  - Informs the type, size, and complexity of potential fish passage strategies and facilities
- Fish Passage Assessment of Existing Features in the Bypass Reach
  - Can be categorized into representative groups with like swimming and leaping abilities
  - Limited/no information available for some species

FOCAL SPECIES
FISH PASSAGE FACILITIES ASSESSMENT

FA-04 Study Plan Species	NOA Species for Consideration
Chinook Salmon	Chum Salmon
Coho Salmon	Pink Salmon
Sockeye Salmon	Sea-run Cutthroat Trout
Steelhead	Dolly Varden
Bull Trout	Pacific Lamprey
	Salish Sucker

- Do all species require passage?
- What reservoir to reservoir passage is required for adfluvial populations?

FISH PASSAGE FACILITIES – BIOLOGICAL DATA REQUIREMENTS

Data Requirement	What We Have	Information Needs
Target species and life stages	Study Plan and extended list from June 2021 NOA species	
Migration timing and periodicity – adult and juvenile	HSC periodicity Reservoir populations	
Abundance – total and peak	Existing for reservoir spp. Annual totals for anadromous spp.	Target total and peak for life stages requiring passage at each dam
Fish length, size, and age information	Reservoir populations	Anadromous populations
Connectivity between reservoirs	Bull Trout telemetry studies	Species and life stages requiring passage at each dam
Fish movement and timing in each reservoir	Bull Trout reservoir studies	Other spp. information
Expectations for performance for species and life stages	Examples from existing facilities	Expectations for Skagit Project
Biosecurity (disease)	Information from other facilities	Agency concerns for Skagit River mainstem and Project reservoirs
Genetic considerations	NMFS PAD comments and proposed FA-06 study plan	Results from FA-06 (Reservoir Native Baseline Genetics)

FOCAL SPECIES
FISH PASSAGE ASSESSMENT OF EXISTING FEATURES

Study Plan Target Species	Other Species for Consideration
Chinook Salmon	Chum Salmon
Coho Salmon	Pink Salmon
Sockeye Salmon	Sea-run Cutthroat Trout
Steelhead	Dolly Varden
Bull Trout	Pacific Lamprey
	Salish Sucker

- Consolidated groups based on swimming/leaping ability characteristics
- Identification of analogue species when no data is available

FISH PASSAGE AT EXISTING BARRIERS – BIOLOGICAL DATA REQUIREMENTS

Data Requirement	What We Have	Information Needs
Target species and life stages	Study Plan species	
Migration timing and periodicity – adult and juvenile	HSC periodicity Reservoir populations	
Fish length, size, and age information	Reservoir populations	Anadromous populations
Swimming Capability	Derived from the literature	
Leaping Capability	Derived from the literature	

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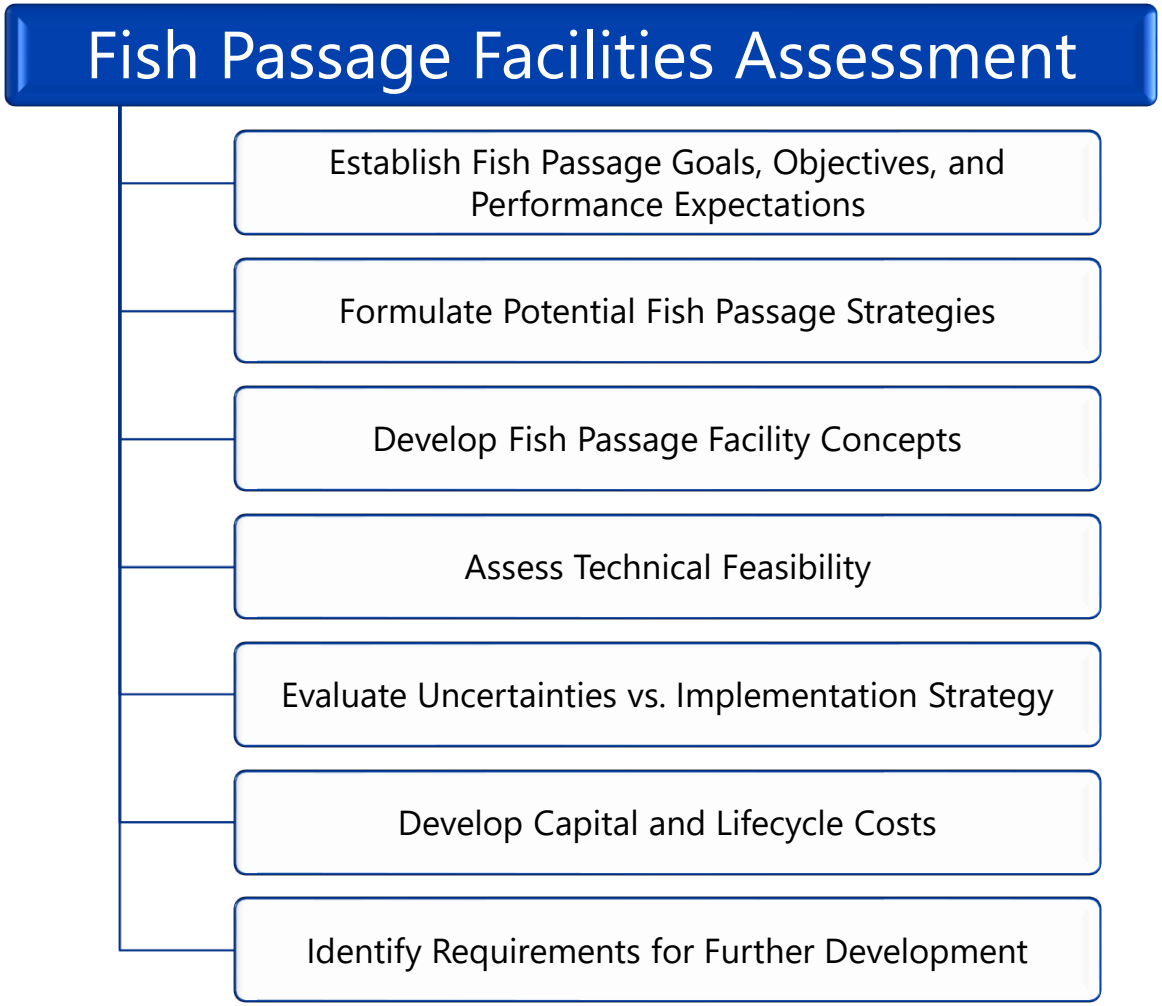
OVERVIEW – FISH PASSAGE FACILITIES ASSESSMENT

FISH PASSAGE FACILITIES ASSESSMENT

- Objective: assess the potential feasibility of upstream and downstream passage at the three Project developments.
- Outcomes
  - Concept-level upstream and downstream passage strategies and alternatives
  - Technical viability, Project modifications, potential performance, and opportunities/limitations
  - Planning level Opinion of Probable Construction Costs and Lifecycle Cost

FISH PASSAGE FACILITIES ASSESSMENT



POTENTIAL LINKAGES TO OTHER STUDIES

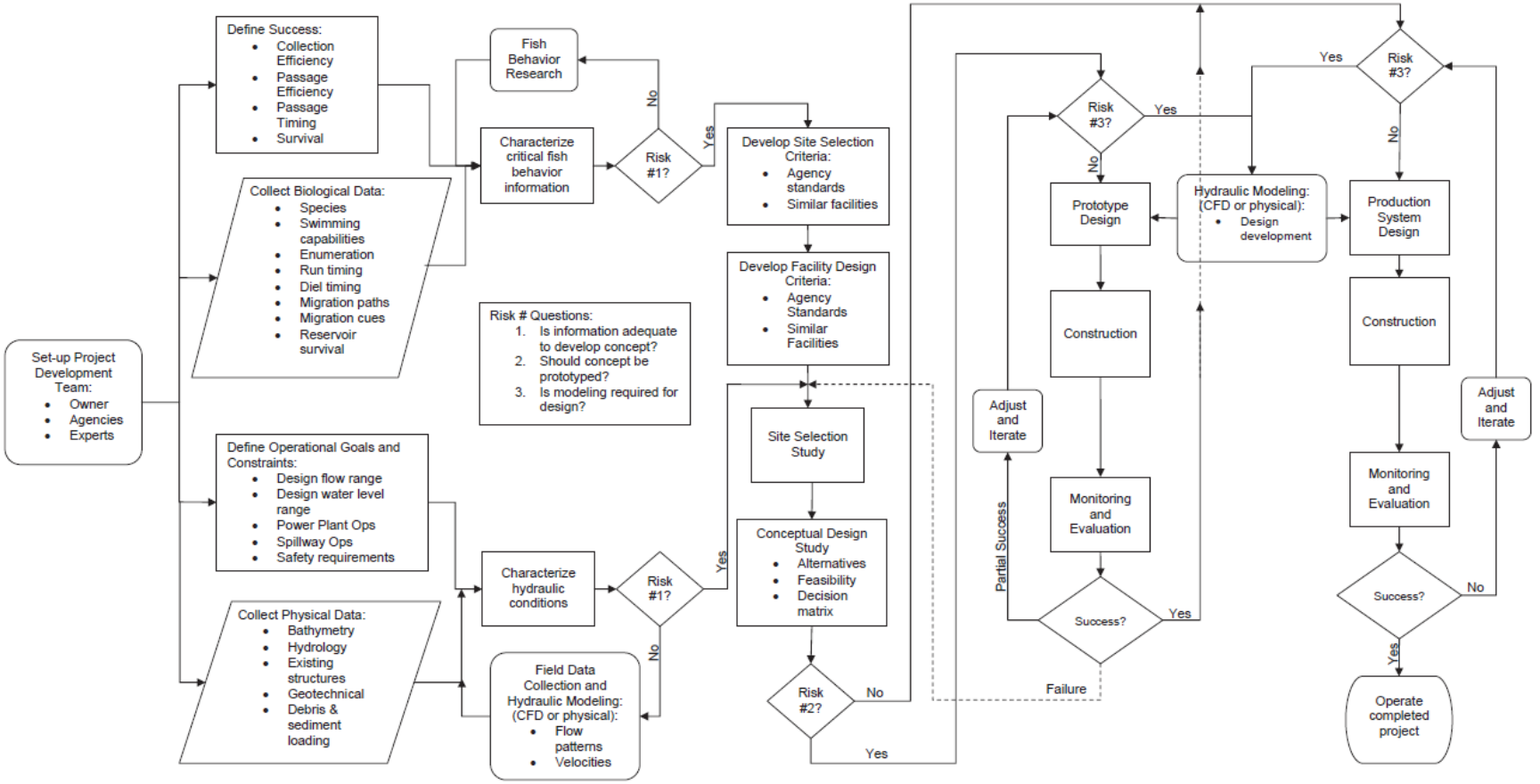
The facilities assessment considers existing physical data and Project operations to define design constraints and assess construction and operational feasibility. On-going studies that may inform this assessment include:

Study	Linkage to FA-04
OM-01: Operational Model	May identify future hydrologic operational scenarios that would impact passage facility efficiency and operation.
RA-01: Recreation Use and Facility Assessment	May identify land use conflicts.
FA-08: Fish Entrainment	May provide additional insight on fish protection, exclusion, collection, and bypass requirements for fish passage facilities.

POTENTIAL LINKAGES TO OTHER STUDIES

- In addition to FA-04, data from the following studies may inform future goals and objectives for fisheries management upstream of Project dams, including ESA resources:
  - OM-1: Operational Model
  - FA-01: Water Quality Monitoring
  - FA-03: Reservoir Stranding and Trapping Risk Assessment
  - FA-06: Reservoir Native Baseline Genetics
  - FA-07: Reservoir Tributary Habitat Assessment
- City Light has agreed to meet with Licensing Participants to identify relicensing study linkages for the entire Project.

ASSESSMENT METHODOLOGY – FEASIBILITY AND DESIGN PROCESS



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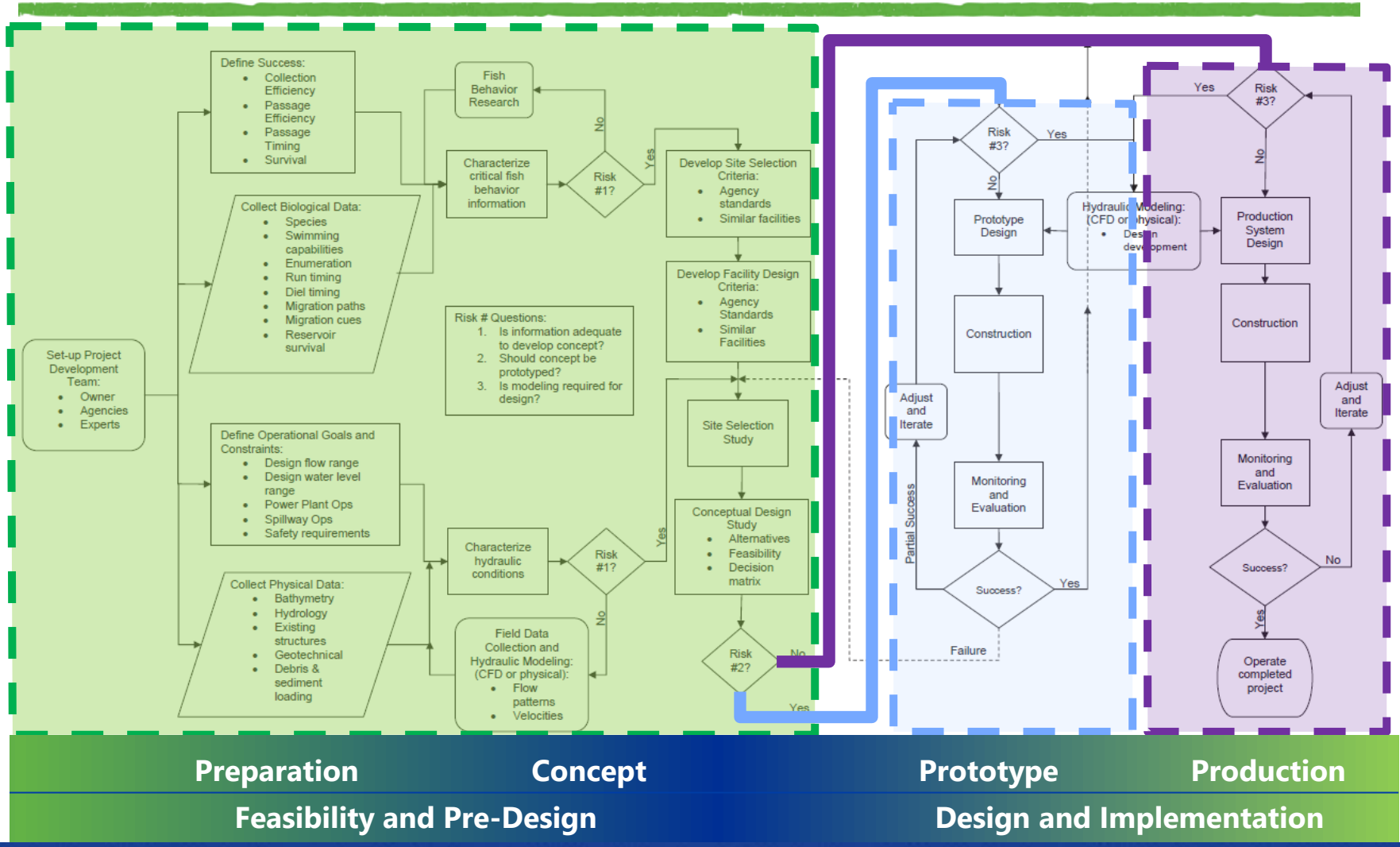
ASSESSMENT METHODOLOGY – FEASIBILITY AND DESIGN PROCESS



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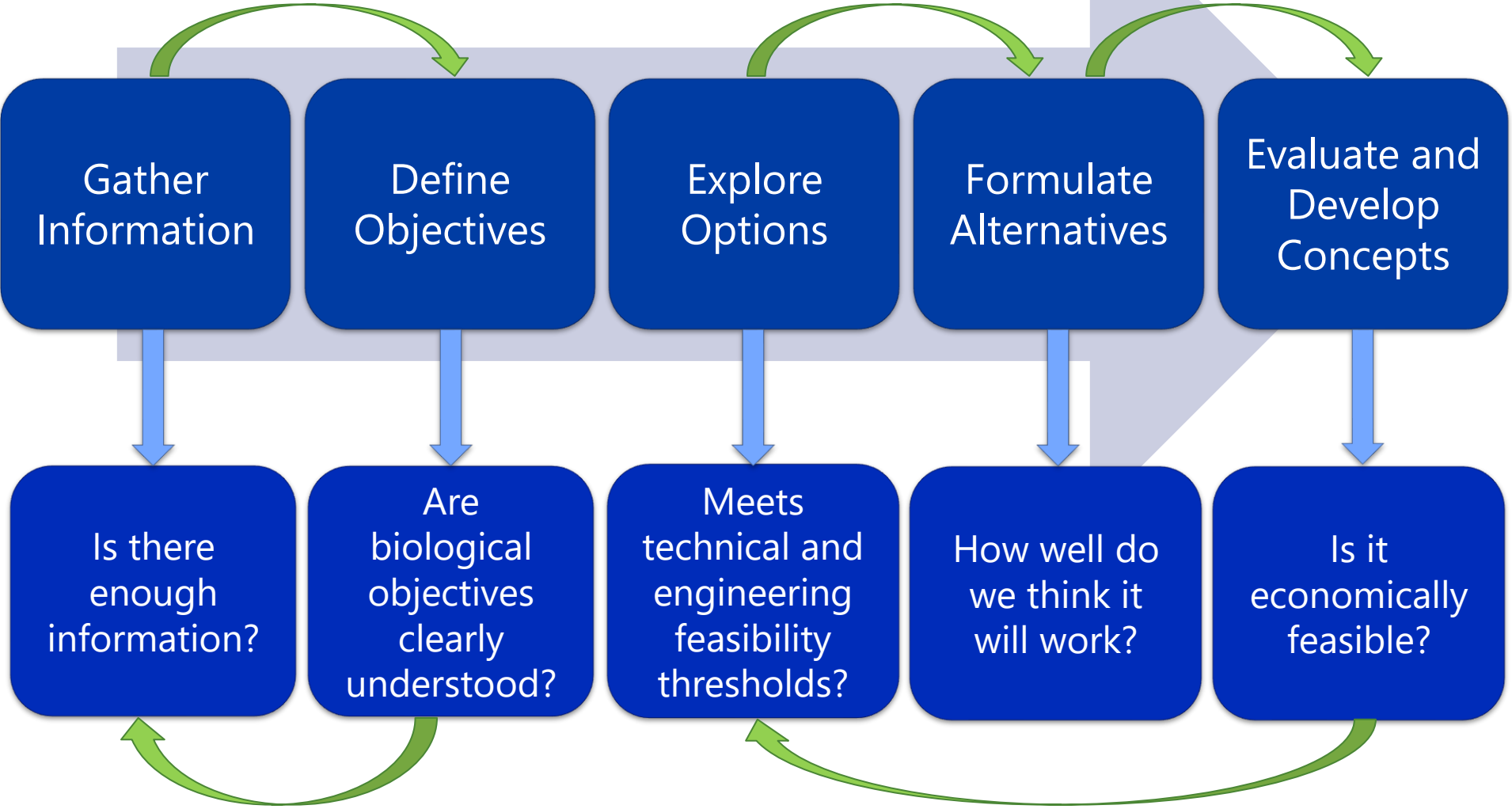
ASSESSMENT METHODOLOGY – ASSESSMENT OF TECHNICAL FEASIBILITY



FISH PASSAGE FACILITIES ASSESSMENT

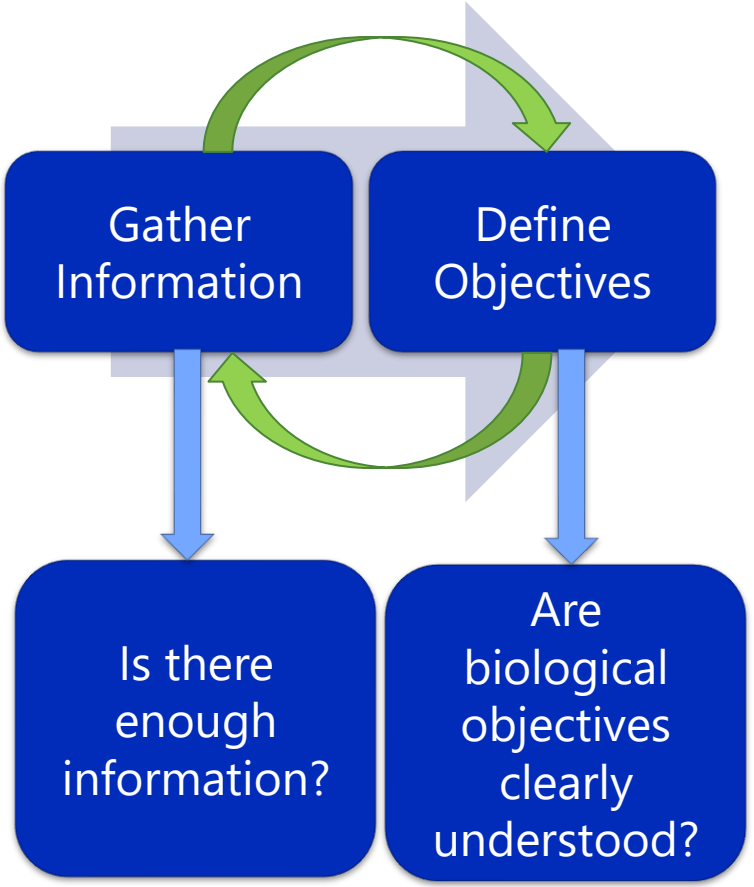
- Fish passage feasibility can be evaluated in the following terms:
  - Technical feasibility
  - Biological/Ecological feasibility
  - Economic feasibility
- Definition is subjective and commonly defined in the early stages of each study, by study participants

FISH PASSAGE FACILITIES ASSESSMENT

- Technical feasibility - Does it satisfy operational and engineering related objectives of the project?
  - Compliance with technical design guidelines, operational criteria/constraints, and performance standards agreed to for the project.
  - Compliance with life and safety requirements
  - Consistent with the intent of the existing operational requirements (i.e. water supply, flood control, hydropower, and/or recreation)
  - Can it be built and operated as intended following applicable engineering design standards?

ASSESSMENT METHODOLOGY – FEASIBILITY AND DESIGN PROCESS

- Create collaborative relationships
- Define the feasibility process and rules (decision tree)
- Establish common goals, objectives, criteria, and expectations
- Gather site specific biological and environmental data



ASSESSMENT METHODOLOGY – OBJECTIVES, OUTCOMES, AND DATA REQUIREMENTS

Project Objectives
- Improve passage
- Introduction/reintroduction

Definition of Success
- Monitoring and evaluation
- Collection and passage efficiency
- Passage timing
- Survival

Operational Objectives
- Design flow range
- Design water level range
- Power plant operations
- Spillway operations
- Safety requirements

Biological Data
- Target species and life stages requiring passage
- Migration timing
- Population abundance and peak rate of migration
- Migration cues
- Reservoir transit and survival
- Colonization method (for introduction/reintroduction projects)

Physical Data
- Existing infrastructure
- Access / Ownership
- Geotechnical
- Debris loading conditions
- Bathymetry
- Hydrology

BIOLOGICAL FACTORS INFLUENCING DESIGN AND ALTERNATIVES DEVELOPMENT

Why are biological linkages important to the technical and economic feasibility?

Significant influence on the facility type, size, location, configuration, and operational requirements

Biological Basis of Design

- Ecological objectives
- Target species and life stages requiring passage
- Migration timing and cues
- Population abundance and peak rate of migration
- Site biomechanics
- Habitat suitability/availability
- Colonization method (for introduction/reintroduction projects)

Operational Requirements

- Performance objectives
- Monitoring and evaluation
- Project operational constraints

PHYSICAL FACTORS INFLUENCING DESIGN AND ALTERNATIVES DEVELOPMENT

Stream/Reservoir Conditions

- Hydrologic conditions: spill, peak timing, duration, magnitude
- Site hydraulic conditions
- Reservoir rule curves and operating limits
- Reservoir temperature conditions

Physical Site Conditions

- Facilities features – dams, spillways, intakes.
- Topography and bathymetry
- Existing facilities and operational requirements/objectives
- River/stream mechanics and natural processes - sediment and debris
- Existing facilities and operational requirements/objectives

FISH PASSAGE FACILITIES ASSESSMENT – NEXT STEPS

- Continue gathering and synthesizing data to address remaining data gaps
- Begin engagement with AWS
- Establish preliminary technical, operational, and biological goals, criteria, and constraints.
- Prepare Fish Passage Facilities Design Criteria Report

FISH PASSAGE FACILITIES ASSESSMENT – NEXT STEPS

Fish Passage Facilities Design Criteria Report
Preliminary Draft (9/17/2021)

- Maps and Drawings of Existing Facilities
- Reservoir rule curves and operating limits, historical operations data, debris accumulation information, and data on thermal regimes of the reservoirs
- List of conceptual alternatives to be evaluated
- Performance of PNW passage facilities at high-head dams
- Biological and Technical Performance Goals
- Technical Design Criteria

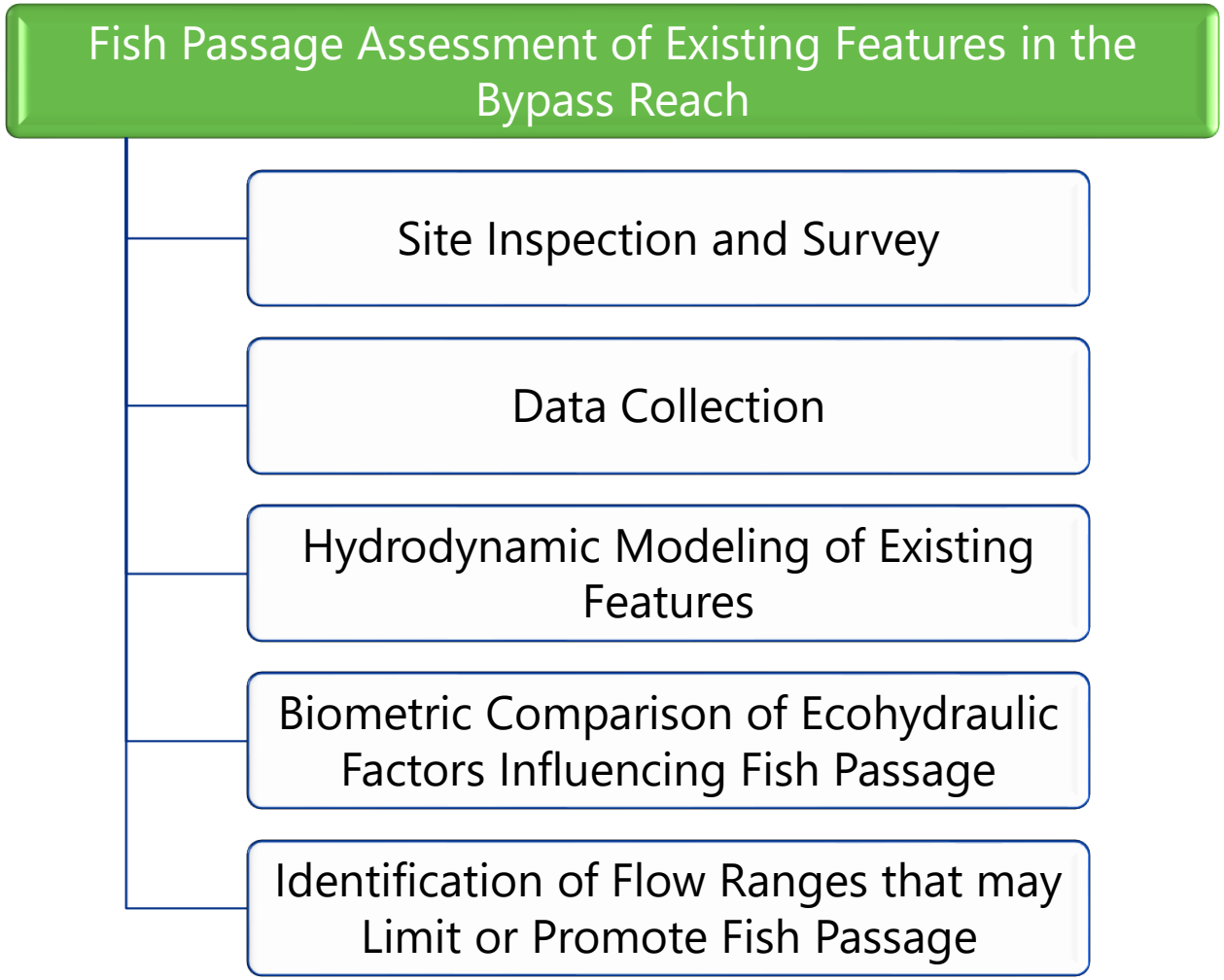
Seattle City Light

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – OBJECTIVES AND OUTCOMES

- Objectives and Outcomes
  - Establish swimming and leaping capabilities of fish that may migrate through the Bypass Reach.
  - Characterize and document the physical structure and hydraulic conditions of the Existing features throughout the range of observed and/or modeled flows.
  - Identify ranges of hydraulic conditions where fish may be able to ascend the Bypass Reach
  - Identify conditions that are anticipated to impede passage

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES



FISH PASSAGE ASSESSMENT OF EXISTING FEATURES - LINKAGES TO OTHER STUDIES

This assessment considers physical data obtained from other studies to assess fish passage potential in the Gorge bypass reach. On-going studies that may inform this assessment include:

Study	Linkage to FA-04
FA-02: Instream Flow Model Development	Using hydraulic model outputs from FA-05, this study will also assess physical criteria (depth and velocity) that may inform passage conditions in the bypass reach.
FA-05: Skagit River Gorge Bypass Reach Hydraulic and Instream Flow Model Development	The model developed under FA-05 will inform physical conditions related to hydraulics and flow, which will provide information to aid in the assessment of fish passage potential in the bypass reach under a range of flow conditions.

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – FISH PASSAGE METHODS AND TOOLS

- Numerous examples of fish passage evaluation methods and complexities exist
- Guidelines provide insight consistent with their purpose and within a range of applicable conditions
- Custom methods suit more unique site-specific conditions
- Conclusions require a multi-faceted approach and professional judgement
- Not intended to replace or replicate direct observations and conclusions from long-term monitoring programs

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – FISH PASSAGE METHODS AND TOOLS

- WDFW 2019 provides guidance on assessing natural barriers for fish passage
- Suggests that gradient barriers are greater than 20% for over 160 meters
- Recognizes variability in species diversity, swimming speed, and feature complexity – cascades and waterfall features
- Existing features in the Bypass Reach are complex and require a site-specific detailed evaluation

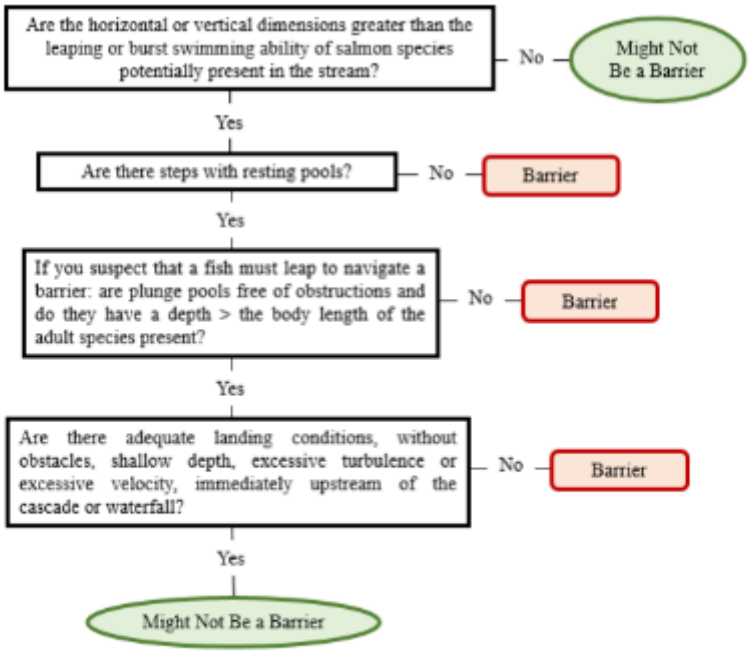
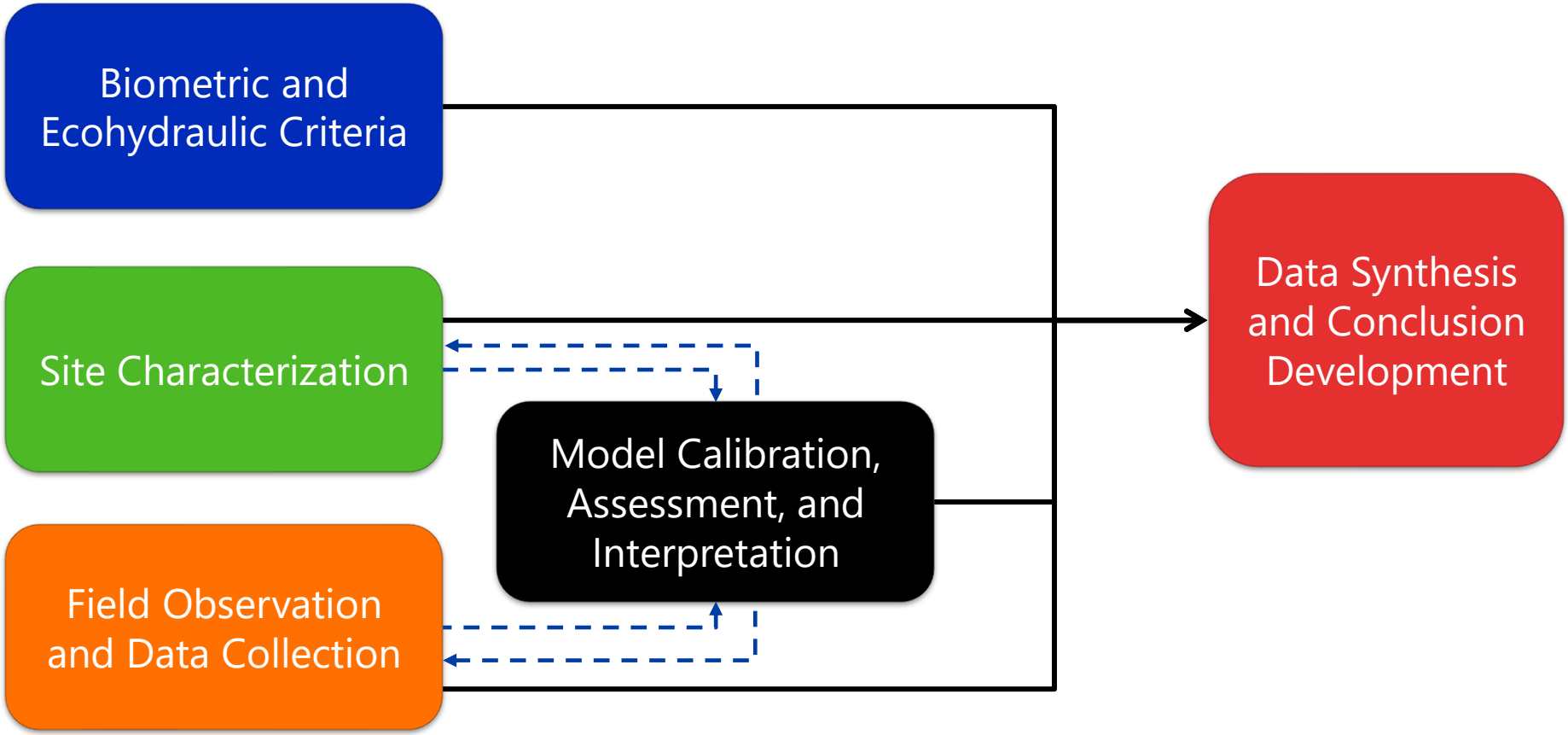


Figure 7.7. Cascade barrier determination. This flowchart provides guidance for determining whether a cascade is a barrier. Remember to consider the range of flows that occur at the site when evaluating the barrier status of a cascade.

Source: WDFW (2019)

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – PROCESS OVERVIEW



FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – PROCESS OVERVIEW

Biometric and Ecohydraulic Criteria

- Fish species and characteristics
- Swimming capability
- Leaping capability

Field Observation and Data Collection

- Video Documentation
- Photo Documentation
- Flow Measurement
- Water depth and elevation data
- Velocity

Data Synthesis and Conclusion Development

Site Characterization

- Topography
  Aerial photography
- Site Inspection
- Site Characterization

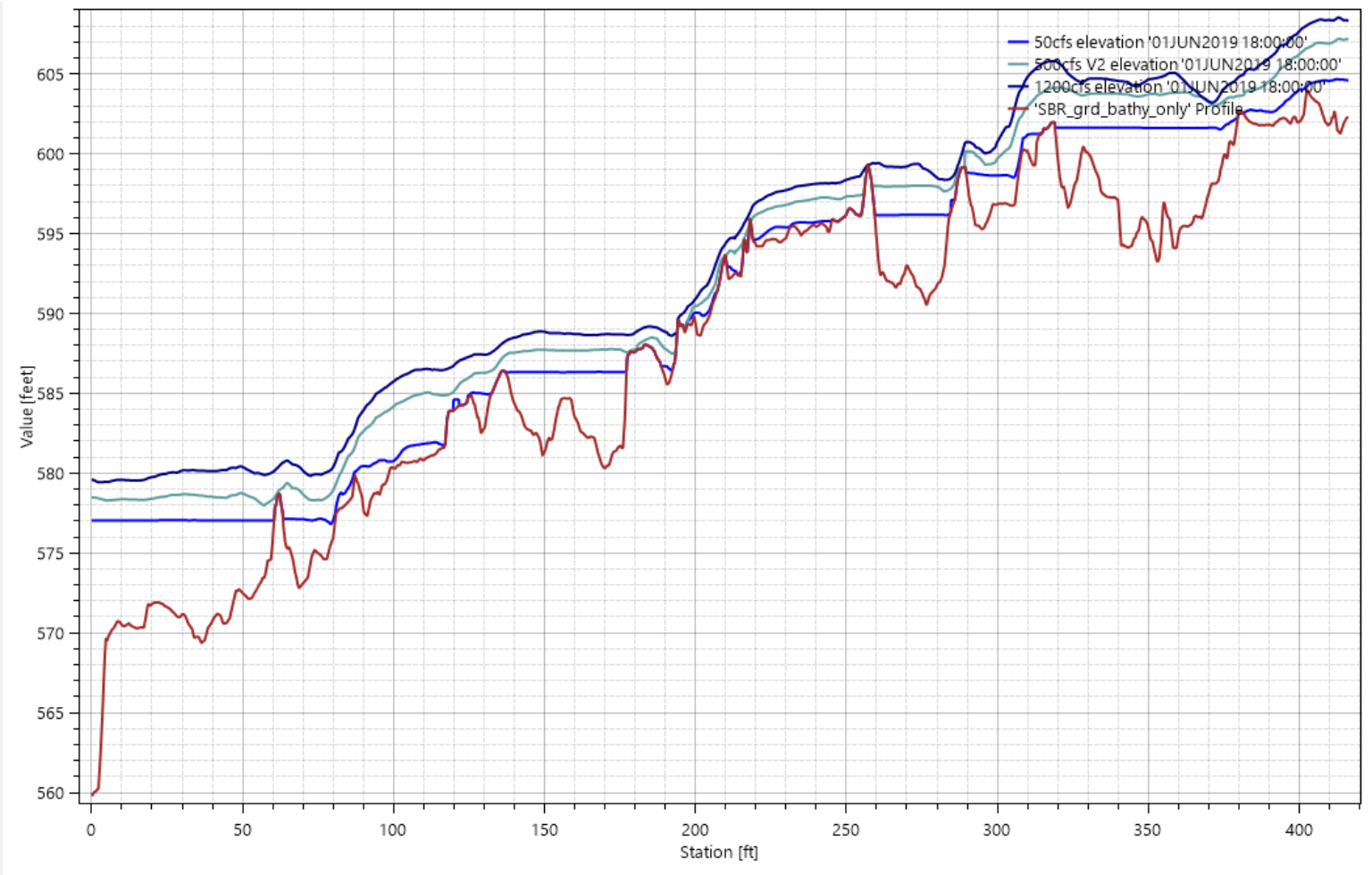
Model Calibration and Assessment

- Hydraulic pathways
- Hydraulic trends and variability assessment
- Water surface profile assessment
- Water velocity assessment

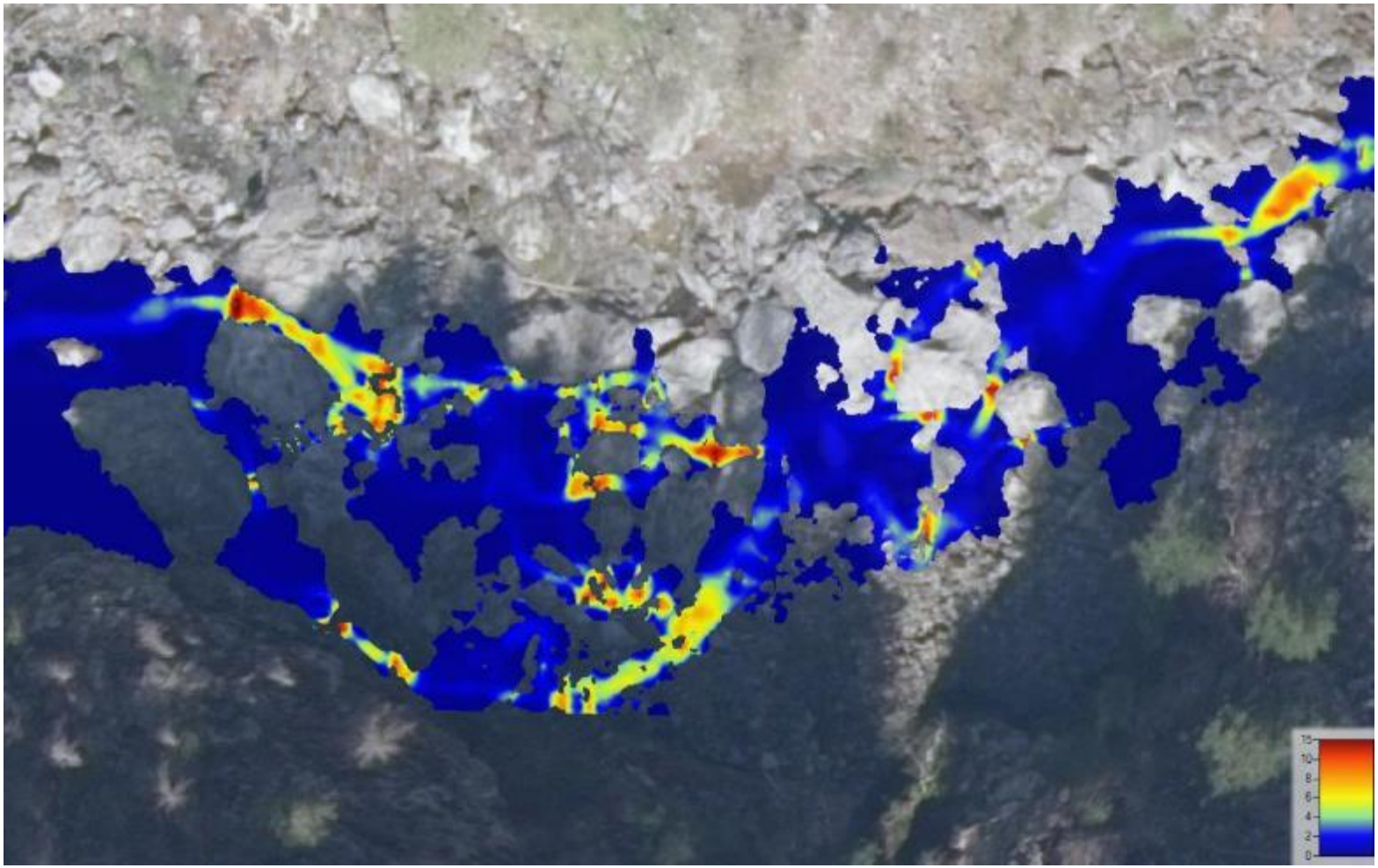
FISH PASSAGE ASSESSMENT OF EXISTING FEATURES –ROLE OF HYDRAULIC MODELING

- Informs data collection methods
- Informs development of hydraulic pathways that may provide passage
- Informs transition between plunging and streaming flow regimes – leaping vs swimming conditions
- Provides a tool to study trends across the range of flows experienced at the site
- Not intended to be a quantitative tool to dictate pass or fail

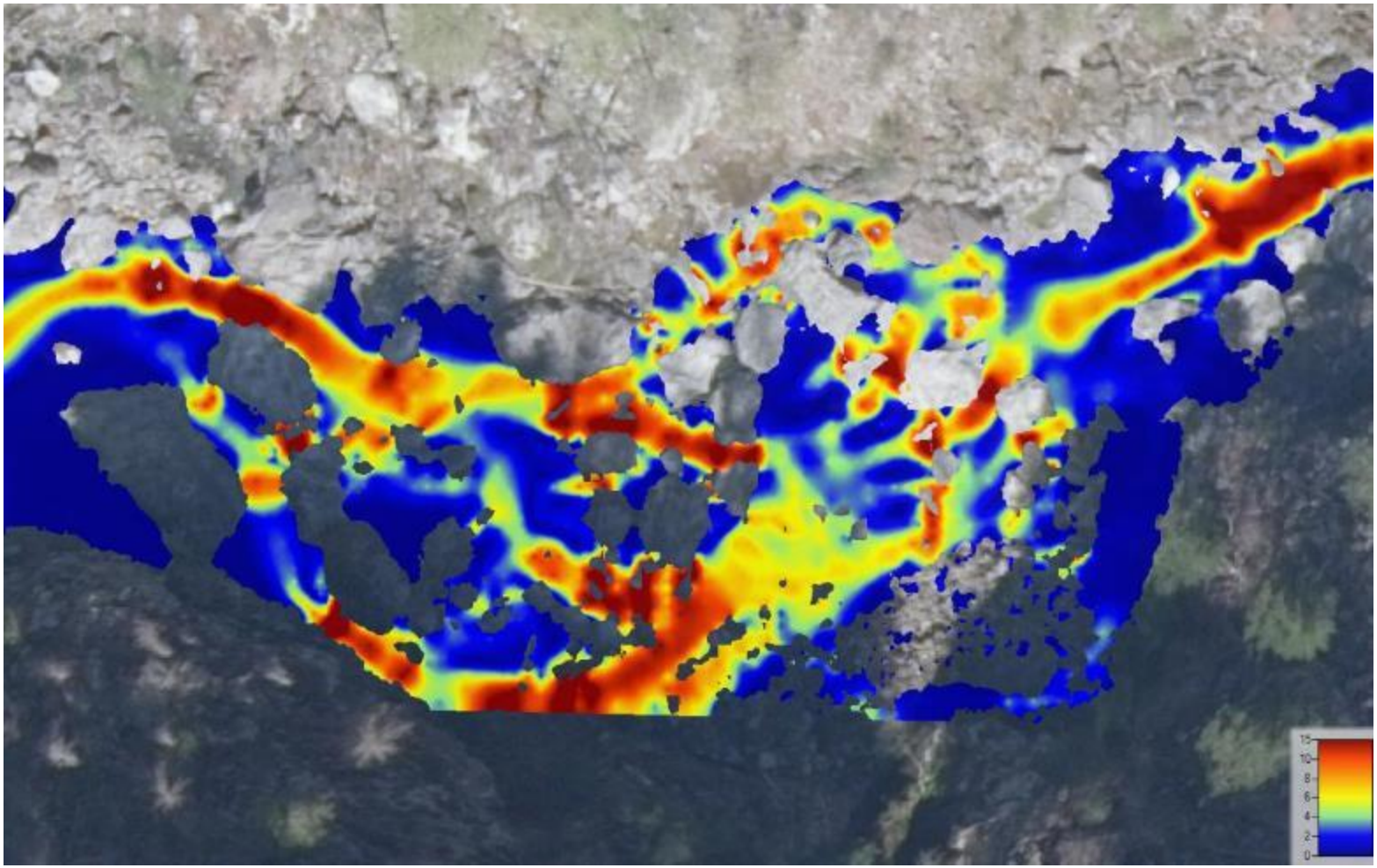
FISH PASSAGE ASSESSMENT OF EXISTING FEATURES –UNCALIBRATED WSEL PROFILE



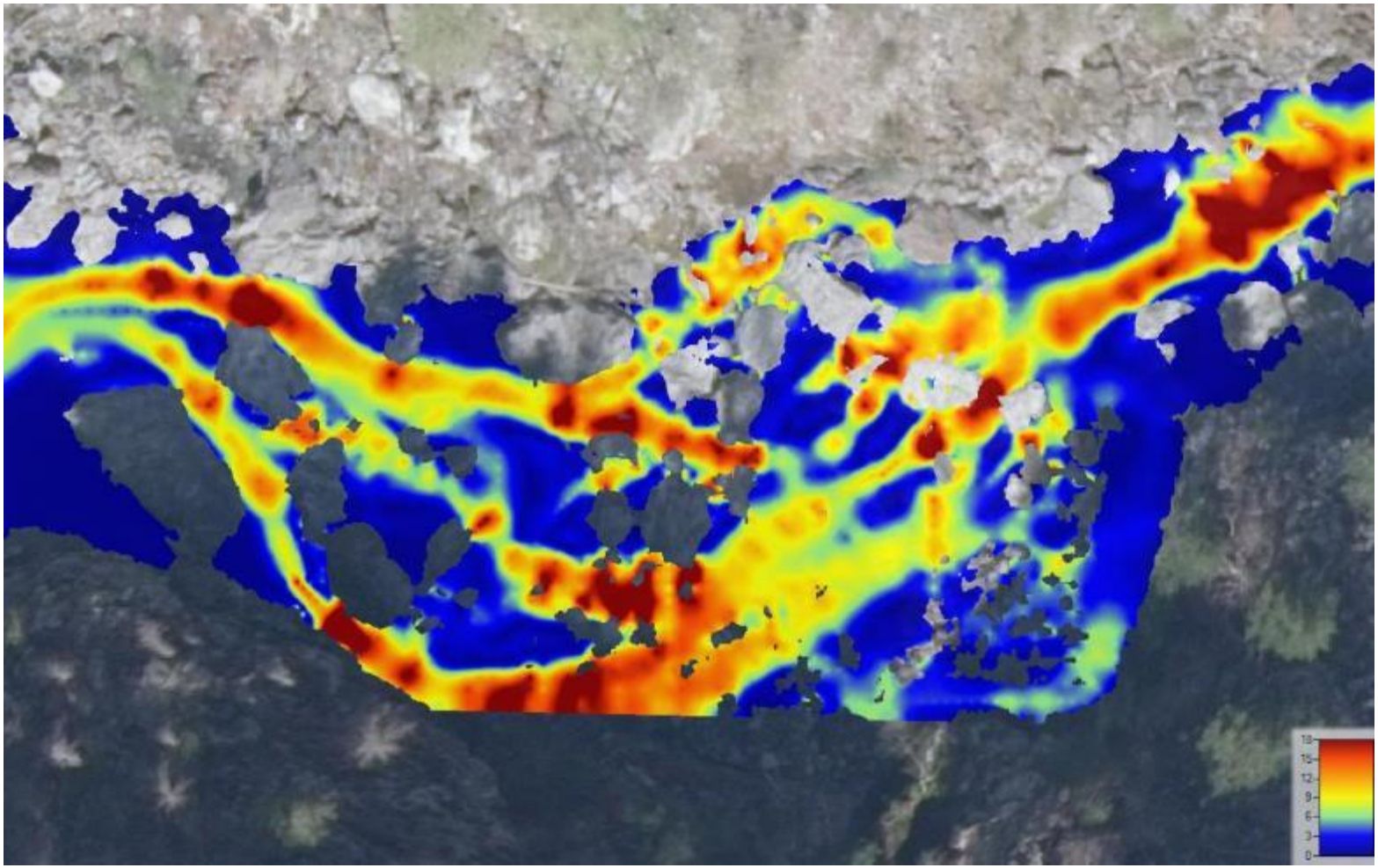
FISH PASSAGE ASSESSMENT OF EXISTING FEATURES –UNCALIBRATED VELOCITY 50 CFS



FISH PASSAGE ASSESSMENT OF EXISTING FEATURES –UNCALIBRATED VELOCITY 500 CFS



FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – UNCALIBRATED VELOCITY 1200 CFS



FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – EXAMPLE FISH PASSAGE ASSESSMENTS

- Numerous site-specific assessment examples exist with varying level of detail, complexity, and rigor.
- Example fish passage evaluations
  - Clearwater River
  - Mission Creek
  - Nelson Dam Removal
  - Example fish passage simulation technique

SF CLEARWATER RIVER

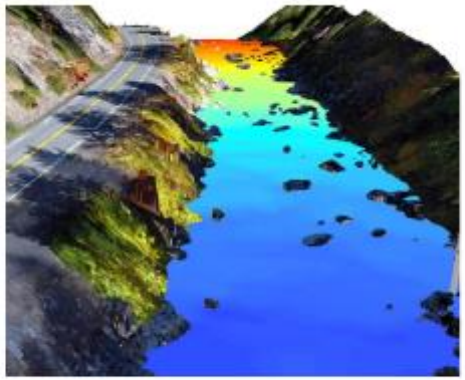
CRAMER FISH SCIENCES

nhc northwest hydraulic consultants

SOUTH FORK CLEARWATER RIVER

MP 28 Hypothesized Velocity Barrier

Final Report



Prepared for:

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Prepared by:

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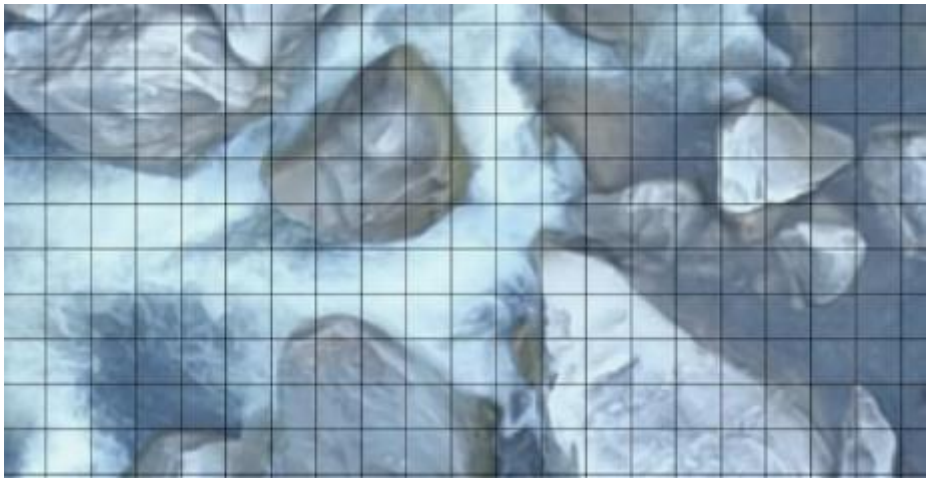
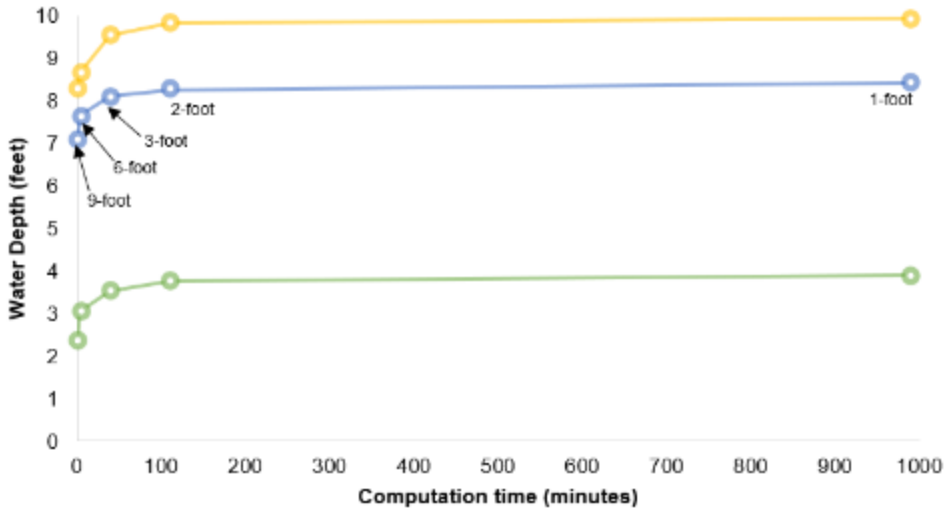
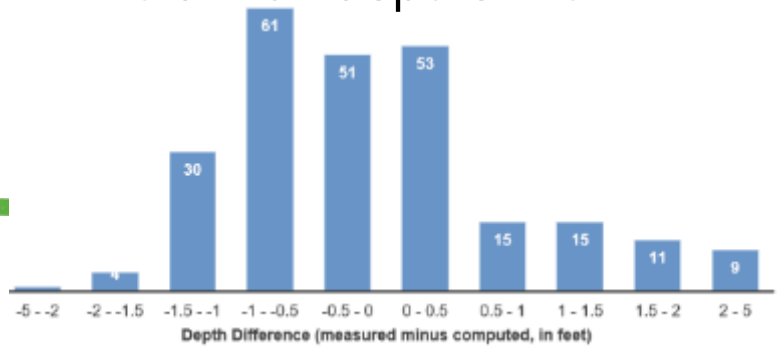
January 18, 2017





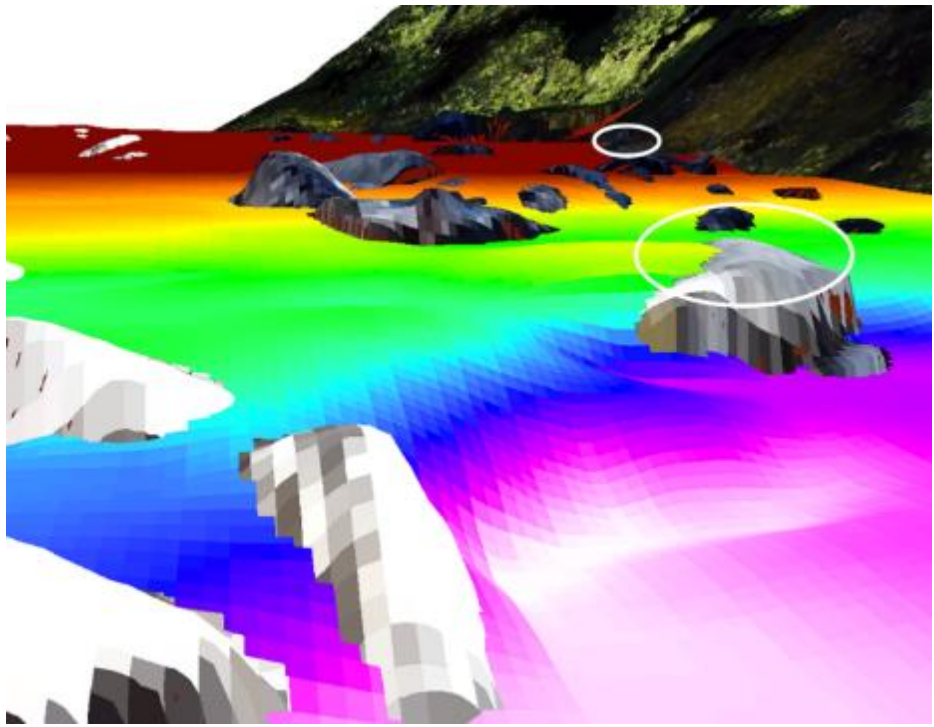
SF CLEARWATER RIVER

- 74% of 182 depths within ± 1′



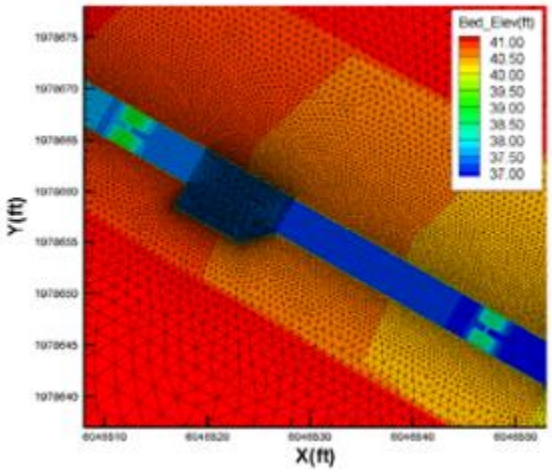
- May 5, 2016 (~1074 cfs)

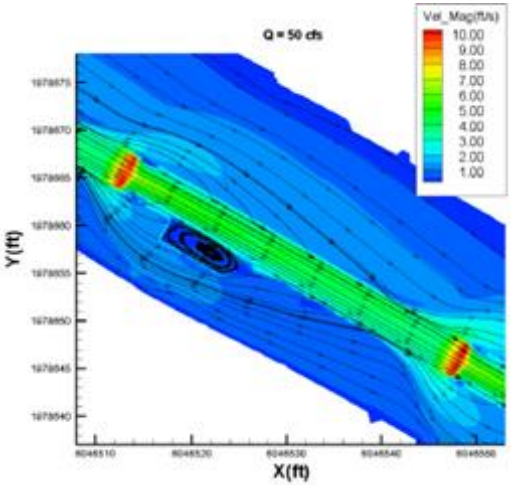
- Calibrated RAS model (1100 cfs)

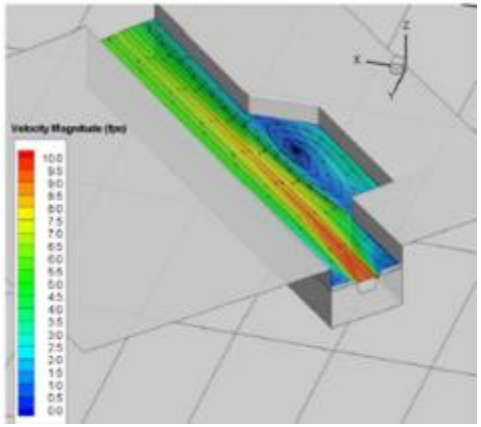


MISSION CREEK

- 1D, 2D, 3D, and physical model development
- 2D model calibrated from physical model results
- 2D model results used to perform energy expenditure simulation informing steelhead passage







TRABUCO CREEK PHYSICAL MODEL STUDIES

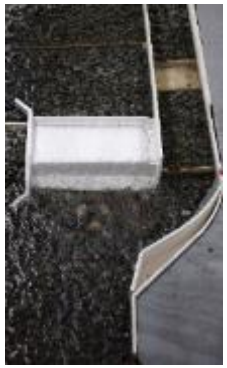
- Metrolink Rail Crossing
  - 1:6 Fishway Model
  - 1:20 Comprehensive Model
  - Fish Passage around 30-ft Barrier
  - Objective: Fish Passage
  - Target: California Steelhead

Metrolink Existing Barrier

1:20 Comprehensive

1:6 Fishway

I-5 Comprehensive



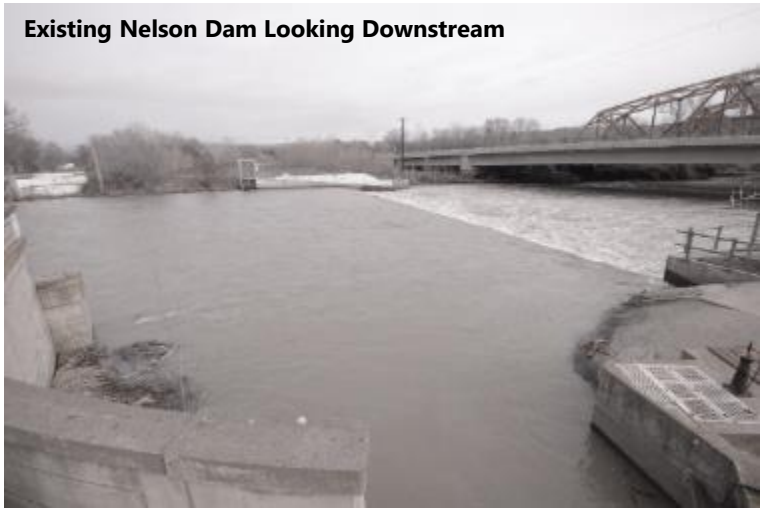
I-5 Fishway Entrance

I-5 Fishway

- I-5 Crossing
  - 1:8 Fishway Model
  - 1:25 Comprehensive Model
  - Fish Passage through Existing Concrete Culverts and Stilling Basin
  - Objective: Fish Passage
  - Target: California Steelhead

NELSON DAM REMOVAL PHYSICAL MODEL STUDIES

- 1:24 Scale Model
- Objective: Dam Removal & Fish Passage
- Fish Channel and Sluiceway



NELSON DAM REMOVAL FISH PASSAGE EVALUATION

Figure 2-3. Swim Distance vs. Flow Velocity for 250 mm and 1,000 mm Salmonids

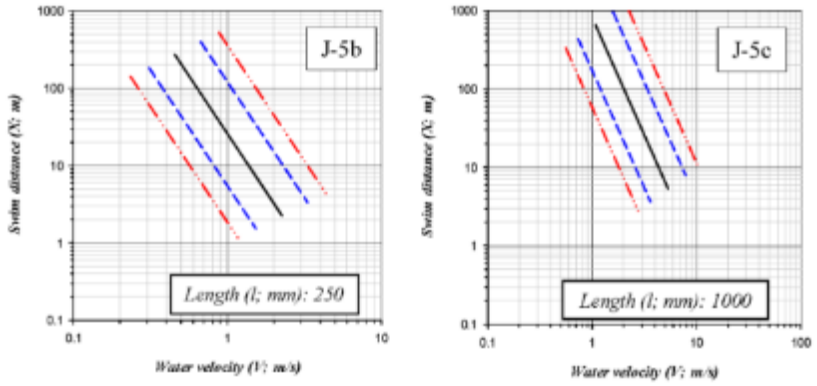
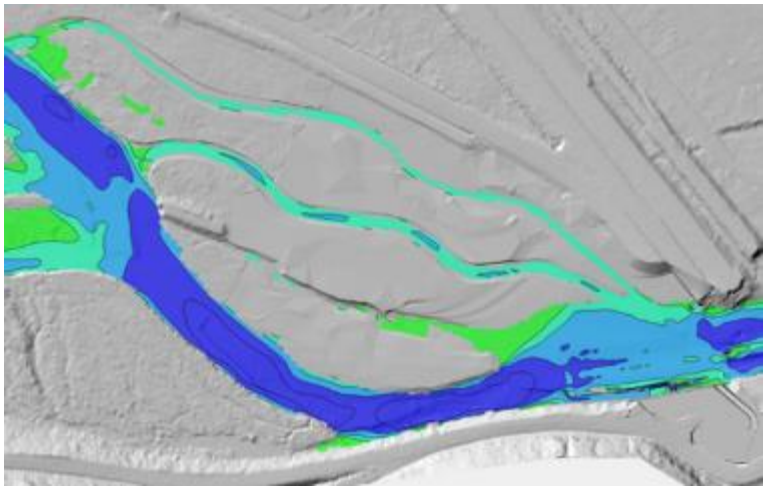
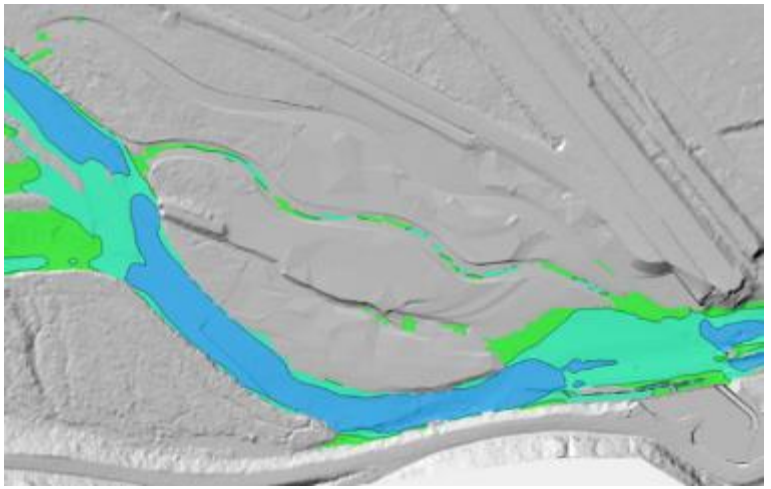


Table 4-8. Swimming Speeds For 250-mm, 1,000-mm, And 710-mm Salmonids for 75th Percentile

Fish Length	Time	Water Velocity (fps)	Swim Distance (ft)	Correlated Swim Speed (fps)
250mm[a] (10 inches)	5 seconds	9.5	16.4	12.8
	20 seconds	6.9	45.9	9.2
	3 minutes	4.3	229.6	5.5
	30 minutes	2.1	1,312.0	2.9
710mm[b] (28 inches)	5 seconds	18.0	30.5	24.1
	20 seconds	12.7	86.2	17.0
	3 minutes	7.3	450.9	9.8
	30 minutes	4.0	2,418.5	5.4

[a] Obtained from Katopodis and Gervais (2016), Appendix E, Charts J-5b and J-5c.
[b] Interpolated from Katopodis and Gervais (2016) data using dimensionless length ratio.





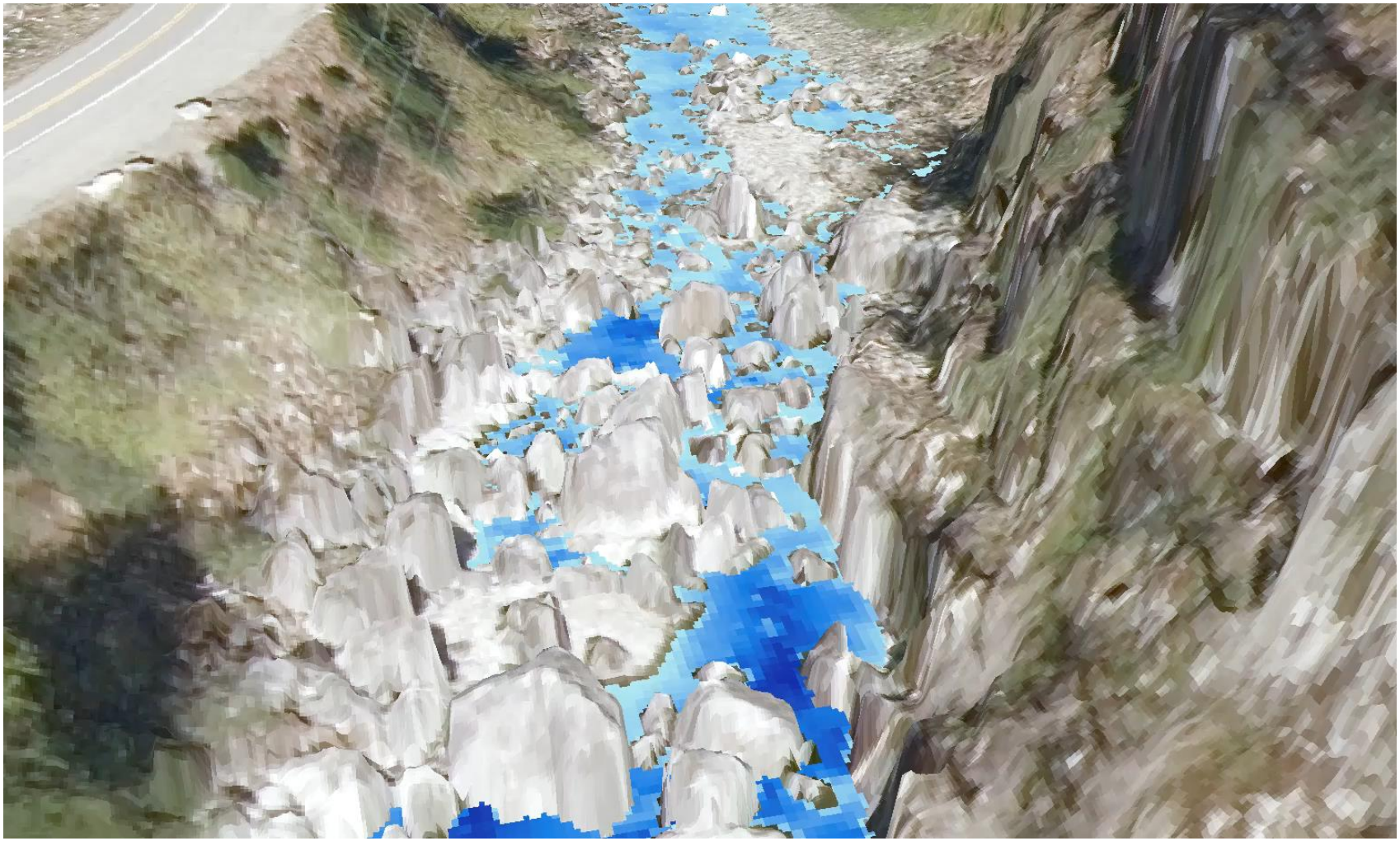
FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – DATA REQUIREMENTS

- Physical Data
  - Topography / Bathymetry
  - Flow magnitude
  - Flow depth and water surface profiles
  - Flow velocity
  - Hydraulic pathways and connectivity
  - Turbulence, air entrainment (hydraulic chaos)
  - Range of observable discharges

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – DATA COLLECTION

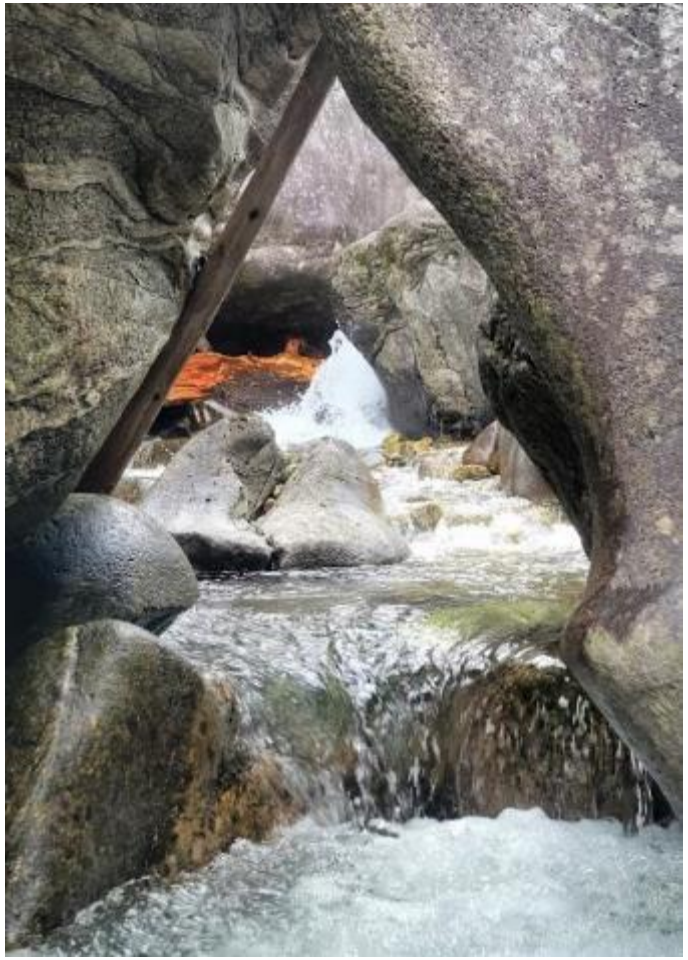
- Strategies for site inspection and visual observation
  - 2 time-lapse cameras capturing imagery throughout range of flow conditions
  - UAV video with particle tracking imagery for controlled releases
- Collection of flow magnitude, depth, elevation, and velocity data
  - Water surface elevation profiles for baseflow (no release from Gorge Dam) and controlled releases of 50 cfs, ~300 cfs, 500 cfs and 1,200 cfs.
  - Detailed monitoring (depth, velocity, discharge) at 5 transects under baseflow and controlled releases.
  - 12 continuous water level recorders provide data to refine model in passage sections and support fish passage evaluation – for both controlled releases and unscheduled spill in monitoring period.

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – FEATURE TOPOGRAPHY



FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – SITE INSPECTION AND VISUAL OBSERVATION

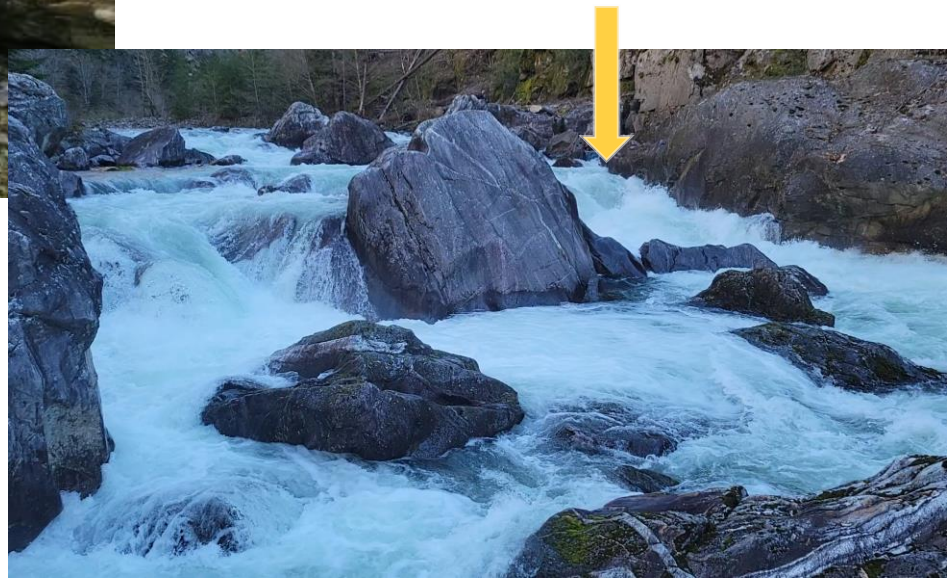
Feature complexity



FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – SITE INSPECTION AND VISUAL OBSERVATION

Feature 1

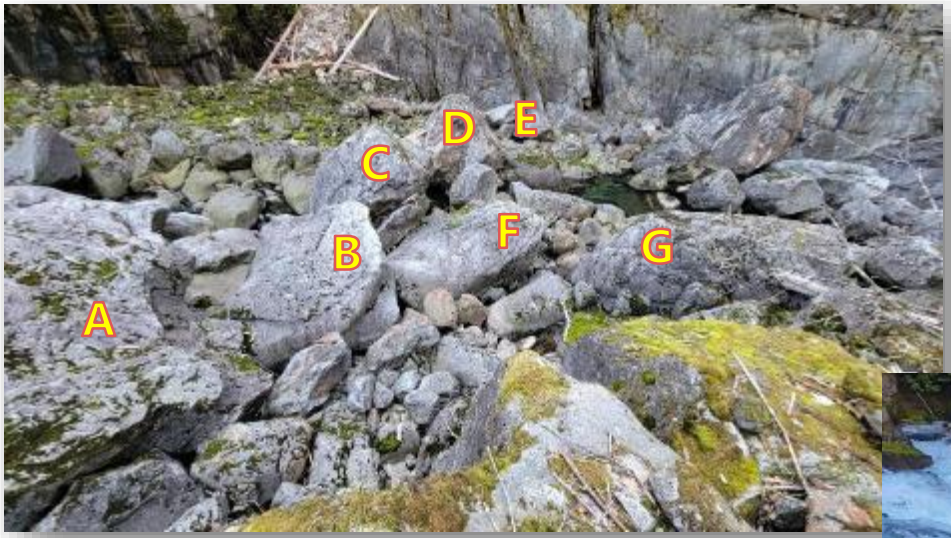
Base flow ~5 to 10 cfs



~1,200 cfs

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – SITE INSPECTION AND VISUAL OBSERVATION

Feature 2

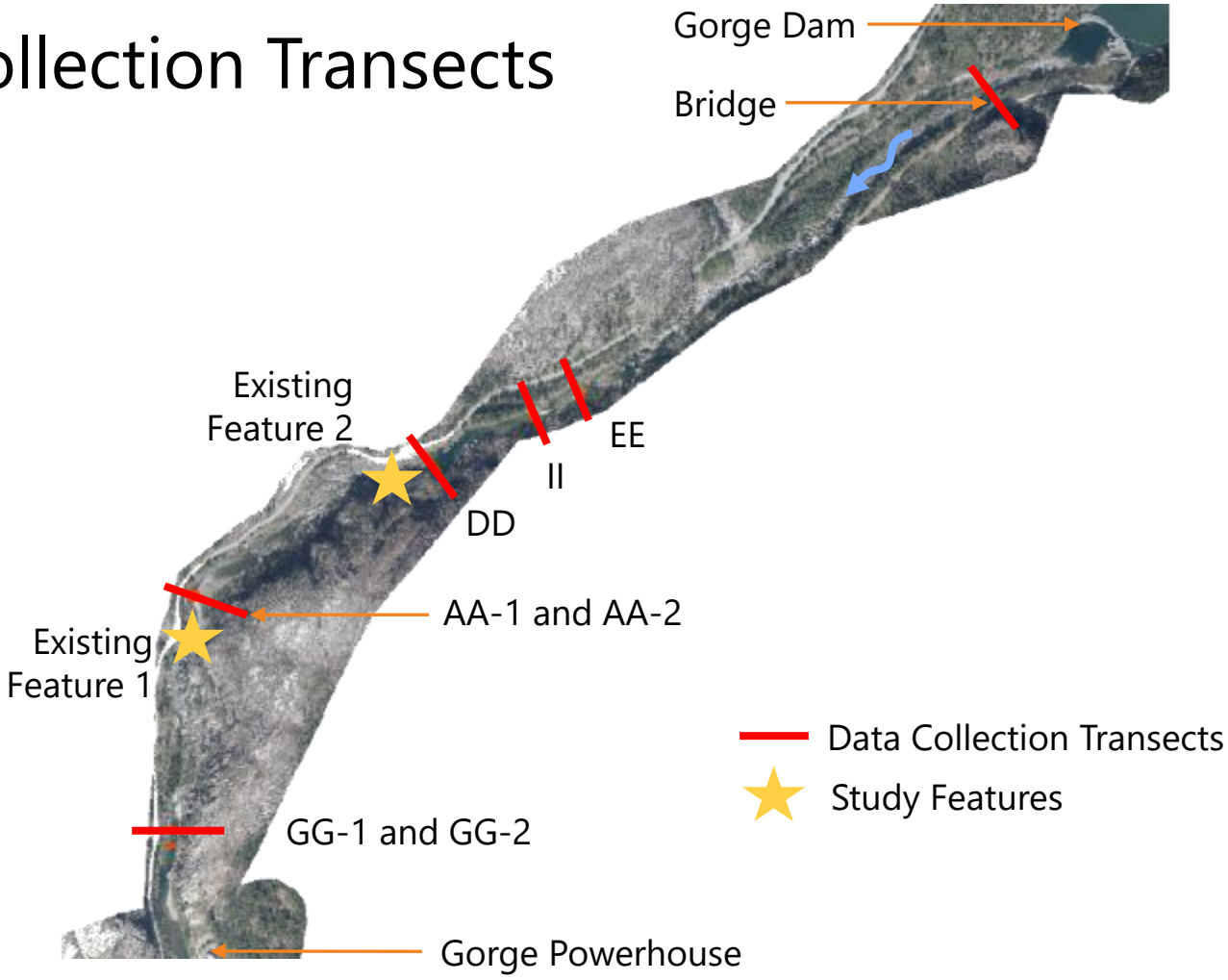


Base flow ~5 to 10 cfs

~1,200 cfs

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – FLOW MAGNITUDE

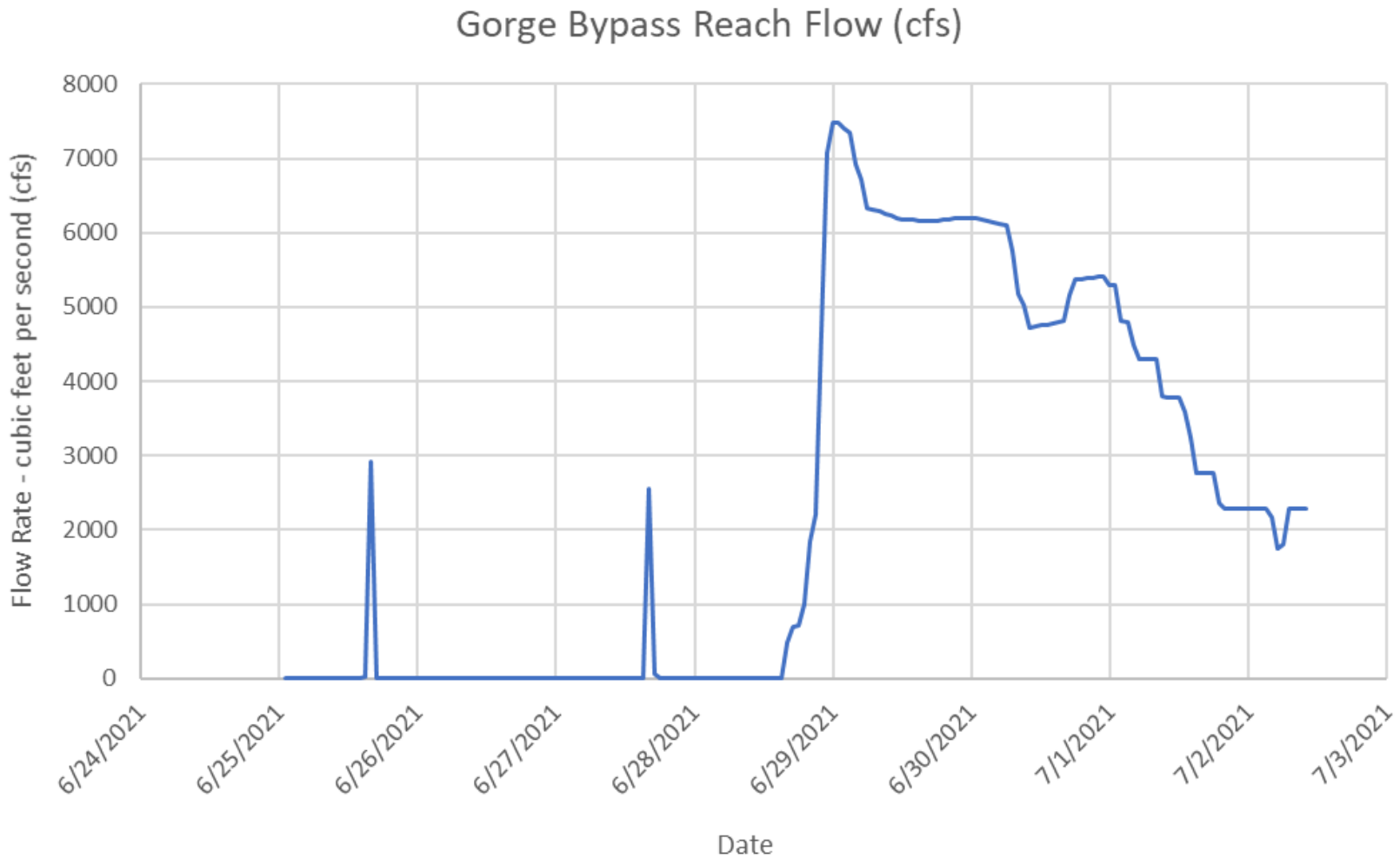
- Flow Data Collection Transects
  - GG-1
  - GG-2
  - AA-1
  - AA-2
  - DD
  - II
  - EE
  - BRIDGE



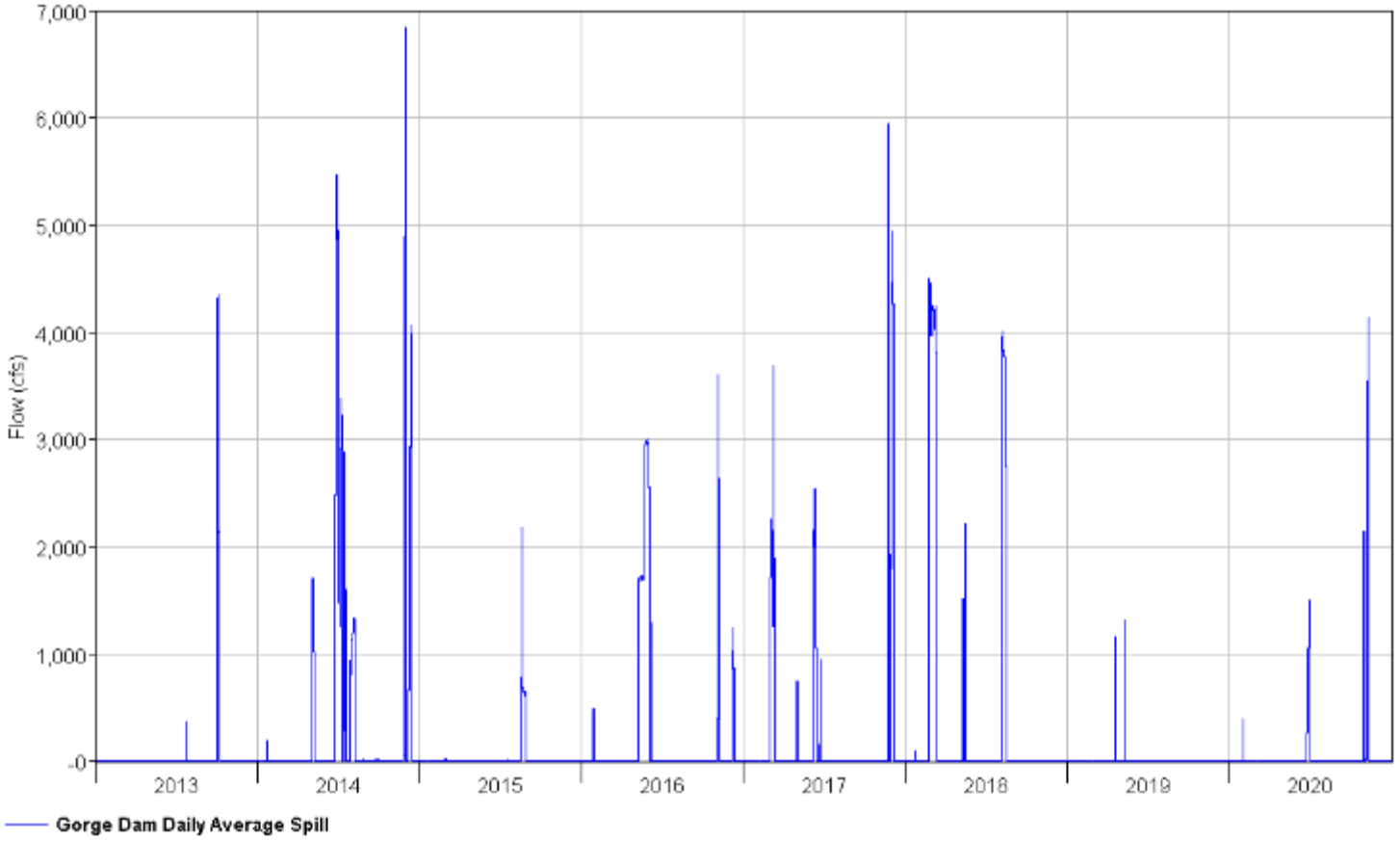
FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – FLOW MAGNITUDE

- Opportunistic Spill – opportunity for data collection at higher flows
  - Flows up to 5,000+ cfs observed in records for spring/early summer freshet; 10,000+ cfs in fall/early winter storms.
  - Level loggers and time lapse cameras will be collecting data throughout this period
  - Duration variable dependent upon spill occurrence

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – JUNE/JULY 2021 HYDROGRAPH



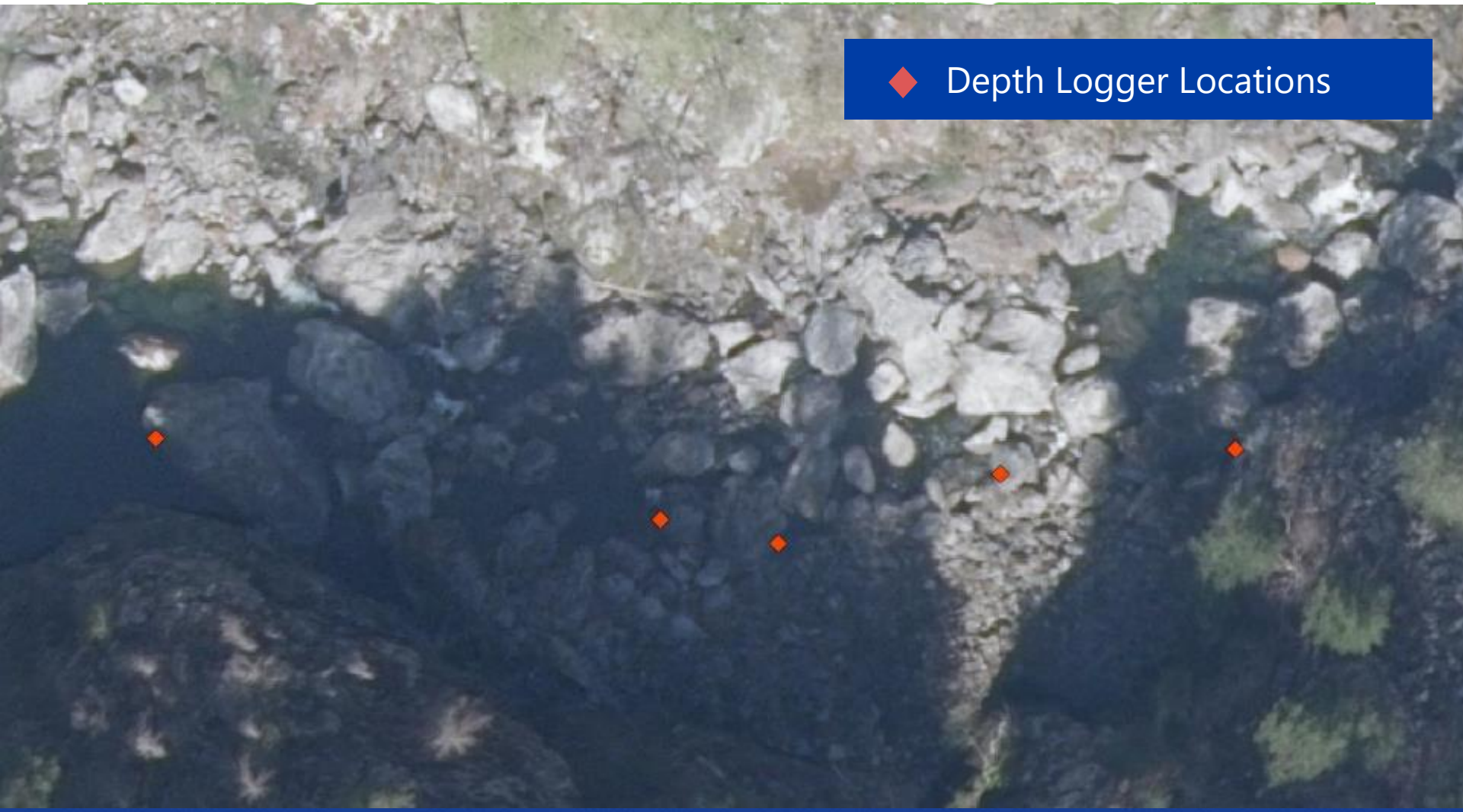
FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – RANGE OF OBSERVABLE DISCHARGES



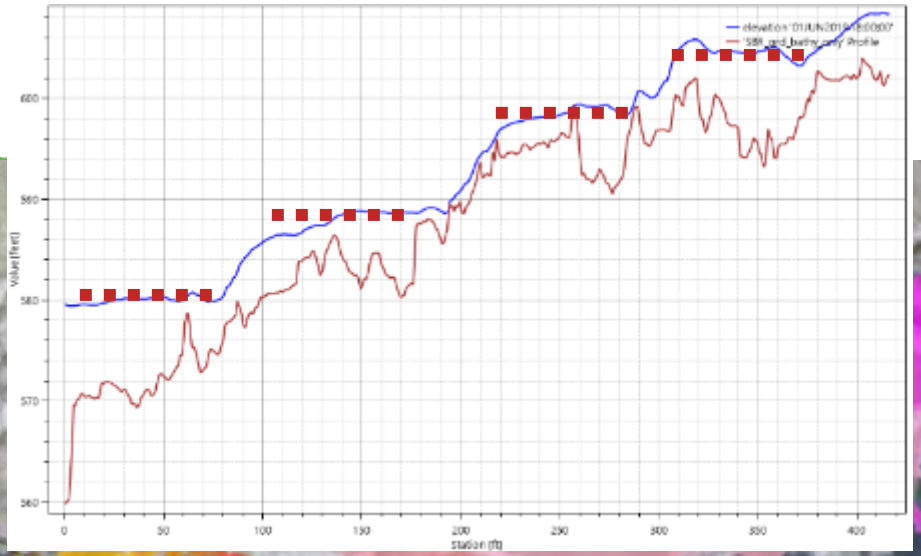
FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – DEPTH MEASUREMENT

- Depth monitoring locations identified using site investigation and initial/uncalibrated 2D model
- Deployment of level probes at 12 select locations
  - 5 at each feature (total of 10)
  - 2 at selected flow measurement transects
- Locations refined further after observations of features at ~1,200 cfs

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – UPSTREAM FEATURE



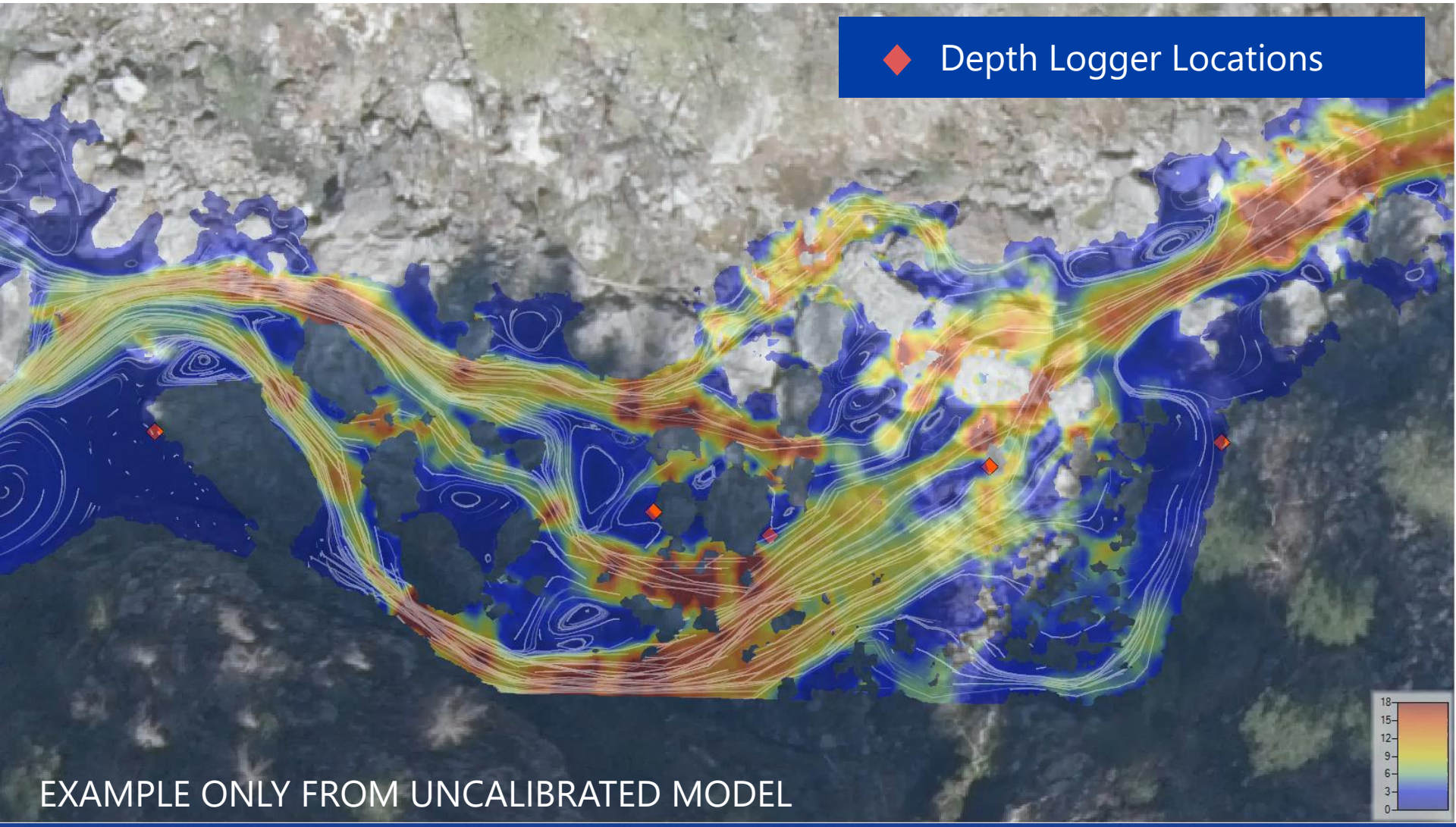
UPSTREAM FEATURE



EXAMPLE ONLY FROM UNCALIBRATED MODEL

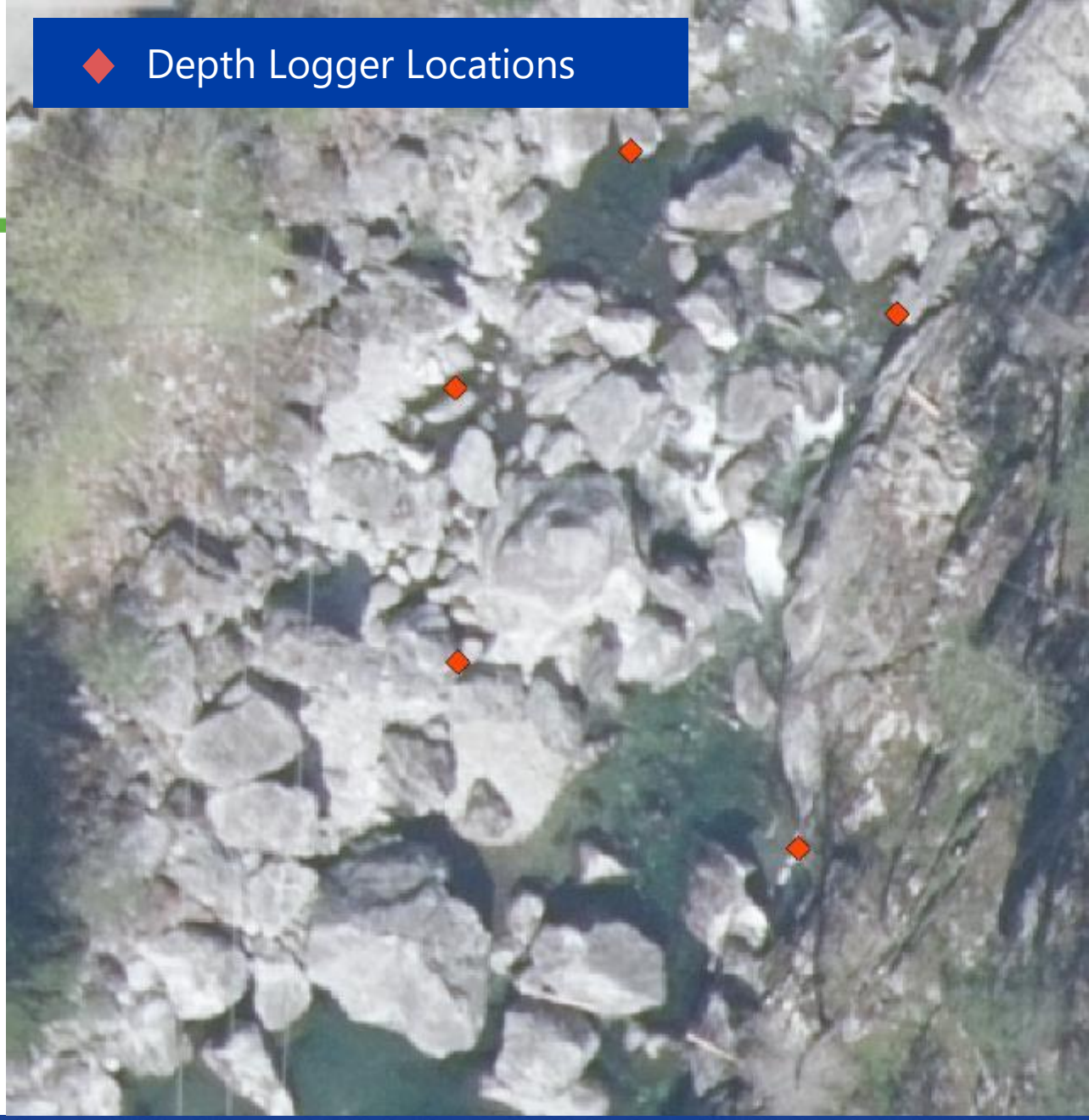
◆ Depth Logger Locations

UPSTREAM FEATURE



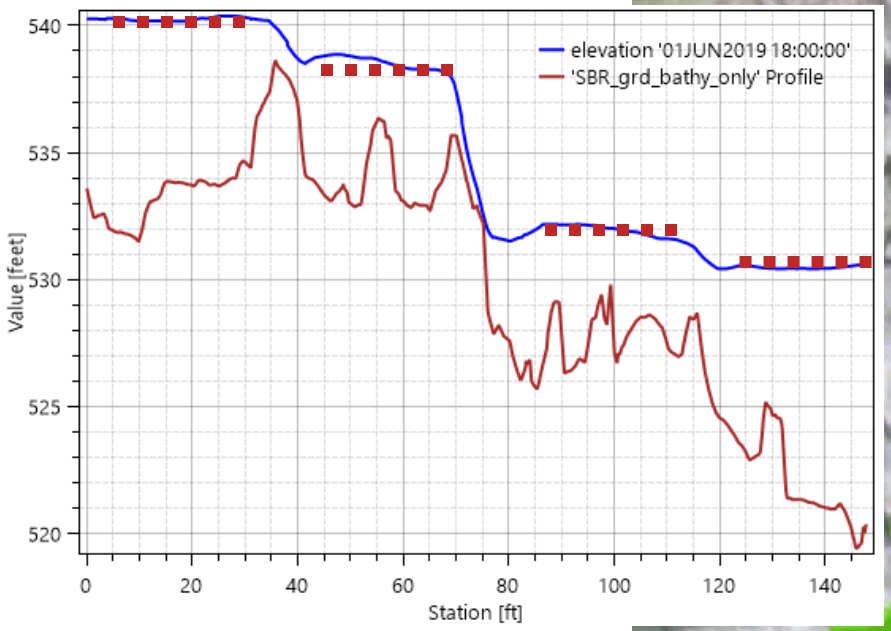
EXAMPLE ONLY FROM UNCALIBRATED MODEL

DOWNSTREAM FEATURE



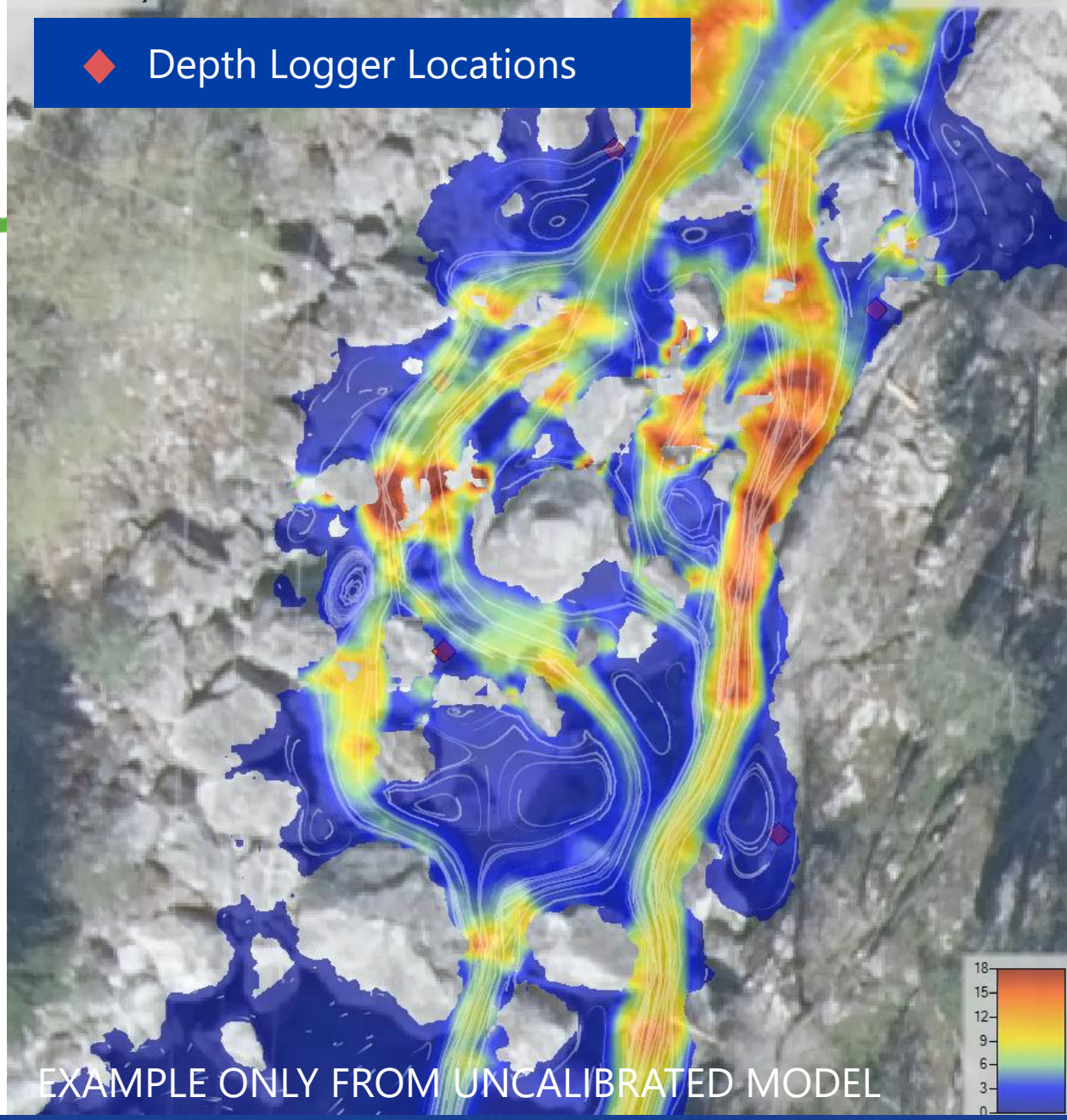
DOWNSTREAM FEATURE

Depth Logger Locations



EXAMPLE ONLY FROM UNCALIBRATED MODEL

DOWNSTREAM FEATURE



FISH PASSAGE ASSESSMENT OF EXISTING FEATURES - VELOCITY MEASUREMENT

- Difficult and unsafe access at flows above 50 cfs
- High levels of turbulence and multi-directional flow
- Conventional methods likely inadequate
- Strategy for estimating velocities include:
  - UAV aerial and stationary video using particle tracking methodology
  - HEC-RAS 2D hydraulic model using coincident data collected for calibration

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – DATA REQUIREMENTS

- Biological characteristics of species considered
  - Range of size by species
  - Condition upon arrival
  - Swimming capability
  - Leaping capability
- Availability and variance in information available influences basis of biometric or ecohydraulic comparisons

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – DATA REQUIREMENTS

- Criteria development:
  - Fish Swimming Capability
    - Factors that influence swimming capability
    - Key data available from the literature
    - Swimming capability approach
  - Fish Leaping Capability
    - Key factors that influence leaping capability
    - Methods from the literature
    - Leaping capability approach

FISH SWIMMING CAPABILITY – POTENTIAL FACTORS INFLUENCING SWIMMING CAPABILITY

Topic	References
Length	Topic reviewed in Beamish 1978.
Time to exhaustion	Topic reviewed in Beamish 1978.
Weight	Beamish 1978; Fry and Cox 1978.
Condition Factor	Beamish 1978; Vincent 1960; Green 1964.
Stage of Maturity	Williams and Brett 1987. Collins et al. 1962
Sex	Brett 1965; Williams and Brett 1987.
Disease	Swanson et.al. 1998. Parasitic infections reviewed in Beamish 1978.
River time	Paulik and DeLacy 1957. Sakowicz and Zarnecki (1962)
Strains	Thomas and Donahoo 1977
Stock	Taylor and McPhail 1985; Peake et al. 1997; Gauley and Thompson 1962.
Hatchery vs Wild	McDonald et al. 1998a.

FISH SWIMMING CAPABILITY – POTENTIAL FACTORS INFLUENCING SWIMMING CAPABILITY

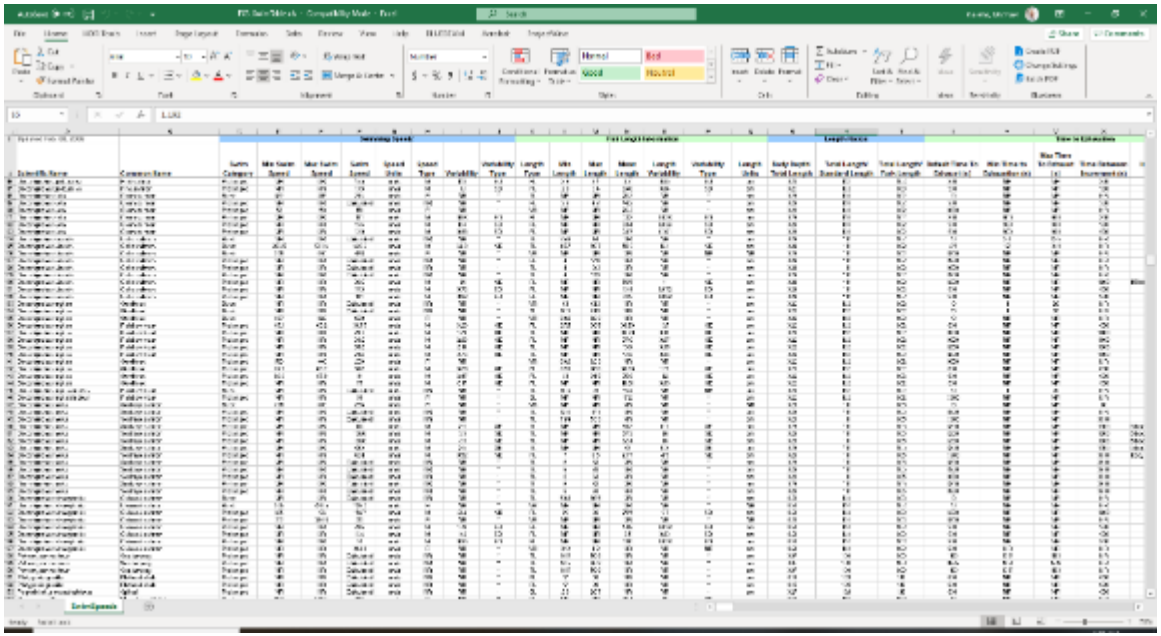
Topic	References
Feeding	Furrell et al. 2001.
Nutrition	Beamish et al. 1989.
Light	Blahm 1963; Pavlou et al. 1972 in Hammer 1995.
Stress	Strange and Cesh 1992.
Oxygen	Topic reviewed in Beamish 1978.
Carbon Dioxide	Dahlberg et al. 1968.
Salinity	Topic reviewed in Beamish 1978.
Toxins	Topic reviewed in Beamish 1978 and in Hammer 1995; Peterson 1974.
Temperature: Sustained and Prolonged Speed	Topic reviewed in Beamish 1978 and in Hammer 1995.
Temperature: Burst Speed	Beamish 1978; Booth et al. 1997.
Previous Training	Topic reviewed in Hammer 1995; Ward and Hilwig 2004.

FISH SWIMMING CAPABILITY – KEY FACTORS INFLUENCING SWIMMING CAPABILITY

- Species
- Fish condition (fatigue/energy stores)
- Fish length
- Water turbulence and air entrainment

FISH SWIMMING CAPABILITY – KEY DATA AVAILABLE FROM THE LITERATURE

- Numerous sources of swim and endurance data available for focal species
- Not all species have reliable information – variability exists
- Example: FishXing 3 Swim Table
- 230 records
- Over 25 species

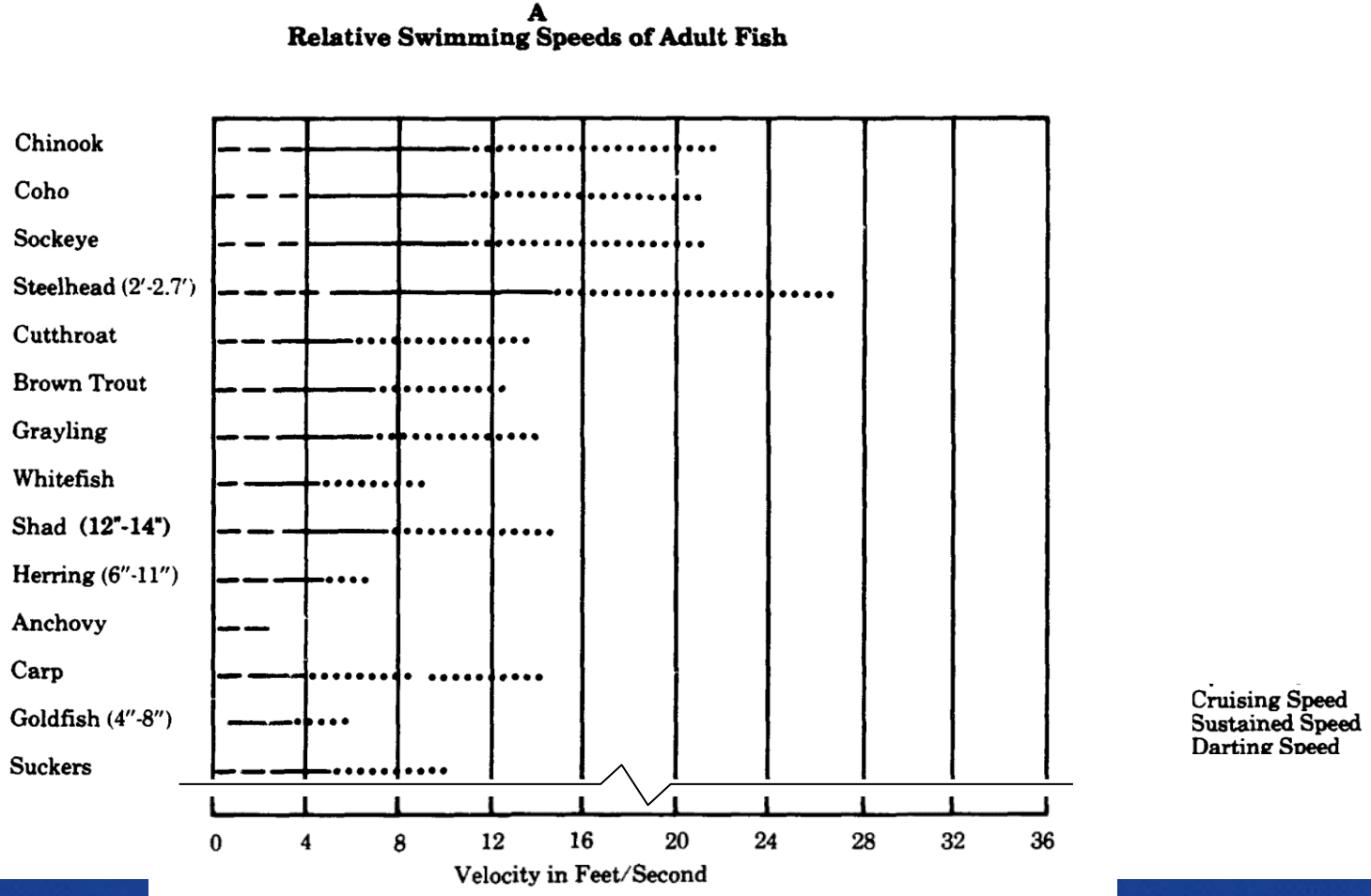


FISH SWIMMING CAPABILITY – KEY DATA AVAILABLE FROM THE LITERATURE

- Hunter and Mayor (1986) – Swimming ability and time to exhaustion calculated based upon regression curves using historical flume data
  - Calculated "sustained," "prolonged," and "burst" swim speeds and durations were used to assess those situations where steep gradients create high velocity, turbulent conditions through chutes or cascades.
  - The combination of calculated swimming and leaping capabilities was used to identify whether or not a hydraulic feature (high velocity or leap condition) is passable.

FISH SWIMMING CAPABILITY – KEY DATA AVAILABLE FROM THE LITERATURE

- Bell (1986) – Swimming Speeds of Adult and Juvenile Fish

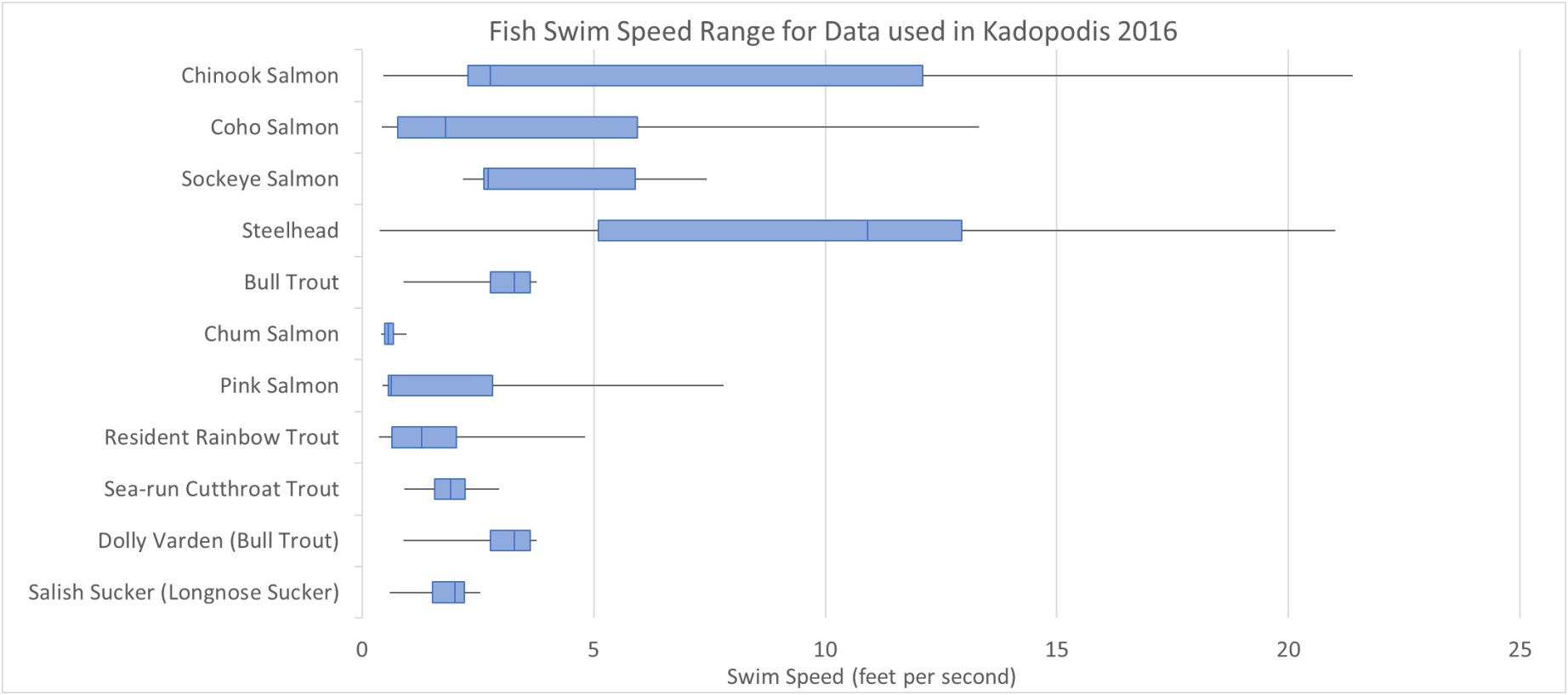


FISH SWIMMING CAPABILITY – ANTICIPATED SWIMMING CAPABILITY BY SPECIES OR ANALOGUE

Species	**Adult Burst Swimming Speed (feet per second)** *Bell, 1991*
Chinook Salmon	21.7
Coho Salmon	21
Sockeye Salmon	21.2
Steelhead	26.7
Bull Trout	-
Chum Salmon	-
Pink Salmon	-
Resident Rainbow Trout	-
Sea-run Cutthroat Trout	13.5
Dolly Varden	-
Pacific Lamprey	6.7
Salish Sucker	-

FISH SWIMMING CAPABILITY – KEY DATA AVAILABLE FROM THE LITERATURE

- Katopodis and Gervais (2016) – swimming speed data
  - Emphasizes data available from 1990 forward



FISH SWIMMING CAPABILITY – KEY DATA AVAILABLE FROM THE LITERATURE

- Katopodis and Gervais (2016) – swimming time vs swimming speed regression

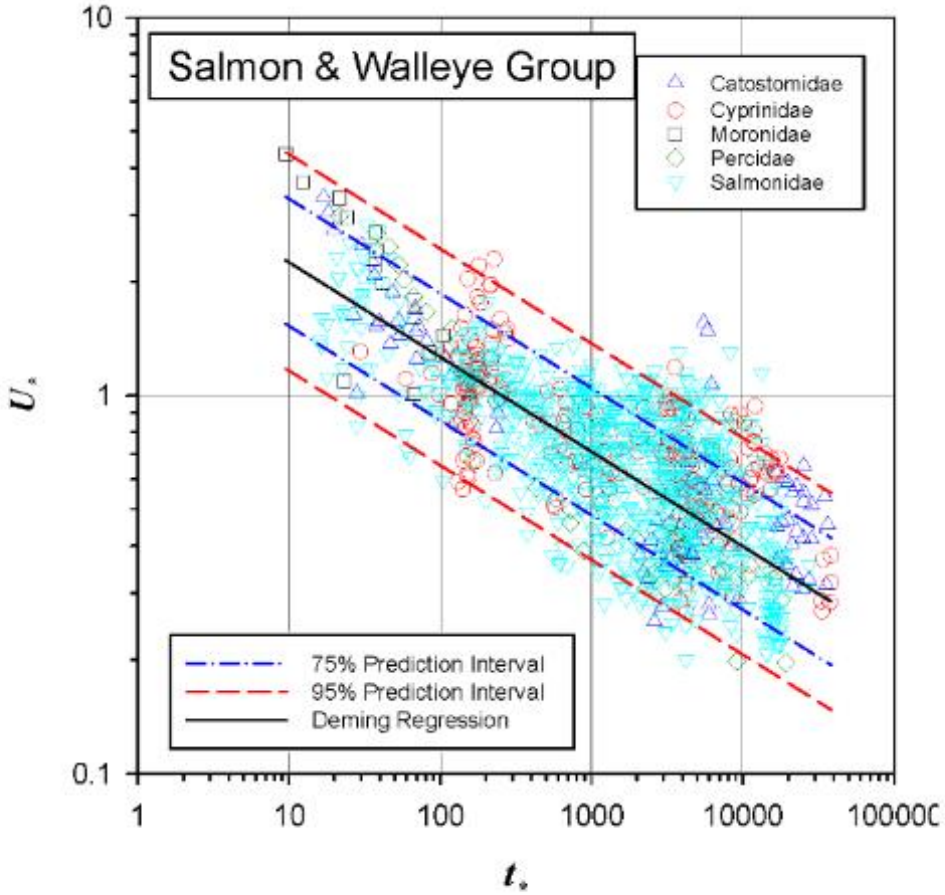
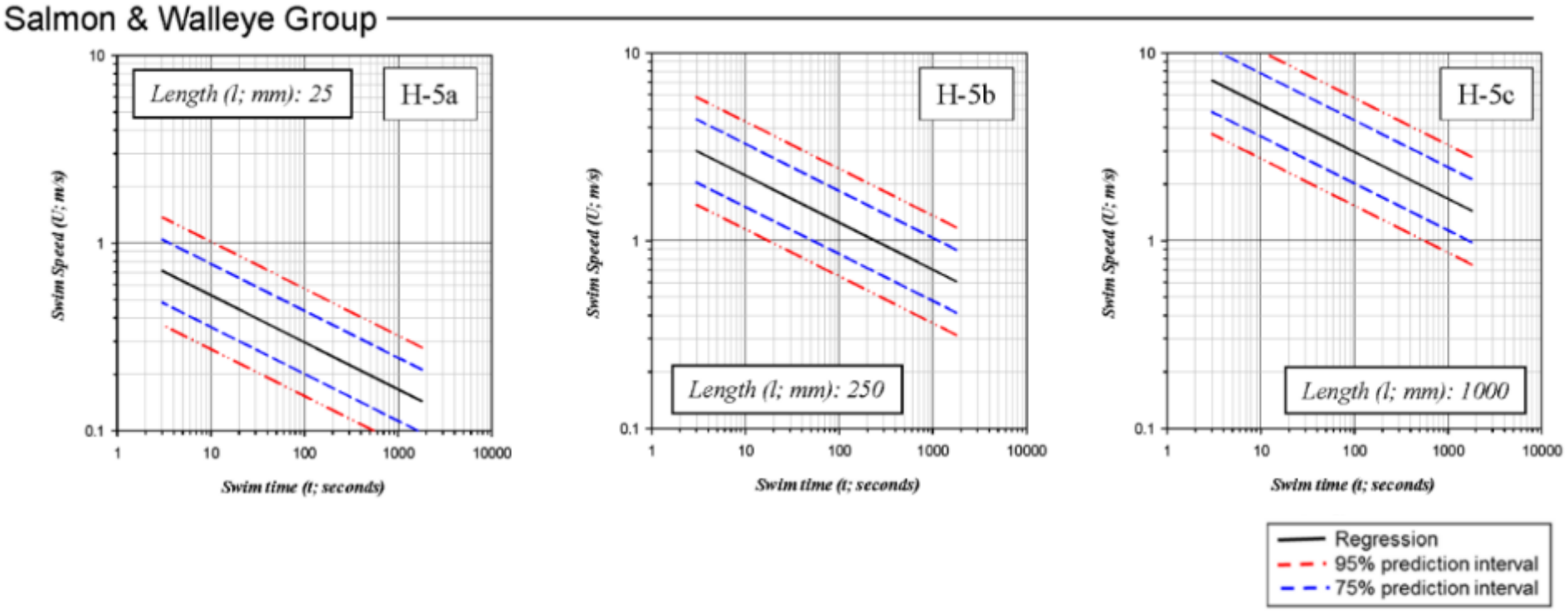


Figure G-5. Salmon and Walleye Group using dimensionless variables with Deming Regression line and the 75% and 95% prediction intervals. Dimensionless Swim Speed (U) versus Swim Time (t*).*

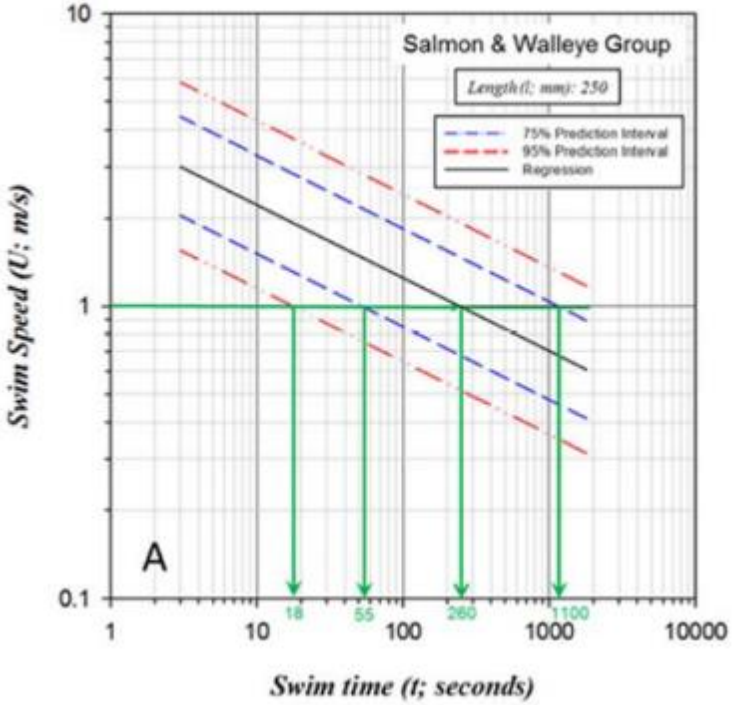
FISH SWIMMING CAPABILITY – KEY DATA AVAILABLE FROM THE LITERATURE

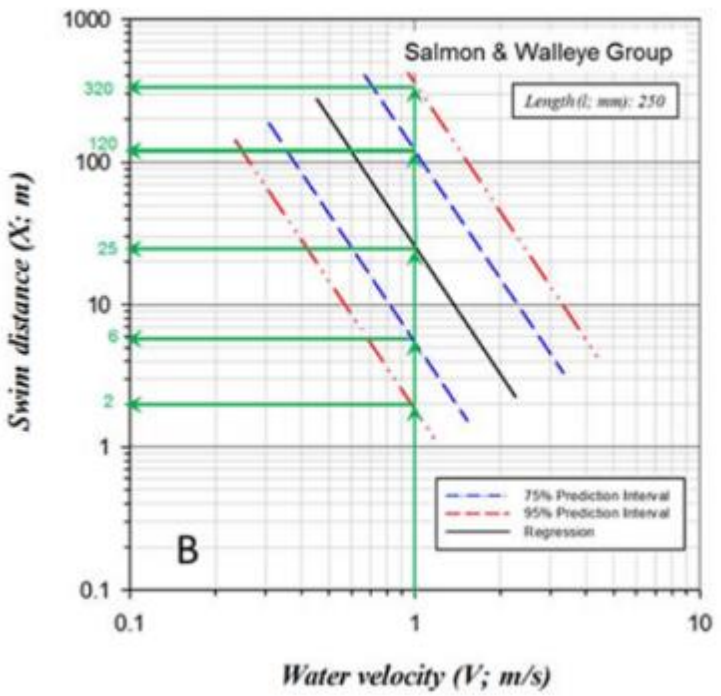
- Katopodis and Gervais (2016) – swimming time vs swimming speed regression by fish length



FISH SWIMMING CAPABILITY – KEY DATA AVAILABLE FROM THE LITERATURE

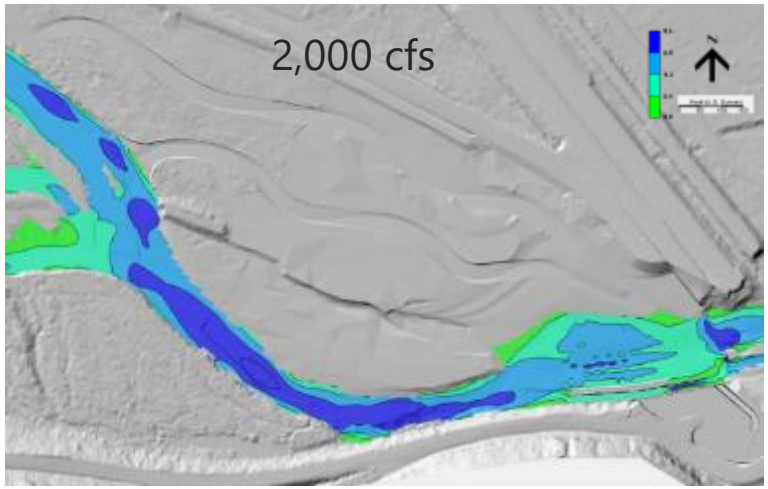
- Katopodis and Gervais (2016) – swimming fatigue nomographs

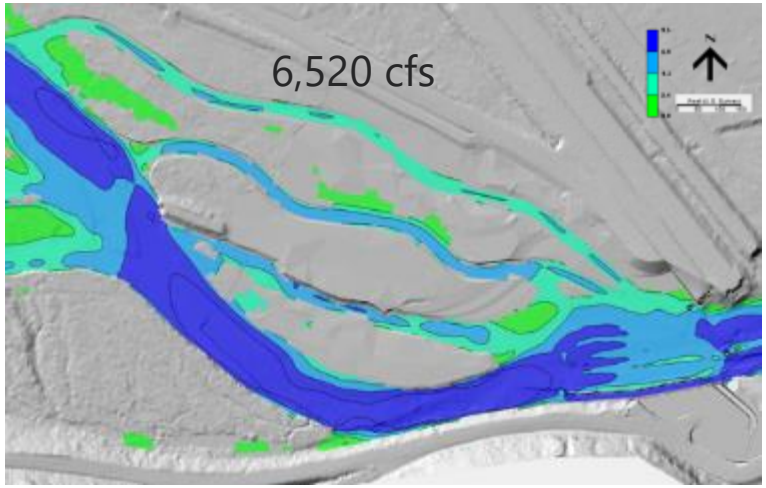




Example of swim endurance and distance estimates for Salmon and Walleye groups for fish length of 250 mm, in Figure A endurance times corresponding to a swimming speed of 1 m/s are shown and in Figure B swim distances corresponding a water velocity of 1 m/s are shown.

FISH SWIMMING CAPABILITY – PROPOSED APPROACH (EXAMPLE: NACHES RIVER)





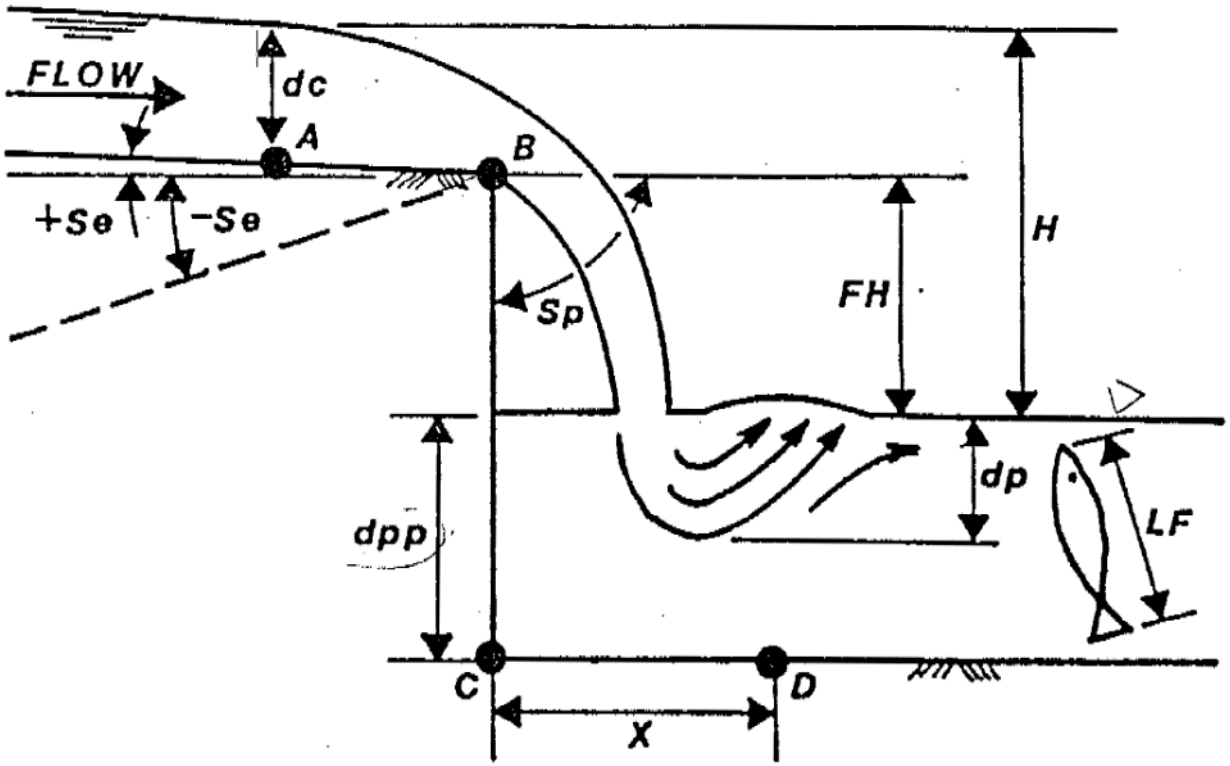
- *Adult Passage Zone 1* (Green; 0 – 4.0 fps): Zone 1 includes corridors in which fish can travel unimpeded. Adult passage through these zones could last for up to 30 minutes up to approximately 2,400 feet.
- *Adult Passage Zone 2* (Light green; 4.0 – 7.3 fps): Zone 2 is characterized by corridors in which fish can travel approximately 3 minutes or 450 feet before requiring a low velocity area (created by channel shape, structures, boulders, etc.)
- *Adult Passage Zone 3* (Light blue; 7.3 – 12.7 fps): Zone 3 is characterized by velocity corridors where adult salmonids could swim for approximately 20 seconds and 85 feet before requiring a low velocity area to rest.
- *Adult Passage Zone 4* (Dark blue; 12.7 – 18.0 fps): Zone 4 is made up of areas with higher velocities, where more velocity refugia are required for larger distances within this zone. Adult salmonids are only expected to be able to traverse approximately 30 feet or 5 seconds.

FISH LEAPING CAPABILITY – KEY FACTORS THAT INFLUENCE LEAPING CAPABILITY

- All factors that influence swimming capability and burst speed
- Feature geometry
  - Depth of leap pool
  - Condition of leap area
  - Condition of landing area
  - Angle

FISH LEAPING CAPABILITY – METHODS FROM THE LITERATURE

- Powers and Orsborn (1985)



Conceptual model of a fall with variables representing physical conditions

FISH LEAPING CAPABILITY – METHODS FROM THE LITERATURE

- WDFW (2019) – Application

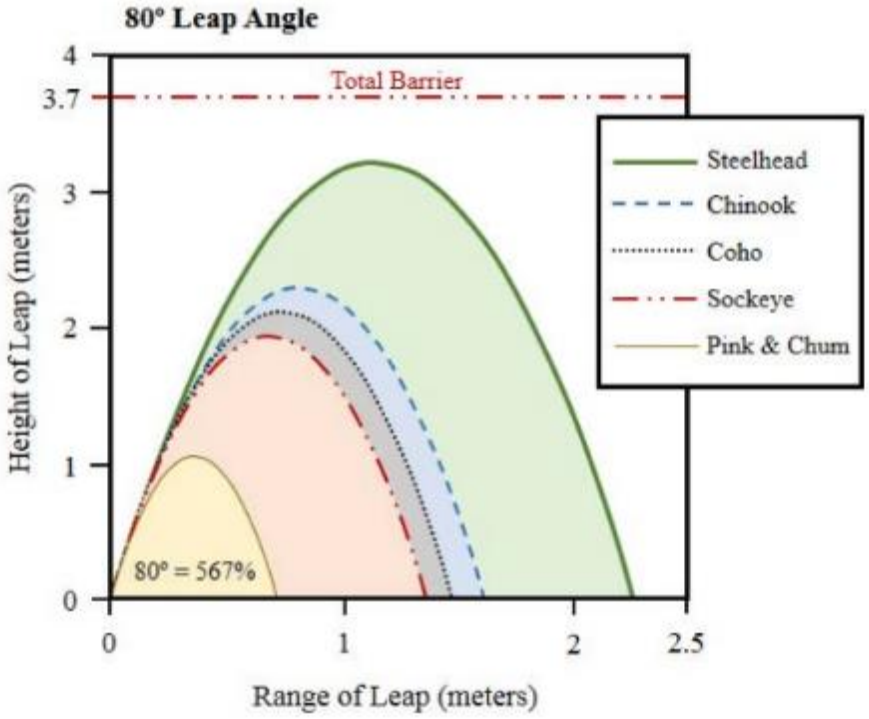


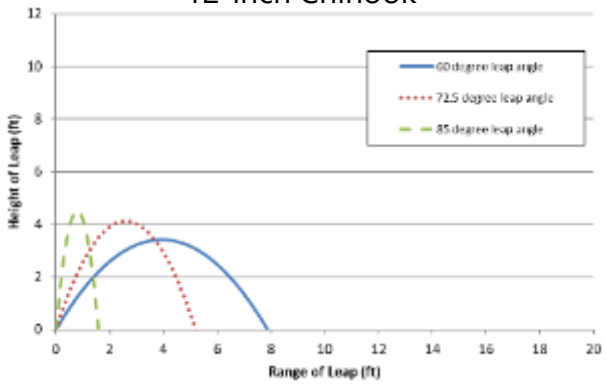
Figure 7.5. Washington State salmon leaping abilities. Illustrates the leap height and range of healthy fish leaving the water at an 80° leap angle (or 567% slope). Figure adapted from Ruggerone (2006) and Powers and Orsborn (1985).

Source: WDFW (2019)

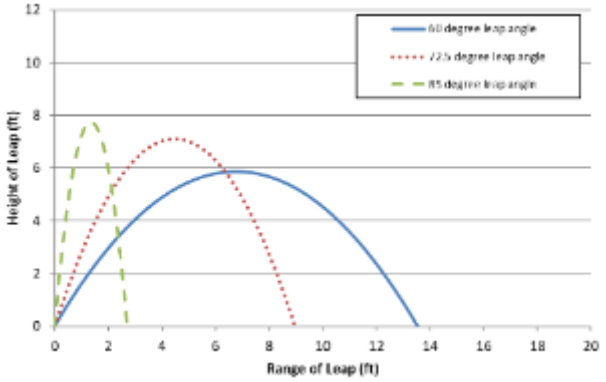
FISH LEAPING CAPABILITY – SUMMARY OF POTENTIAL LEAPING ABILITY

- Powers and Orsborn (1985) - Example: Maximum leaping capability calculated for Chinook and Steelhead in good condition, Cfc=1

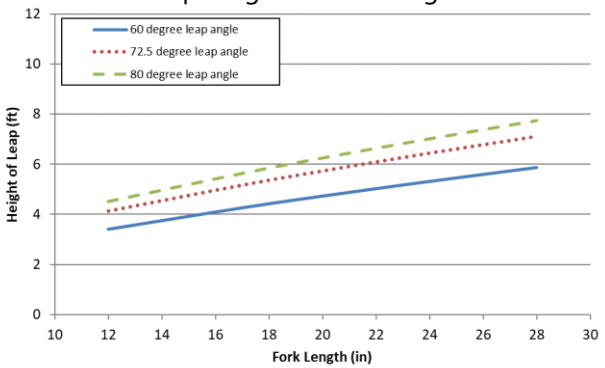
12-inch Chinook



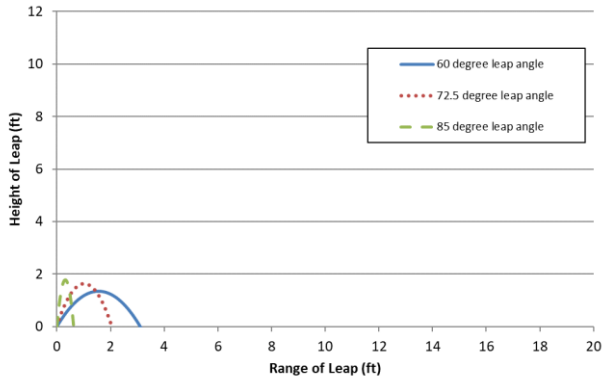
28-inch Chinook



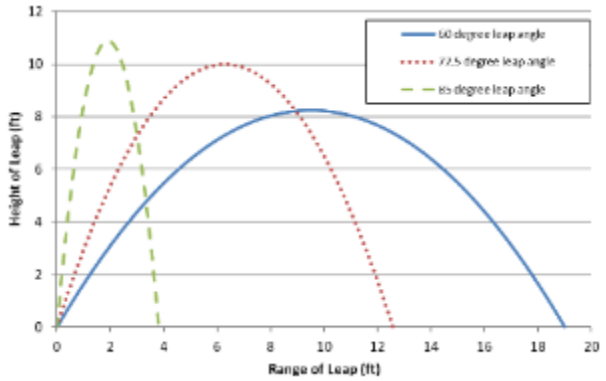
Chinook
Jump Height vs Fork Length



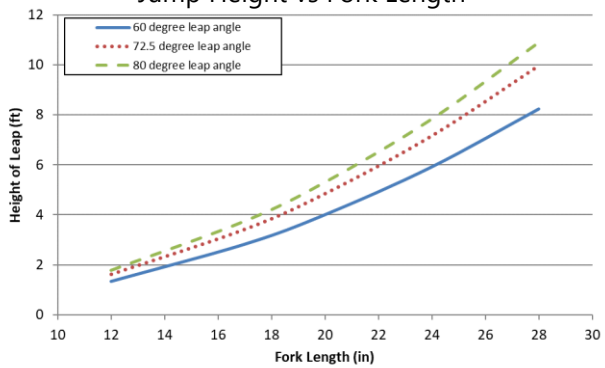
12-inch Steelhead



28-inch Steelhead



Steelhead
Jump Height vs Fork Length



FISH PASSAGE ASSESSMENT OF EXISTING FEATURES – NEXT STEPS

- Complete field data collection program
  - Controlled spills 7/26-7/29
- Begin engagement with AWS
- Establish potential leaping and swimming capabilities for focal fish species or groups

Seattle City Light

NEXT STEPS

FUTURE DISCUSSIONS

- Schedule site visit to existing facilities
- Discuss composition and role of Expert Panel
- Schedule Bi-Weekly Meetings

SCHEDULE, ACTION ITEMS, NEXT STEPS

- Action Items
- Next Steps

OUR MISSION

Seattle City Light is dedicated to delivering customers affordable, reliable and environmentally responsible electricity services.

OUR VISION

We resolve to provide a positive, fulfilling and engaging experience for our employees. We will expect and reinforce leadership behaviors that contribute to that culture. Our workforce is the foundation upon which we achieve our public service goals and will reflect the diversity of the community we serve.

We strive to improve quality of life by understanding and answering the needs of our customers. We aim to provide more opportunities to those with fewer resources and will protect the well-being and safety of the public.

We aspire to be the nation's greenest utility by fulfilling our mission in an environmentally and socially responsible manner.

OUR VALUES

Safety, Environmental Stewardship, Innovation, Excellence, Customer Care

THE NATION'S GREENEST UTILITY
SINCE 1905
SEATTLE CITY LIGHT

Seattle City Light

Skagit River Hydroelectric Project
Seattle City Light (City Light)
FA-04 Fish Passage Workshop No. 1
July 15, 2021, 1:00pm – 4:30pm

Meeting Summary

Disclaimer: These notes serve as a high-level summary of the meeting and as a communication tool for the benefit of committee continuity. They are not intended as a formal record of the meeting.

Attendance

Licensing Participants (LPs):
Alphabetical by last name

Brock Applegate, Washington Department of Fish and Wildlife (WDFW)
Curtis Clements, Upper Skagit Indian Tribe
Steve Copps, National Marine Fisheries Service (NMFS)
Jeff Garnett, United States Fish and Wildlife Services (USFWS)
Rick Hartson, USIT
Noah Jenkins (NMFS)
Donnie Jones (NEC)
Grant Kirby, Sauk-Suiattle Indian Tribe
Jonathan Kohr, WDFW
Brian Lanouette, Upper Skagit Indian Tribe (USIT)
Kevin Lautz, (WDFW)
Jim Meyers, (NMFS)
Logan Negherbon (NMFS)
Duncan Pfeifer (WDFW)
Ashley Rawhouser, National Park Service (NPS)
Dudley Reiser, Swinomish*
JonPaul Shanahan, USIT
Kara Symonds, Skagit County
Erik Young, Skagit Fisheries Enhancement Group (SFEG)

Seattle City Light (City Light):
Andrew Bearlin, City Light
Erin Lowrey, City Light
Chris Townsend, City Light
Matt Love, Cascadia Law Group (Legal Counsel)
Andrea Weiser, City Light

Consultant Team:
Mike Garello, Consultant Team
Becky Holloway, Consultant Team
Bao Le, Consultant Team
Theo Malone, Consultant Team
Jacob Vernard, Consultant Team
Matt Wiggs, Consultant Team

Facilitation Team:
Betsy Daniels, Facilitation Team
Olivia Smith, Facilitation Team
Anna Shepherd, Facilitation Team

Meeting Materials[1]

Materials were sent in advance (available upon request):

- FA-04 Fish passage meeting agenda
- FA-04 Fish Passage presentation

Action Items

Action	Responsibility	Deadline
City Light Action Items		

[1] (Add link and footnote as appropriate) Meeting materials are available on the Project SharePoint Site here: Terrestrial Resources and Reservoir Erosion RWG > Meeting Materials > 20200623_RWG_Meeting

Add information and metadata to Project SharePoint as it becomes available with notices to meeting participants.	City Light/HDR	Ongoing
Facilitation Team Action Items		
Discuss future meeting topics listed below with City Light and HDR to get necessary workshops/meetings on the calendar.	Triangle	Week of July 19
Schedule September Fish Passage meeting.	Triangle	Week of July 26
Prepare draft meeting summary and send to participating LPs, City Light, and other attendees for review.	Triangle	Week of August 8
Topics for Future Meetings or Workshops		
Consider linkages between Fish Passage and Operational Scenarios, CE-QUAL, FA-01, etc.		
Review Coho observations found on page 35 of USIT's RSP comments filed May 6, 2021.		
Modeling of channel-bottom velocities.		

Summary of Issues Discussed, Action Items, and Decisions

Welcome, Introductions, Agenda Overview

Mike Garello, Consultant Team, introduced the City Light and Consultant Team and gave an overview of the agenda. Mike explained that the purpose of this meeting was to provide an overview of the from the Revised Study Plan (RSP) that includes the Fish Passage Facilities Assessment and Fish Passage Assessment of Existing Features in the Bypass Reach.

Mike shared the meeting objectives discussed by the agenda setting small group are to:

- Provide an overview of the study schedule, including opportunities for License Participant (LP or Participant) engagement and interim work products.
- Provide an overview of the specifics of the study plan for the two separate fish passage assessments, including a summary of focal species.
- Determine the quantity, coordination, and content of a potential workshops (including invitation list, time materials are provided prior to workshops, agenda development, notes, action items, etc.).
- Identify the next steps moving forward with the study and LP engagement in the process.

Study Plan Overview, Schedule, and Milestones

Mike gave an overview of key milestones, key content of reports, and opportunities for engagement and communication. Mike walked through the project Gantt Chart to explain the timeline with key deliverables, content, and anticipated release dates for the two assessments, along with the overall timeline for FERC mandated delivery (See slides 7-23). Essential discussion items included:

- FA-05 and FA-04 will be implemented in the field at the same time and overlap in modeling efforts.

There will be an opportunity through FA-04 to perform high-level monitoring on unconditional and unplanned spills.

- Four workshops are currently planned for FA-05 with an optional 5th.
    - The second workshop in September will give the LPs an opportunity to review comments on the preliminary draft, discuss design criteria, identify information needs to proceed to the next phase, and share an update on biological performance information gathered on fish passage facilities in the Pacific Northwest.

- A sub-committee of the agency engineers participating in this group will be meeting bi-weekly to stay in touch about the specifics of the studies.

- In response to a question about the linkage of these studies to the Initial Study Report (ISR), Mike responded the ISR will be a status report with some level of assessment about work completed to date and this will provide an opportunity for LPs to comment and City Light to consider updates to the study design.

Mike presented a chart outlining the series of milestones and associated deliverables for the two assessments:

Fish Passage Facilities Assessment

Key deliverables include:

- A draft assessment report due on August 19, 2022, and a final report on December 16, 2022.
- Drafts will be available for comment and feedback before the report is finalized.
- The interim deliverable will be a draft concept development report.
- Workshop 4 will be in March 2022 and Workshop 5, if opted, will be held later that year.

Fish Passage Facilities Assessment of Existing Features in the Bypass Reach

Key components of the assessment will include:

- A site inspection and survey,
- hydrodynamic modeling of existing features,
- biometric comparison of Eco hydraulic factors influencing fish passage, and
- identification of flow ranges that may limit or promote fish passage for each focal species specified in or agreed to through the Revised Study Plan and June 9th Notice of Agreement.

The first iteration will be available in May 2022; the second component with additional data will be provided in October 2022.

Mike gave an overview of dialogue and engagement opportunities within the study schedule:

- *Workshops*: The workshops provide opportunities for LPs to review the study plan process and establish preliminary design criteria.
- *Bi-weekly Agency Working Sessions:* The working sessions are an opportunity for subject matter experts to provide more frequent feedback on interim study progress, methods, and outcomes.
- *Interim deliverables and reports:* These products provide LPs with an opportunity to exchange information and receive feedback at interim milestones during study implementation and identify any data needs or additional data that needs to be incorporated.

LPs and Mike discussed the possibility of adjusting reservoir rule curves that are helping to develop criteria for the study plan. Mike explained that another study is looking at project operations to help give direction on this in the future; however, the fish passage assessment will evaluate existing rule curves. Future rule curves could be incorporated into the assessment as next steps following the initial assessment.

The group discussion the potential for an onsite facilitated meeting. LPs indicated that would be helpful for those not familiar with the site to see the project landscape and features in person. This question will be answered closer to the next Workshop in September.

Focal Species for Fish Passage Assessments
Mike presented a summary of key fish species and explained how the two assessments will begin with the same list of species, but how the species integrate into the two assessments may differ.

- Fish Passage Facilities Assessment. The range of species, difference in body size, and different swimming behavior will help inform the type and complexity of potential strategies and facilities. Certain biological considerations will not be addressed in detail in the study, but will be considered in the strategy, an example being the threshold for how big these facilities will be, given abundance based on input from the LPs.

- Fish Passage Facilities Assessment of Existing Features in the Bypass Reach. The same list of species will be analyzed to identify what species we have data for with swimming/leaping capability. Certain species may have more information than others, but there is an existing analog of species with similar swimming patterns. This similarity may allow the assessment to move forward with certain species grouped by size, types of locomotion, swimming/leaping capability, and whether they attach to rock vs. not (ex. Lamprey).

Commented [GU1]: WDFW: Thank you, the notetaker captured this point very well.

The LPs requested metadata so they can properly prepare for these workshops in advance. Mike offered that the consultant team will deliver a preliminary draft report outlining information obtained to date ahead of the next workshop.

***Action Item*:** City Light will add information and metadata to Project SharePoint as it becomes available with notices to meeting participants.

Fish Passage Facilities Assessment
Mike provided an overview of the status and next steps for the study plan and shared objectives and outcomes, data requirements, and assessment methodology. The objective of the assessment is to assess the potential feasibility of upstream and downstream passage at each of the three project developments. Outcomes will include analysis of potential performance and state of science, and the capital costs associated with fish passage improvements looking at level upstream and downstream passages.

- An LP requested clarification on whether the outcomes outlined in the presentation were the same as those in the RSP. Mike and others clarified that they are the same, but that the RSP was more of a high-level overview. The presentation went into more detail.

Upper Skagit Indian Tribe (USIT) asked about dam removal as a possible project modification to consider in the study and that dam removal and fish passage are synonymous from their point of view. City Light noted that while conversations will continue in the future to better understand LP interests, City Light is not considering dam removal at this time.

Commented [GU2]: SCL has since changed their minds. SCL will make an assessment of their dams on whether they should remove the dams.

Commented [A(3R2]: WDFW Comment

Mike explained that this assessment will take an adaptable approach and focus primarily on technical feasibility. The details of the assessment are subject to discussion and are commonly defined by participation within the workgroups. The study will look closely at compliance with technical design guidelines. Efforts are currently focused on gathering data, defining objectives, and considering requirements to implement. To determine technical feasibility, the assessment will need to determine whether the facility satisfies the operational and engineering-related objectives of the project. This will be site-specific and unique to the specific environments and species.

- A Participant asked whether the study would evaluate biological feasibility and cultural and economic feasibility. Mike acknowledged the interlinkages between the elements but said this study plan will focus on technical feasibility. Participants noted how important it is to accurately describe the cultural significance of fish passage in the study. In response to another question about whether the biological/economic/cultural feasibility elements would happen as part of a broader, more complex

evaluation or separately, Mike explained that these elements would not be part of this study plan but could be part of a more comprehensive future evaluation.

- An LP asked whether the study team will consider linkages to other studies. Mike responded that this would be the case. Information generated from the operation model would help inform fish passage facility configurations (i.e., facility type, size, location, configuration, and operational requirements).
- An LP asked whether City Light has a dollar amount in mind to measure economic feasibility. City Light explained that they do not have a dollar amount and that commitments for this study are made based on ecosystem needs rather than costs.

Topic for Future Meeting or Workshops: Consider linkages between Fish Passage and Operational Scenarios, CE-QUAL, FA-01, etc.

Fish Passage Assessment of Existing Features in the Bypass Reach

Mike gave an overview of the objectives and outcomes, went over assessment methodology and data collection, and discussed the range of observable discharge. The discussion covered evaluation methods and tools, emphasizing species diversity, swimming speed, and feature complexity that would require site-specific evaluation. The role of hydraulic modeling was also discussed. Mike walked through a process diagram showing biometric and Eco hydraulic factors and how they inform model calibration. He noted that the hydraulic model will be used as a tool, not a pass/fail approach, and will inform where devices are placed, the windows of passage flows for each species, and how velocities are interpreted in some cases.

- USIT noted that the recent documentation of Coho salmon above cascade gardens reaffirms the importance of direct observation as a data collection method. Mike agreed that direct observation should be incorporated into the assessment. (For some reason, the comment section quit working): WDFW's 2019 guidelines for fish passage assessment emphasizes a direct observation as the best method/proof of upstream fish passage.

Topic for Future Meeting or Workshops: Review Coho observations found on page 35 of USIT's RSP comments filed May 6, 2021.

- An LP asked how the assessment will average to find true bottom considering the complexity of the features in the bypass. Mike acknowledged that this is a very complex reach and that the model has limitations. They will need to consider several factors when determining how useful the model is.
- An LP asked whether pass-flow windows will be wide enough to capture flow variability in the river system. Mike said there are two potential flow ranges the team will be looking at: 1) where the model can be calibrated and 2) where the team can use it. They will use a range of scheduled releases to calibrate the model and consider any unplanned releases that could occur later in the season. He noted that data use will depend on the data-collection equipment at that time, and the ability to detect the range of flows. Mike noted that the presentation would cover the range of flows in more detail later in the meeting.
- An LP asked whether City Light was still planning additional flow releases into the bypass reach between 50 and 500 CFS, and whether the model would show values for depth as well as velocity. Mike noted that the model can show velocities that exist when depth exceeds a certain threshold, and that the presentation would go into more detail on planned flow releases shortly. Dudley Reiser clarified that the three flows shown depict uncalibrated model estimates and not the actual flow releases that will occur.

Mike gave an overview of where the loggers were installed upstream and downstream to gather velocity and depth measurements. He noted the data collected would help identify pathways that fish might use to ascend the feature. Mike explained the strategies for visual observation and site inspection and covered some details on the plan for collecting flow magnitude, depth, elevation, and velocity data.

- An LP questioned whether this study would represent velocities along the channel bottom and whether unplanned release events would provide sufficient data. Mike responded that the team is unable to measure that velocity except during the lowest flows but can approximate based on the average.
- LPs asked for clarification on whether the model would be based on a real data point for calibration based on 1,200 CFS. HDR staff explained that they are looking at whether they collected the larger calibration data in the 4,000 to 6,000 CFS range during a recent spill, and that they would try again in the fall or conduct another controlled spill to get the proper calibration point.

Mike summarized criteria and key factors influencing fish swimming and leaping capability, and shared key takeaways from the literature and examples on fish swimming and leaping capability.

- An LP asked whether any literature mentioned included the influence of epigenetics on physical performance. Mike responded that this kind of information can be considered another variable and used if available. Still, the greater question is how it should be used to modify the understanding of swimming capability. Another Participant added it would be helpful if the model also looked at critical rifle passage – or how long fish have to swim over a shallow area. LPs indicated interest in a future meeting on modeling channel bottom velocities.

Topic for Future Meeting or Workshops: Modeling of channel bottom velocities.

Mike noted that the next steps are to 1) complete the field data collection program, with controlled spills planned for 7/26 and 7/29, 2) begin engagement with AWS, and 3) establish potential leaping and swimming capabilities for focal fish species.

Schedule, Action Items, Next Steps
The facilitator noted that the next FA-04 meeting in September will focus on the conceptual design criteria and the fish passage engineers will be meeting biweekly. LPs commented it would be helpful to have another meeting to review the design criteria before meeting in September. The facilitator mentioned the possibility of meeting in person for September, recognizing federal regulations may impact whether this can happen.

***Action Item*:** Triangle to identify the best date for next fish passage meeting.
***Action Item*:** Discuss future meeting topics listed below with City Light and HDR to get necessary workshops/meetings on the calendar.
***Action Item*:** Prepare draft meeting summary and send to participating LPs, City Light, and other attendees for review.

FISH PASSAGE TECHNICAL STUDIES INTERIM REPORT

ATTACHMENT B

FA-04 FISH PASSAGE STUDY WORKSHOP NO. 2 MEETING MATERIALS

Seattle City Light

MEETING AGENDA

Skagit Hydroelectric Project Relicensing Meeting

FA-04 Fish Passage Workshop No. 2

September 23, 2021: 12:00pm – 4:00pm

WebEx Meeting: [LINK]

Conference Call: +1-510-338-9438 USA Toll

Access code: 1827024467

(Meeting ID: 1827 02 4467)

MEETING PURPOSE

- The intent of this workshop is to discuss the design basis and criteria needed to begin development of upstream and downstream passage facility alternatives to the concept level and to begin discussing any initial feedback on the first FA-04 Study deliverable: *Preliminary Draft Fish Passage Conceptual Design Criteria Document (DCD)*. Specific objectives include:

- **Provide General Overview of Preliminary DCD and Review LP Comments (Advise and Inform)**
- **Identify Data Gaps and Information Needed to Inform Next Phase of Study (Advise)**
- **Review and Assemble Potential Range of Fish Passage Strategies and Technologies that May be Considered for Evaluation (Advise)**
- **Discuss Performance Information for Existing High Dam Passage Facilities (Advise)**
- **Discuss process to establish preliminary technical, operational, and biological goals, criteria, and constraints (Advise)**

AGENDA

12:00 – 12:10 pm (10 min)	**Introductions** – *Facilitator*
12:10 – 12:20 pm (10 min)	**Meeting Objectives and Agenda Overview** – *Mike Garello (HDR)* Review meeting agenda and discussion topics. Request inclusion of additional agenda topics.
12:20 – 1:20 pm (60 min)	**Overview of Preliminary DCD –** *Mike Garello (HDR)* Provide overview of Preliminary Draft Design Criteria Document contents and discuss current data sources and resulting considerations that may be used to formulate fish passage strategies and facility alternatives. 1. Overview of DCD Milestones and Review Cycles • Preliminary DCD comments appreciated by 10/7 2. Outline Review

	3. Discuss Data Obtained to Date and Included in the DCD for: 4. Present preliminary considerations and criteria with respect to their influence on fish passage strategy and facility development. **Discuss Initial LP comments on DCD – *All participants***
1:20 – 2:05 pm (45 min)	**Discuss Data Gaps and Identify Data Sources and Timeline to Receive –** *Jacob Venard (HDR) and LPs* Discuss current available sources of data and data gaps identified during report development. 1. Discuss biological RFI and data received to date. Additional data need/refinements include: 2. Upstream and downstream passage efficiency requirements 3. Other design criteria necessary to assist with the layout and configuration of concept-level alternatives
2:05 – 2:20pm (15 minutes)	***Break***
2:20 – 3:00pm (40 minutes)	**Review and Assemble Potential Range of Fish Passage Strategies and Technologies that May be Considered for Evaluation** – *Mike Garello (HDR)* Discuss the overall approach of formulating the range of fish passage strategies and fish passage facility concepts.
3:00 – 3:30pm (30 min)	**Existing Biological Performance Information at PNW Fish Passage Facilities and Discussion on the Development of Performance Criteria for Project –** *Mike Garello (HDR) and licensing participants*
3:30 – 4:00pm (30 min)	**Action Items, Next Steps** – *Facilitator and meeting participants* • Additional discussion time • Review action items
4:00pm [End time]	**Meeting Adjourned**

FA-04 FISH PASSAGE TECHNICAL STUDIES

Workshop 2

September 23, 2021

INTRODUCTIONS

- Roll Call
- Introductions

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WORKSHOP OBJECTIVES AND OVERVIEW

MEETING OBJECTIVES

- Provide general overview and discuss Preliminary Draft Fish Passage Conceptual Design Criteria Document (DCD)
- Discuss the design basis and criteria needed to develop upstream and downstream passage facility concepts
- Identify data gaps and information needed to inform next phase of study
- Review and assemble potential range of fish passage strategies and technologies that may be considered for evaluation
- Discuss performance for existing high dam passage facilities
- Discuss process to establish preliminary technical, operational, and biological goals, criteria, and constraints

MEETING AGENDA

Schedule	Topic
12:00 to 12:10	Introductions
12:10 to 12:20	Meeting Objectives and Agenda Overview
12:20 to 1:20	Overview of Preliminary Draft Design Criteria Document (DCD)
1:20 – 2:05	Discuss Data Gaps and Identify Data Sources and Timeline to Receive
2:05 – 2:20	Break
2:20 – 3:00	Fish Passage Strategies and Technologies for Evaluation
3:00 to 3:30	Existing Biological Performance and Development of Performance Criteria
3:30 to 4:00	Action Items and Next Steps
4:00	Meeting Adjourned

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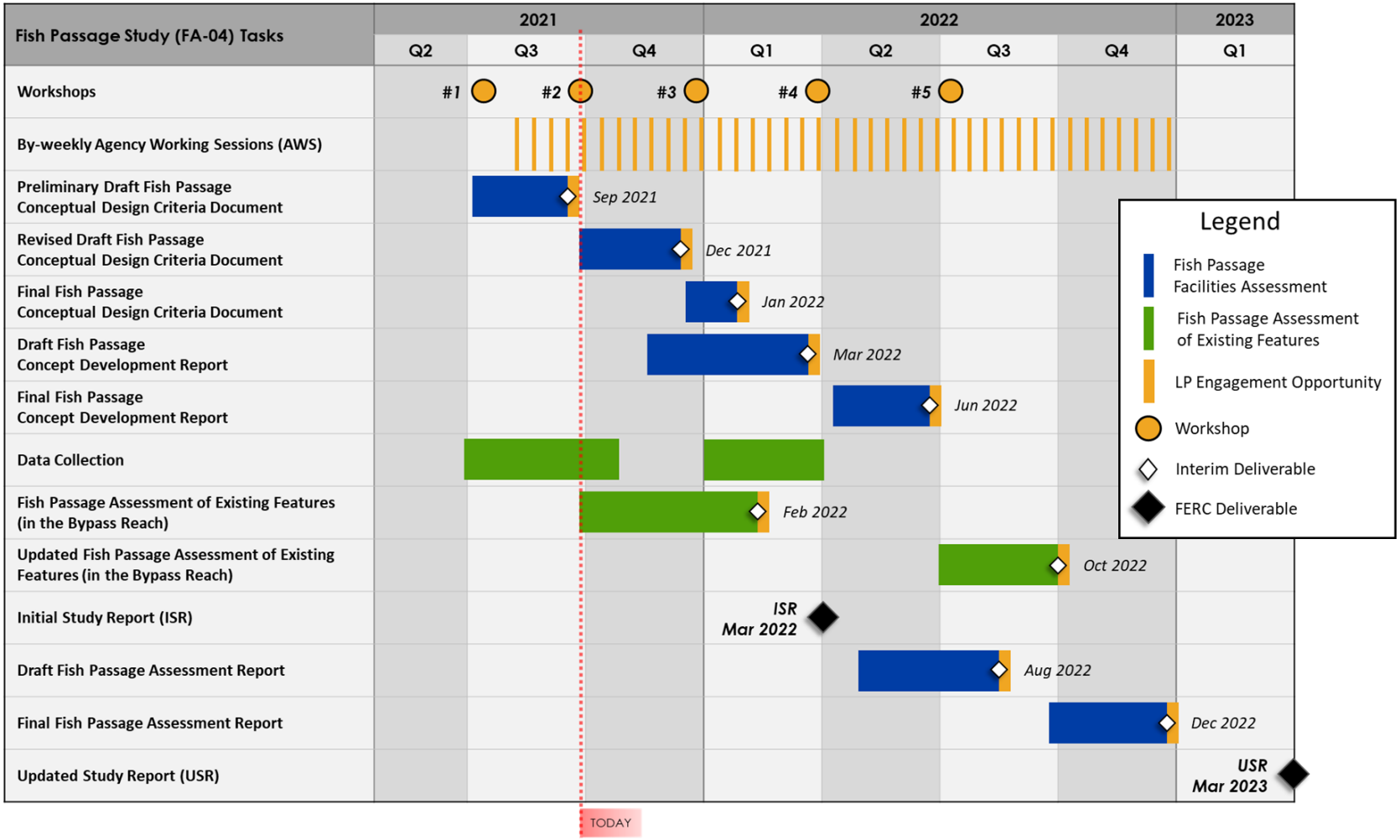
PRELIMINARY DRAFT DESIGN CRITERIA DOCUMENT (DCD) OVERVIEW

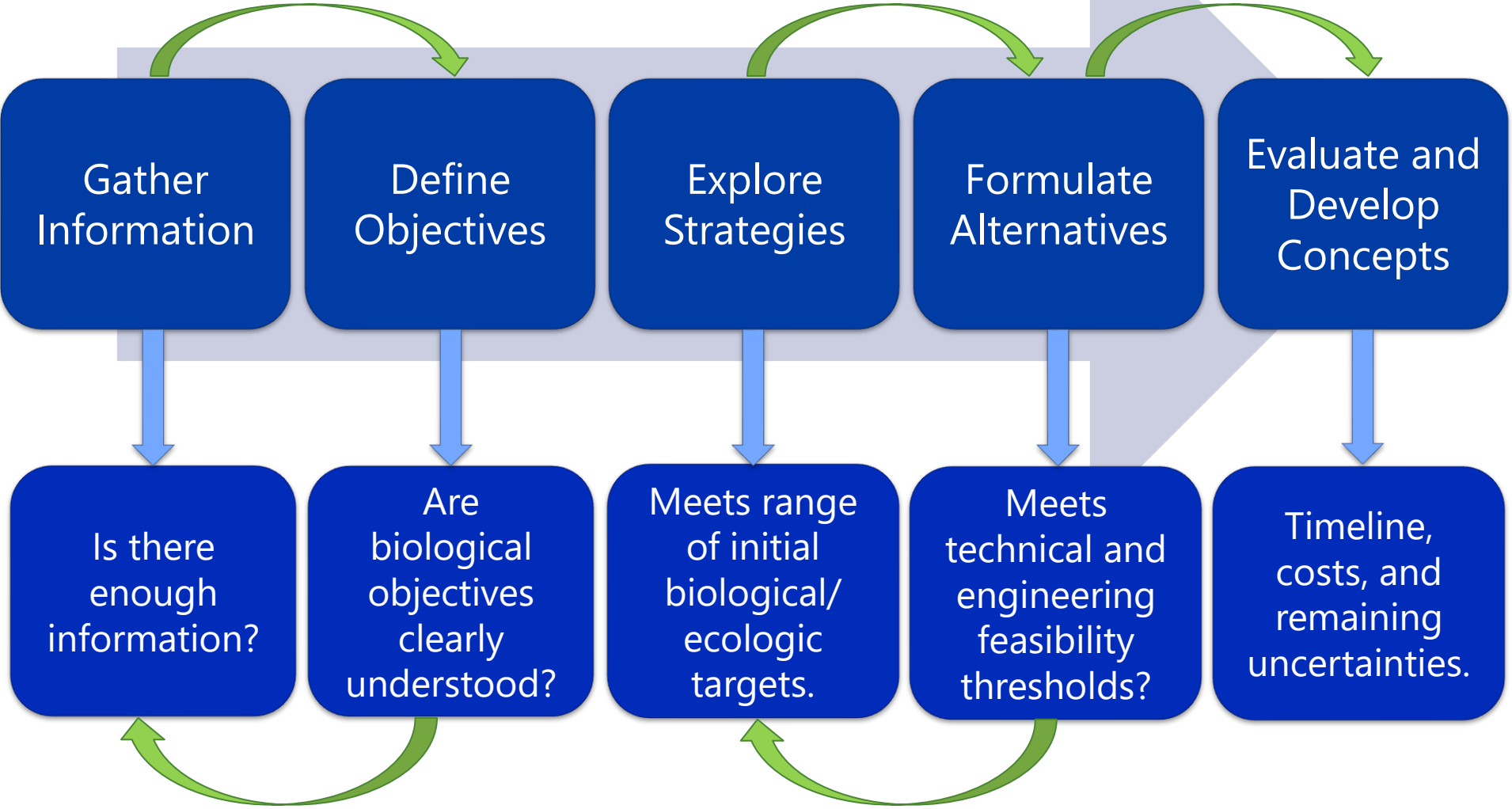
SCHEDULE OVERVIEW



FISH PASSAGE FACILITIES ASSESSMENT – KEY MILESTONES

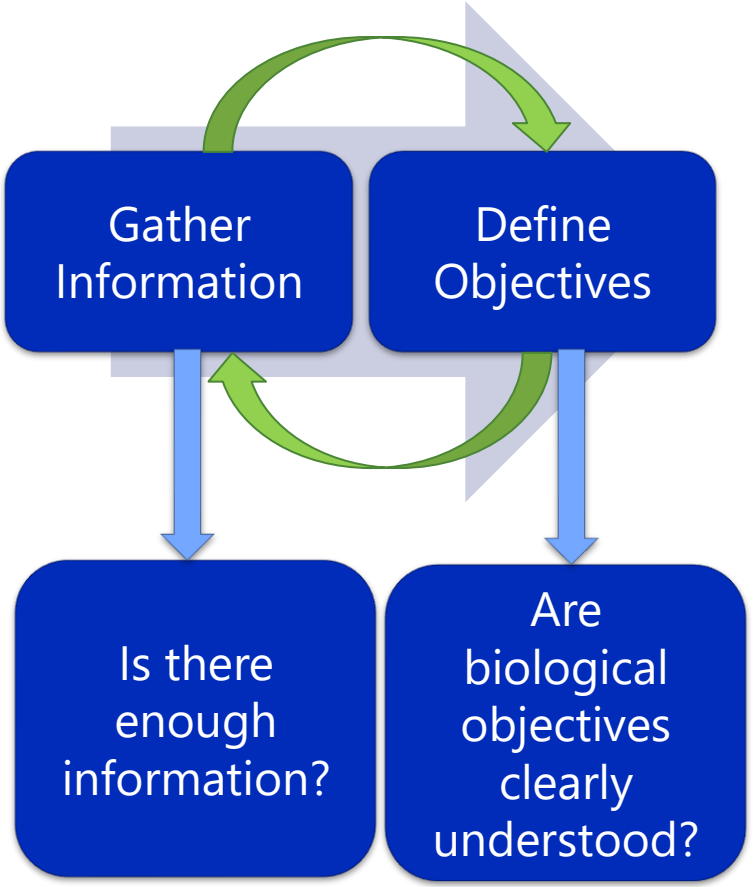
Milestone	Anticipated Schedule
Fish Passage Conceptual Design Criteria Report	
Preliminary Draft DCD and Workshop No. 2	**September 2021**
Revised Draft DCD	December 2021
Final DCD	January 2022
Initial Study Report	March 2022
Fish Passage Concept Development Report	
Draft Report	March 2022
Final Report	June 2022
Fish Passage Assessment Report	
Draft Report	August 2022
Final Report	December 2022
Updated Study Report (USF, Fish Passage Study Sections)	March 2023

FISH PASSAGE FACILITIES ASSESSMENT – COURSE PROCESS OVERVIEW



ASSESSMENT METHODOLOGY – FEASIBILITY AND DESIGN PROCESS

- Initiate AWS and Workshops
- Gather/synthesize specific biological, operational, and physical data
- Establish goals, objectives, criteria, and expectations



FISH PASSAGE FACILITIES ALTERNATIVES ASSESSMENT – CONCEPTUAL DESIGN CRITERIA DOCUMENT

Conceptual Design Criteria Document
Preliminary Draft (9/17/2021)**, Revised Draft** (12/1/2021)**, Final** (1/21/2022**)**

- Photos, Maps, and Drawings of Existing Facilities
- Physical, Biological, and Operational data and information that inform the development of fish passage alternative concepts
- Conceptual Design Criteria
- Biological and Technical Performance Goals and Objectives
- Performance of PNW passage facilities at high-head dams
- List of conceptual alternatives to be evaluated

FISH PASSAGE FACILITIES ALTERNATIVES ASSESSMENT – CONCEPTUAL DESIGN CRITERIA DOCUMENT

- DCD Goals:
  - Document the existing Project operating environment
  - Formulate range of potential fish passage goals, objectives, and alternatives
  - Share information with the LPs and obtain feedback throughout completion of this study (FA-04)

FISH PASSAGE FACILITIES ALTERNATIVES ASSESSMENT – CONCEPTUAL DESIGN CRITERIA DOCUMENT

- DCD Objectives:
  - Compile existing information and describe the current potential operating environment for conceptual fish passage alternatives and facilities
  - Document range of fish passage goals and objectives
  - Document conceptual level criteria that are used to formulate alternatives
  - Summarize performance standards and observed performance at other facilities
  - Summarize list of potential fish passage alternatives, strategies, and technologies

FISH PASSAGE FACILITIES ALTERNATIVES ASSESSMENT – CONCEPTUAL DESIGN CRITERIA DOCUMENT

- This Preliminary Draft DCD
  - Summarizes Biological, Physical, and Operational data collected to date
  - Summarizes known guidelines, documents, and technical criteria used in fish passage facility design
  - Begins discussion of performance standards and performance of known fish passage facilities at high dams
  - Begins summary of fish passage strategies and technologies

FISH PASSAGE FACILITIES ALTERNATIVES ASSESSMENT – CONCEPTUAL DESIGN CRITERIA DOCUMENT

- The next Revised Draft DCD
  - Will begin formulation of fish passage goals and objectives
  - Will better define biological setting
  - Will better define facility operational environments at specific Project locations
  - Will begin discussion of fish passage implementation and program execution
  - Will refine strategies, technologies, and will list initial fish passage alternatives

DCD TABLE OF CONTENTS (TOC) OVERVIEW

- 1.0 Introduction
- 2.0 Physical Setting
- 3.0 Biological Setting
- 4.0 Technical Fish Passage Facility Design Criteria and Guidelines
- 5.0 Selection of Specific Fish Passage Design Criteria Governing Alternative Formulation
- 6.0 Performance of PNW Fish Passage Facilities at High Head Dams
- 7.0 Overview of Potential Fish Passage Strategies and Technologies to be used in Alternative Formulation
- 8.0 Conclusions
- 9.0 References

DCD TOC – PHYSICAL SETTING

- Section 2.0: Physical Setting
  - Project Location
  - Existing Facilities
  - Existing Operations
  - Debris and Sedimentation Management
  - Water Temperature Conditions

DCD TOC – BIOLOGICAL SETTING

- Section 3.0: Biological Setting
  - Focal Fish Species
  - Fish Migration Timing
  - Fish Abundance
  - Fish Size

DCD TOC – TECHNICAL CRITERIA AND GUIDELINES

- Section 4.0: Technical Fish Passage Facility Design Criteria and Guidelines
  - General Fish Passage Engineering and Design Guidance Documents
  - Fish Screen Criteria
  - Fish Bypass Criteria
  - Fishway Criteria
  - Debris Rack Criteria
  - Fish Trapping and Holding Criteria

DCD TOC – CRITERIA FOR CONCEPT DEVELOPMENT

- Section 5.0: Selection of Specific Fish Passage Design Criteria Governing Alternative Formulation
  - Focal Species selected for fish passage
  - Working Definition of Technical Feasibility
  - To be included…
    - Goals and Objectives
    - Risks, Benefits, and Constraints
    - Facility Performance Standards and Expectations
    - Execution/Implementation
    - Abundance and Peak Rates of Migration
    - Reservoir Operations and Stage Fluctuation

DCD TOC – PERFORMANCE OF PNW FISH PASSAGE FACILITIES

- Section 6.0: Performance of PNW Fish Passage Facilities at High Head Dams
  - Regulatory Performance Standards
  - Measured Performance of Existing Upstream Passage Facilities
  - Measured Performance of Existing Downstream Passage Facilities

DCD TOC – OVERVIEW OF STRATEGIES AND TECHNOLOGIES

- Section 7.0: Overview of Potential Fish Passage Strategies and Technologies to be Used in Alternative Formulation
  - Formulation of Fish Passage Strategies
  - Potential Fish Passage Technologies

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DATA COLLECTION AND INFORMATION NEEDS

DATA COLLECTION AND INFORMATION NEEDS

- Request for Information (RFI) Tracking Table
  - Biological Factors
  - Operational Requirements
  - Physical Characteristics

DATA COLLECTION AND INFORMATION NEEDS

- Summary of data collected
  - Biological Factors
    - Focal Species
    - General life history periodicity and migration timing
    - General annual fish abundance
  - Operational Requirements
    - Reservoir purpose and management goals
    - Facility operation and maintenance programs
    - Reservoir historic operating levels and rule curves
    - General operational constraints

DATA COLLECTION AND INFORMATION NEEDS

- Summary of data collected
  - Physical Characteristics (examples)
    - Maps, charts, Project configuration drawings
    - Property ownership
    - Access routes and transportation infrastructure
    - Engineering drawings of primary structures and facilities
    - Geology and seismicity
    - Mean daily reservoir elevations
    - General reservoir temperature characterization
    - Preliminary basin hydrology

NEXT STEPS – REVISED DCD DEVELOPMENT

- Comments on Preliminary Draft DCD are requested by October 7th
- Study team will continue to move forward with next deliverable – Revised Draft DCD
- Respond to and incorporate feedback from LPs
- Transition from primarily data collection to goal setting

NEXT STEPS – REVISED DCD DEVELOPMENT

- Next discussion topics over the next three months:
  - Goals and Objectives
  - Risks, Benefits, and Constraints
  - Facility Performance Standards and Expectations
  - Execution/Implementation
  - Abundance and Peak Rates of Migration
  - Reservoir Operations and Stage Fluctuation
  - Working Definition of Technical Feasibility

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DATA GAPS AND DATA SOURCES

IMPORTANCE OF BIOLOGICAL RFI DATA

- Biological Feasibility – typically requires that data gaps and unknowns have been resolved to reasonable certainty
- An understanding of existing information and data gaps will help guide future conversations defining goals and objectives
- Establishing biological goals and objectives of a fish passage program help define:
  - Benefits
  - Risks
  - Constraints
  - Recolonization strategy
  - Methods for passage

IMPORTANCE OF BIOLOGICAL RFI DATA

- Example fish passage program goals may include but are not limited to:
  - Contribute to recovery of target species in the Upper Skagit River
  - Expand existing populations above Gorge Powerhouse and/or Dam
  - Establish new viable and sustainable populations above Gorge Powerhouse and/or Dam
  - Provide social and cultural benefit upstream of Gorge Powerhouse and/or Dam
- Study efforts have been largely information gathering to date
- Baseline biological data is still needed to define the existing biological setting and resolve data gaps if possible
- Future conversations will focus on developing the potential range of goals and objectives with the LPs

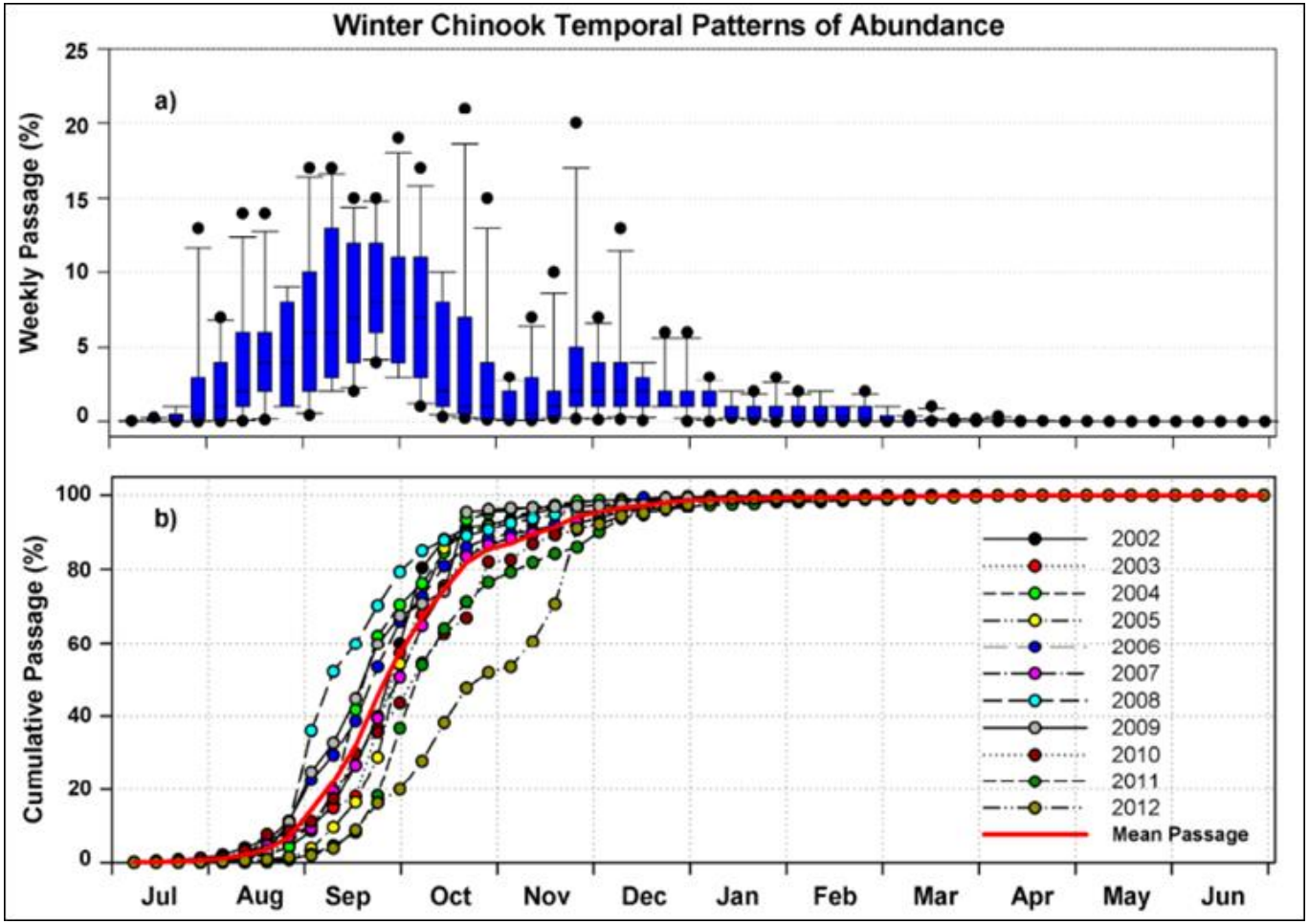
CURRENT SOURCES OF BIOLOGICAL DATA

- Example – Fish abundance and life stage periodicity
- Includes general fish abundance in Skagit basin
  - WDFW escapement data
    - Chinook – Upper Skagit Stock
    - Coho – Skagit Basin
    - Steelhead –Skagit winter-run
  - Bull Trout – WDFW redd counts; mainstem upper Skagit abundance estimate (Lowery 2009)
  - Sockeye – Baker River; no abundance data for upper Skagit

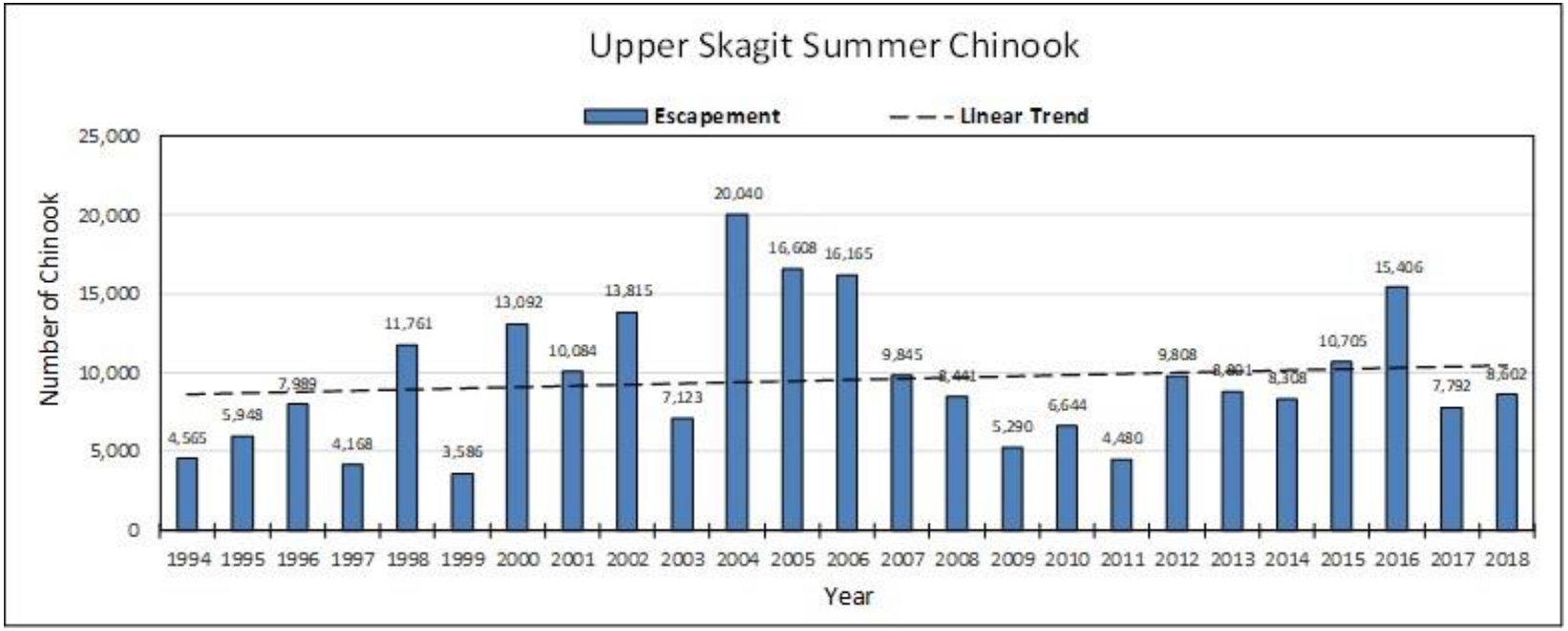
TYPICAL BIOLOGICAL DATA NEEDS

- Data needs include…
  - Abundance and distribution of Salish Sucker
  - Abundance and distribution of Lamprey
  - Additional daily or weekly abundance of fish species if available
  - Others…
- Next steps will require…
  - Establish migration distribution and abundance at point of passage
  - Confirmation of peak run timing
  - Develop target abundances (or range) and peak rates of migration for each species

BIOLOGICAL RFI DATA – TYPICAL INFORMATION USED FOR FISH PASSAGE DESIGN



BIOLOGICAL RFI DATA – AVAILABLE INFORMATION



BIOLOGICAL RFI DATA – AVAILABLE INFORMATION

Species	Minimum	Maximum	Average
Chinook Salmon Upper Skagit summer-run	3,586	20,040	8,663
Coho Salmon Skagit River	5,794	136,054	36,703
Sockeye Salmon Baker River	99	52,773	20,618
Steelhead Skagit River winter-run	2,502	9,084	6,020
Bull Trout Skagit River mainstem	Unknown	Unknown	1,602
Chum Salmon Skagit River	6,700	209,478	34,694
Pink Salmon Skagit River	59,916	1,110,000	345,729
Lamprey	Unknown	Unknown	Unknown

BIOLOGICAL RFI DATA – NEXT STEPS

- Initiate conversations with LPs focusing on the potential range of fish passage goals and objectives
- Establish potential range of methods and timeframes for program execution (implementation)
- Evaluate and establish feasibility framework using existing information
- Begin development of appropriately scaled fish passage concept alternatives
- Revisit information made available from concurrent studies (e.g., FA-06 and FA-07) in Q4 2022

BIOLOGICAL RFI DATA - DISCUSSION

- LP Comments and Discussion
  - What other data is available
  - High priority items to include in next iteration of the document

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USE OF DATA TO INFORM CONCEPT DEVELOPMENT

KEY FACTORS THAT INFLUENCE THE TYPE, SIZE, AND COMPLEXITY OF FISH PASSAGE FACILITIES

- Biological goals and objectives
- Historical record of performance
- Operating environment

KEY FACTORS THAT INFLUENCE THE TYPE, SIZE, AND COMPLEXITY OF FISH PASSAGE FACILITIES

- Historical record of performance (case studies)
- Examples of select benefits resulting from years in service:
  - Operational data
  - Flexibility and reliability
  - Trials and errors made by others
  - Lessons learned from similar installations
  - Cost of construction and operation
  - Influence on fish and fish populations
  - Performance

KEY FACTORS THAT INFLUENCE THE TYPE, SIZE, AND COMPLEXITY OF FISH PASSAGE FACILITIES

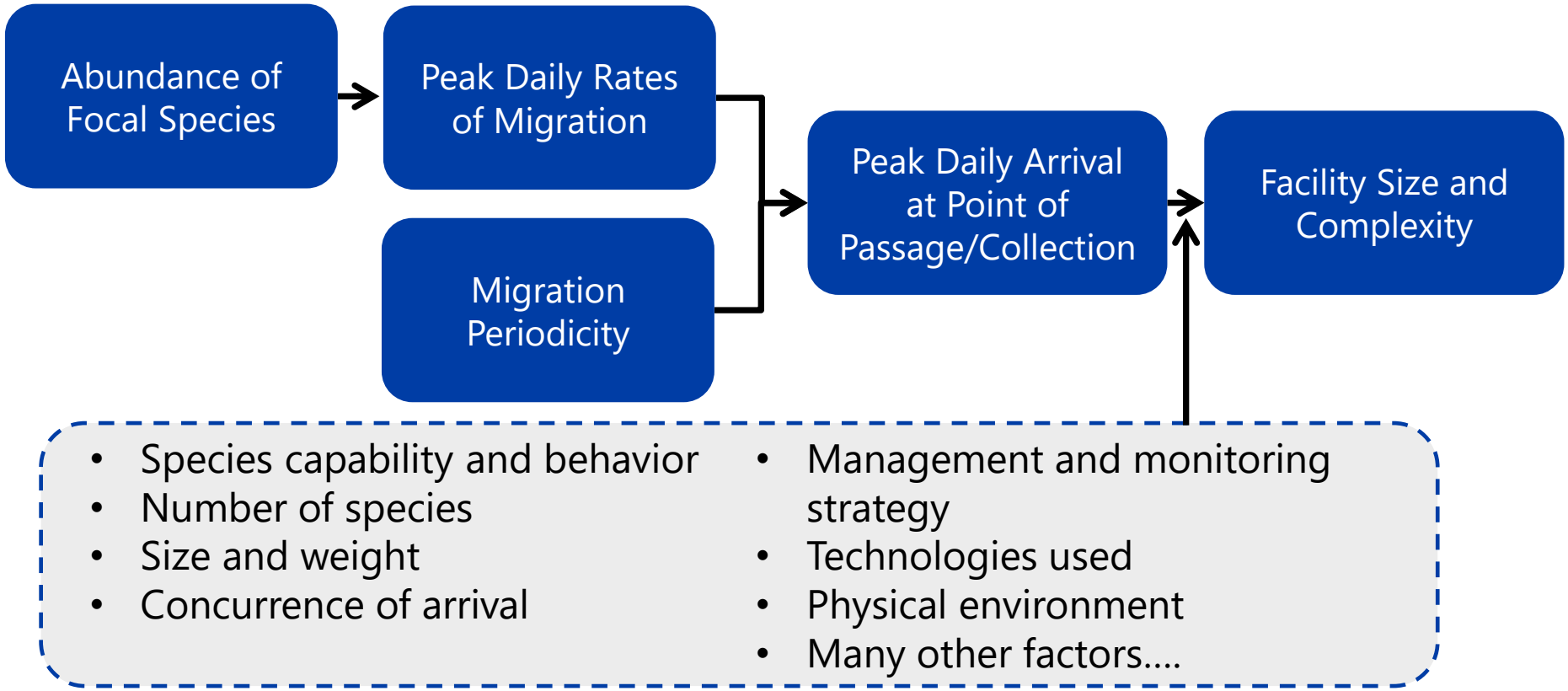
- Operating environment (Examples only)
  - Physical infrastructure
  - Reservoir fluctuation
  - Characteristics influencing reservoir transit (predation, complexity, temperature, migration patterns, etc.)
  - Known fish location and behavior
  - Migration ques
  - Debris characterization
  - Many other important factors…

KEY FACTORS THAT INFLUENCE THE TYPE, SIZE, AND COMPLEXITY OF FISH PASSAGE FACILITIES

- How many fish are going to be there?
- Where are the fish going to be?
  - Depth and orientation to existing infrastructure
  - Migration patterns leading them to the point of collection
  - Contribution of multiple tributaries
- When are fish going to be there?
  - General variation in species life history
  - Migration cues in upper watershed
  - Reservoir conditions

EXAMPLE APPLICATION OF FISH ABUNDANCE ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Simplified Example No.1 - Abundance



EXAMPLE APPLICATION OF FISH ABUNDANCE ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Simplified Example No.1 - Abundance

Initial List of Species for Fish Passage Program Development	
• Chinook Salmon • Coho Salmon • Sockeye Salmon • Steelhead • Bull Trout	• Chum Salmon • Pink Salmon • Sea-run Cutthroat Trout • Dolly Varden • Pacific Lamprey • Salish Sucker*

* Design criteria is currently limited. Passage may be incidental to facility design for other fish species. Further discussion required.

EXAMPLE APPLICATION OF FISH ABUNDANCE ON FACILITY TYPE, SIZE, AND COMPLEXITY

Skagit River Habitat Modeling

Preliminary Periodicity (9/20/2021)

Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Upper Skagit Summer Chinook Salmon	Adult Migration												
	Juv. Outmigration												
Upper Cascade Spring Chinook Salmon	Adult Migration												
	Juv. Outmigration												
Skagit Coho Salmon	Adult Migration												
	Juv. Outmigration												
Skagit River Sockeye	Adult Migration												
	Juv. Outmigration												
Skagit Winter Steelhead	Adult Migration												
	Juv. Outmigration												
Cascade River Summer Steelhead	Adult Migration												
	Juv. Outmigration												
Lower Skagit Core Area Bull Trout	Adult Migration (Fluvial)												
	Adult Migration (Anadromous)												
	Post-spawning outmigration (Fluvial)												
	Post-spawning outmigration (Anadromous)												
Dolly Varden	Adult Migration												
Skagit Pink Salmon	Adult Migration												
	Juv. Outmigration												
Mainstem Skagit Fall Chum Salmon	Adult Migration												
	Juv. Outmigration												
Pacific Lamprey	Adult Migration												
	Juv. Outmigration												
Sea-run Cutthroat Trout (Nooksack River, WRIA 1)	Adult Upstream Migration												
	Adult Outmigration												
	Juvenile Outmigration												
Salish Sucker	Adult Upstream Migration												

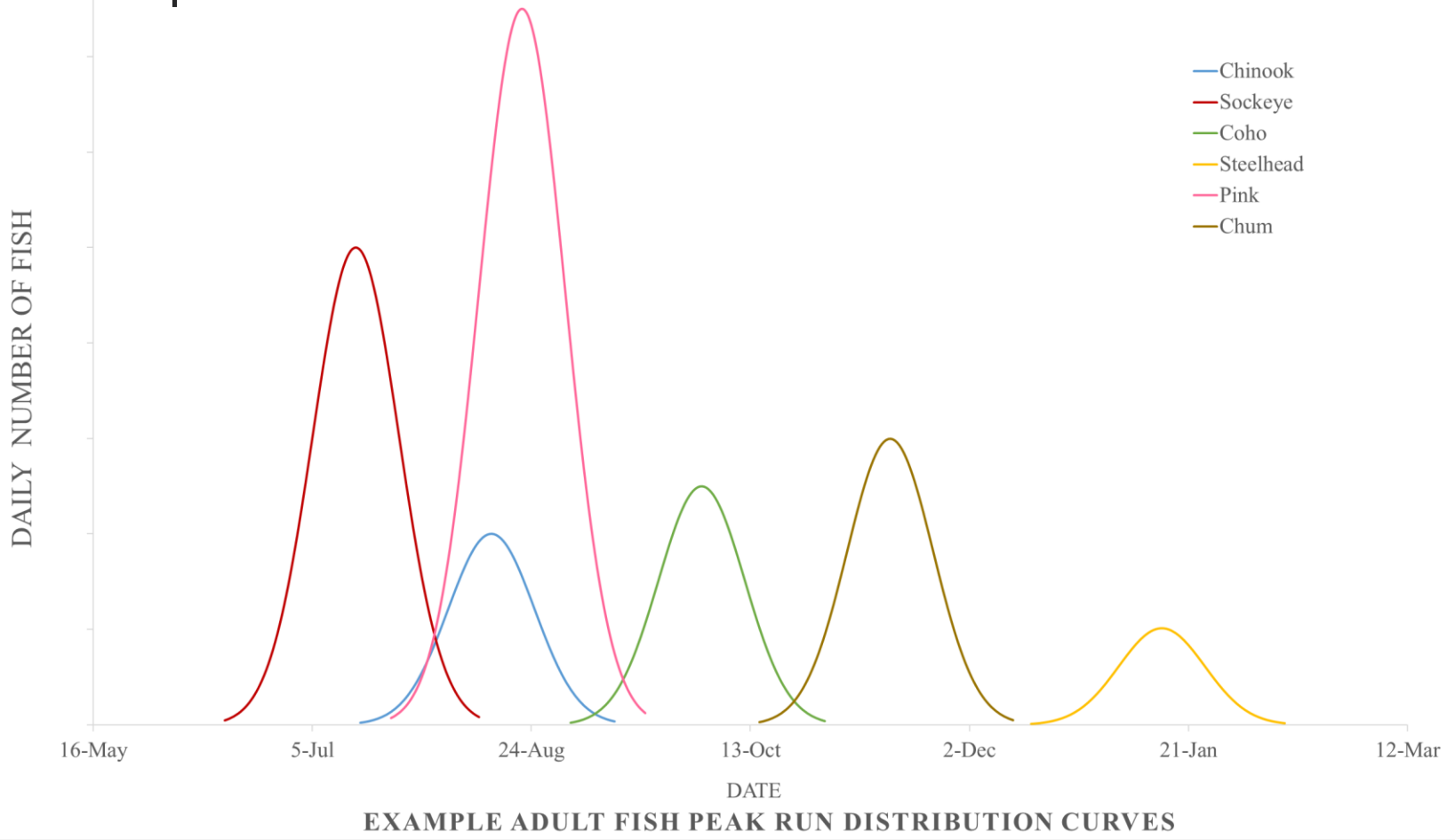
EXAMPLE APPLICATION OF FISH ABUNDANCE ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Potential fish passage facility operation
  - Upstream migration: January through December
  - Downstream migration: January through August
- Distribution and peak months yet to be identified

All Spp.	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Adult Upstream Migration												
	Juv. Downstream Outmigration												

EXAMPLE APPLICATION OF FISH ABUNDANCE ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Example Adult Salmonid Peak Run Distribution Curves



EXAMPLE APPLICATION OF FISH ABUNDANCE ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Simplified Example No.1 – Abundance
  - Example trap and transport facility for 1,000s of fish per day

Baker Adult Collection Facility

EXAMPLE APPLICATION OF FISH ABUNDANCE ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Simplified Example No.1 – Abundance
  - Example trap and transport facility for 1,000s of fish per day

Clackamas Adult Collection Facility at North Fork Dam

EXAMPLE APPLICATION OF FISH ABUNDANCE ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Simplified Example No.1 – Abundance
  - Example photos for 100s to 1,000 fish per year

Lostine Adult Broodstock Collection Facility

EXAMPLE APPLICATION OF FISH ABUNDANCE ON FACILITY TYPE, SIZE, AND COMPLEXITY

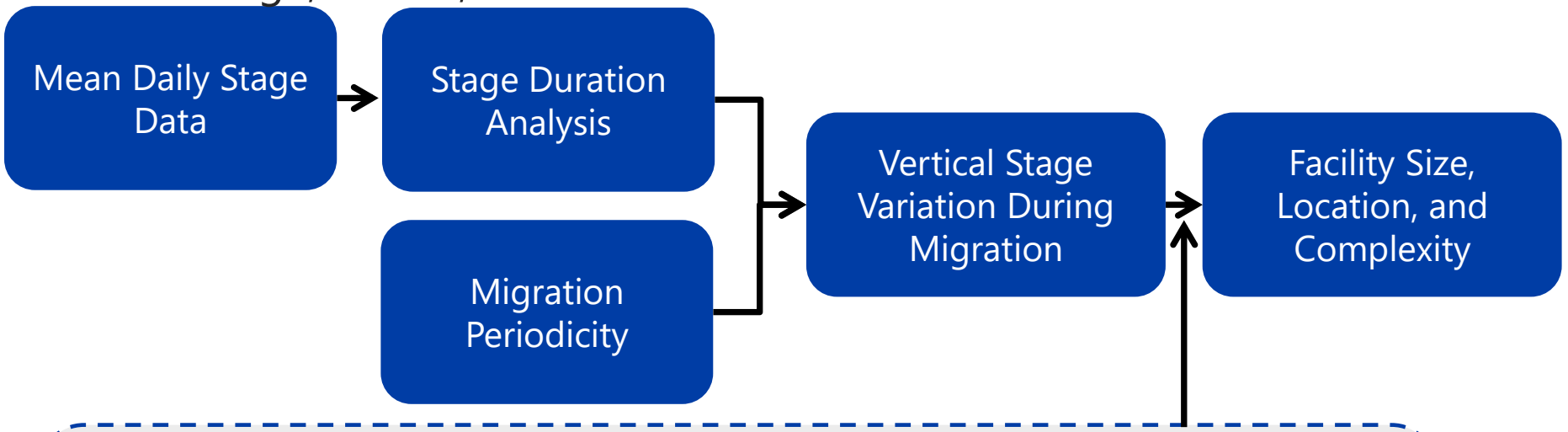
- Simplified Example No.1 – Abundance
  - Example trap and transport facility for 100 fish per year

Los Padres Dam

EXAMPLE APPLICATION OF RESERVOIR FLUCTUATION ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Simplified Example No.2 – Reservoir Fluctuation

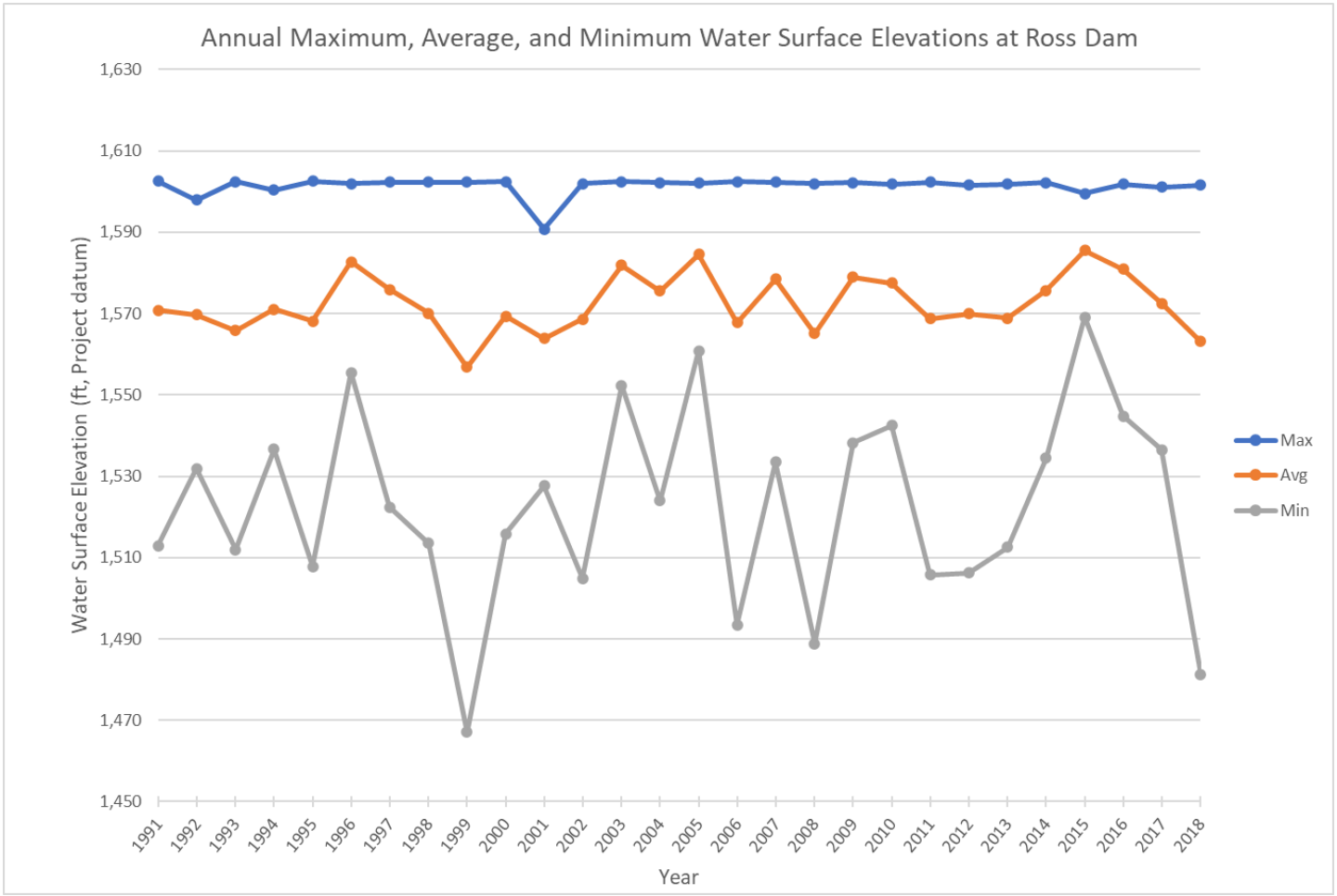
Each for Gorge, Diablo, and Ross



- Species capability and behavior
- Number of species
- Size and weight
- Concurrence of arrival
- Management and monitoring strategy
- Technologies used
- Physical environment
- Many other factors….

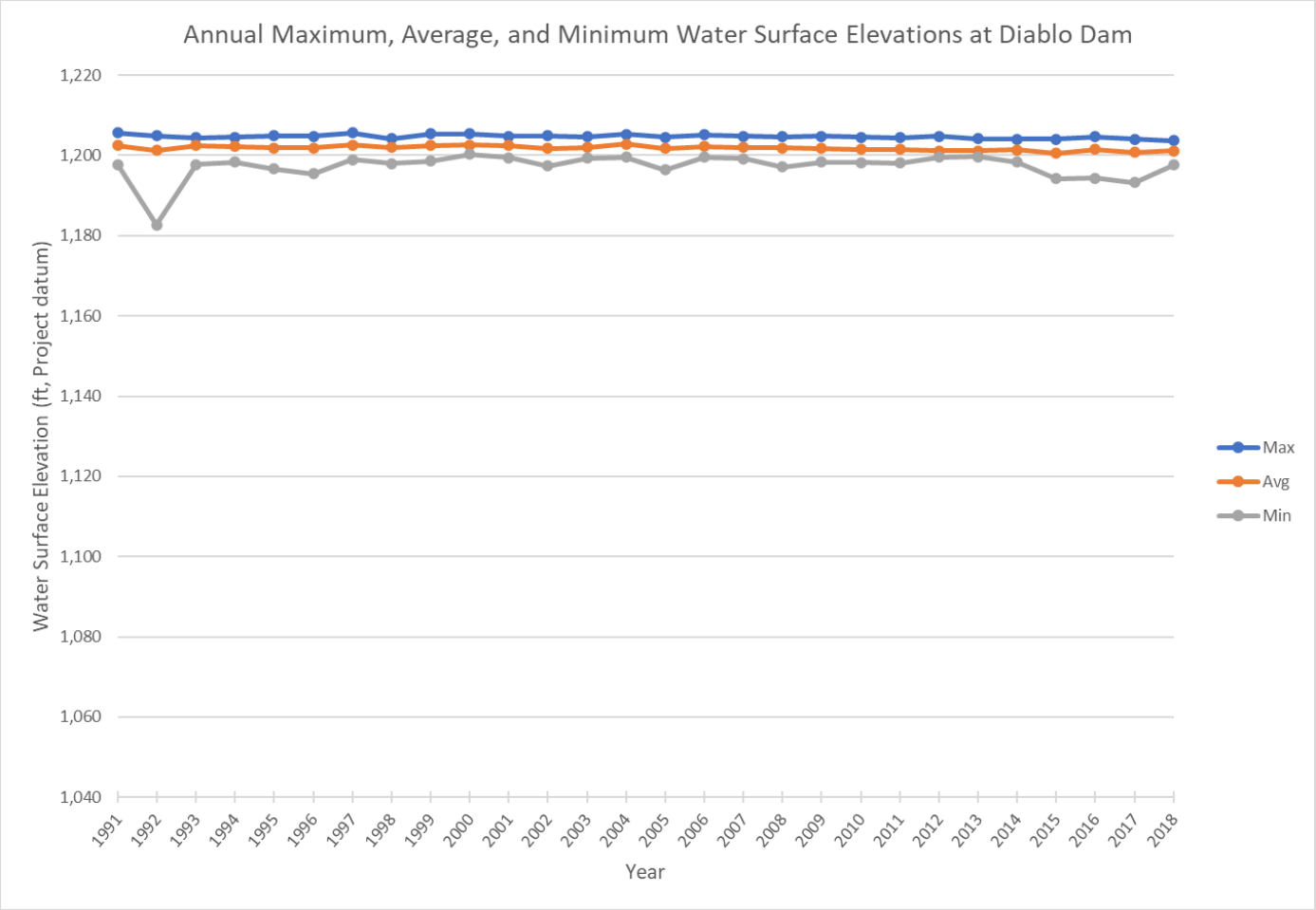
EXAMPLE APPLICATION OF RESERVOIR FLUCTUATION ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Ross Reservoir - Annual Max, Min, and Average Stage (ft)



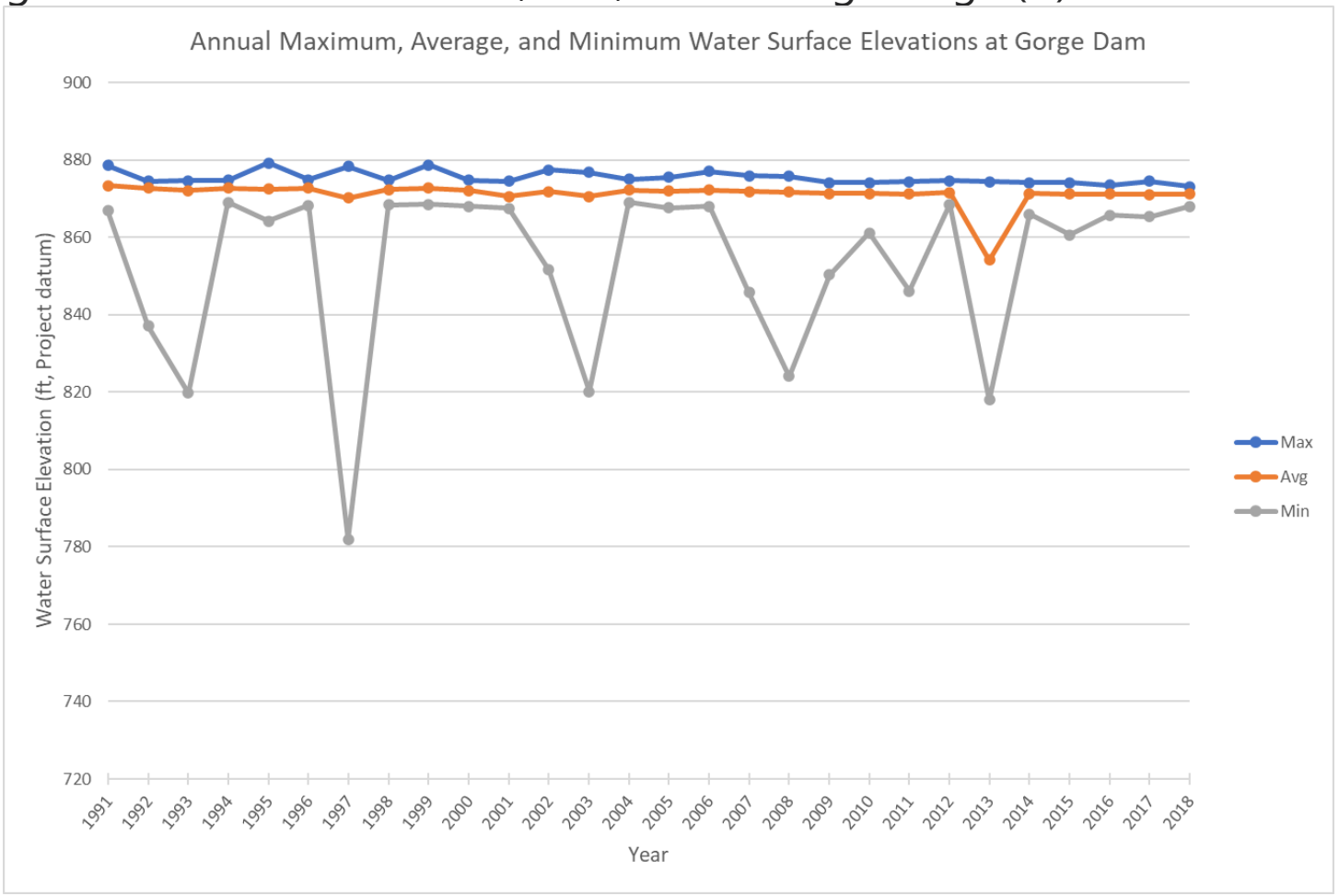
EXAMPLE APPLICATION OF RESERVOIR FLUCTUATION ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Diablo Reservoir - Annual Max, Min, and Average Stage (ft)



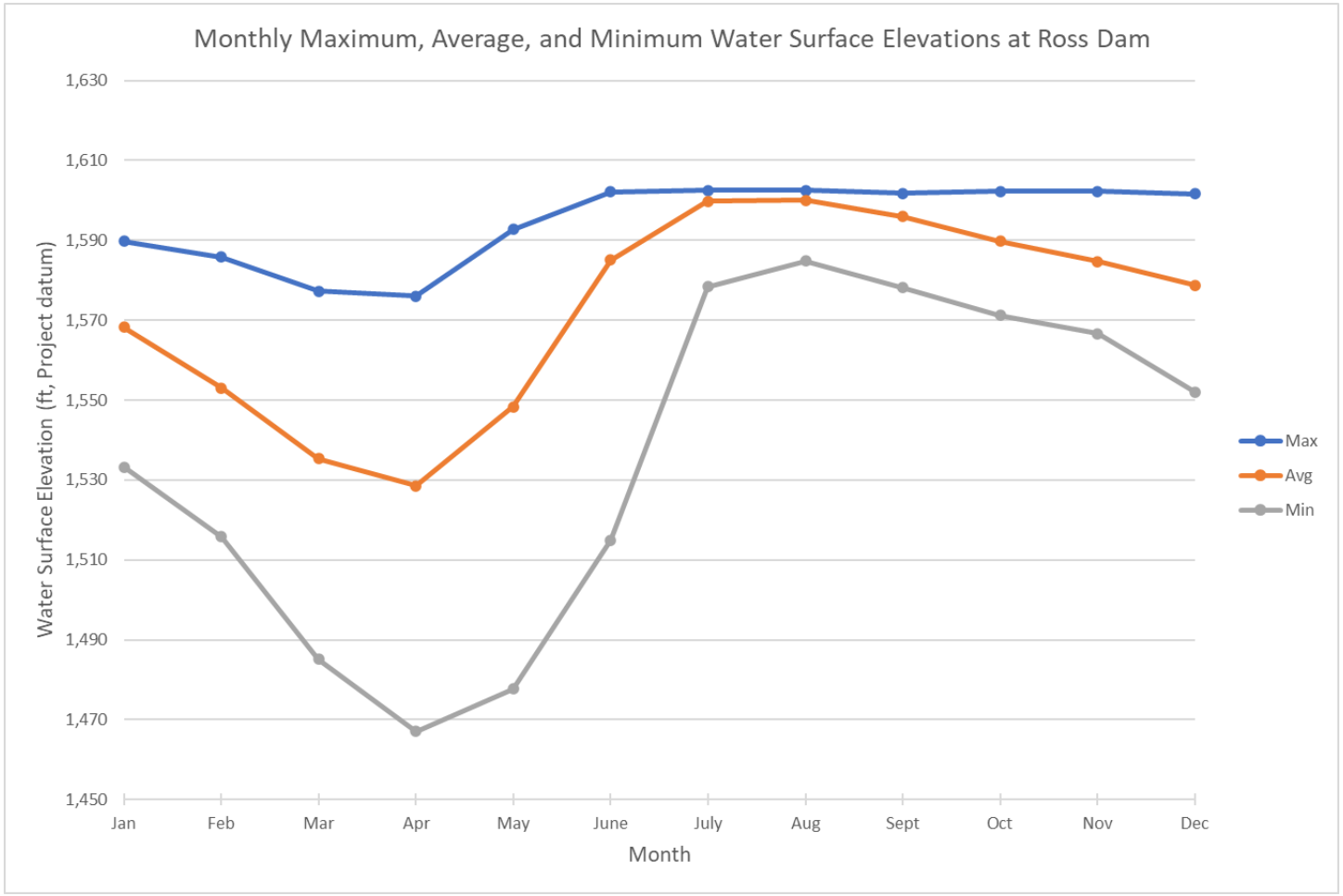
EXAMPLE APPLICATION OF RESERVOIR FLUCTUATION ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Gorge Reservoir - Annual Max, Min, and Average Stage (ft)



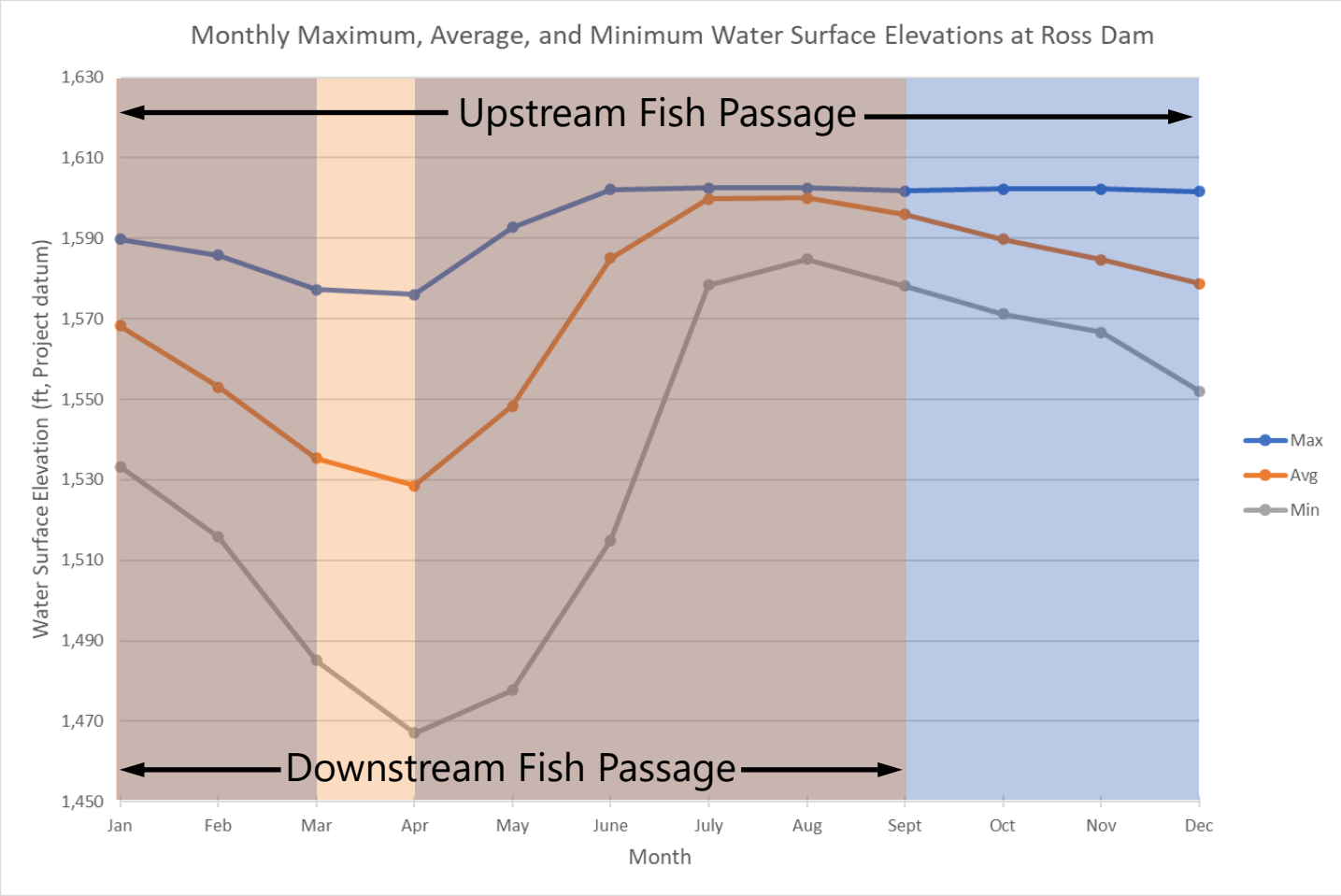
EXAMPLE APPLICATION OF RESERVOIR FLUCTUATION ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Ross Reservoir - Monthly Max, Min, and Average Stage (ft)



EXAMPLE APPLICATION OF RESERVOIR FLUCTUATION ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Ross Reservoir - Monthly Max, Min, and Average Stage (ft)

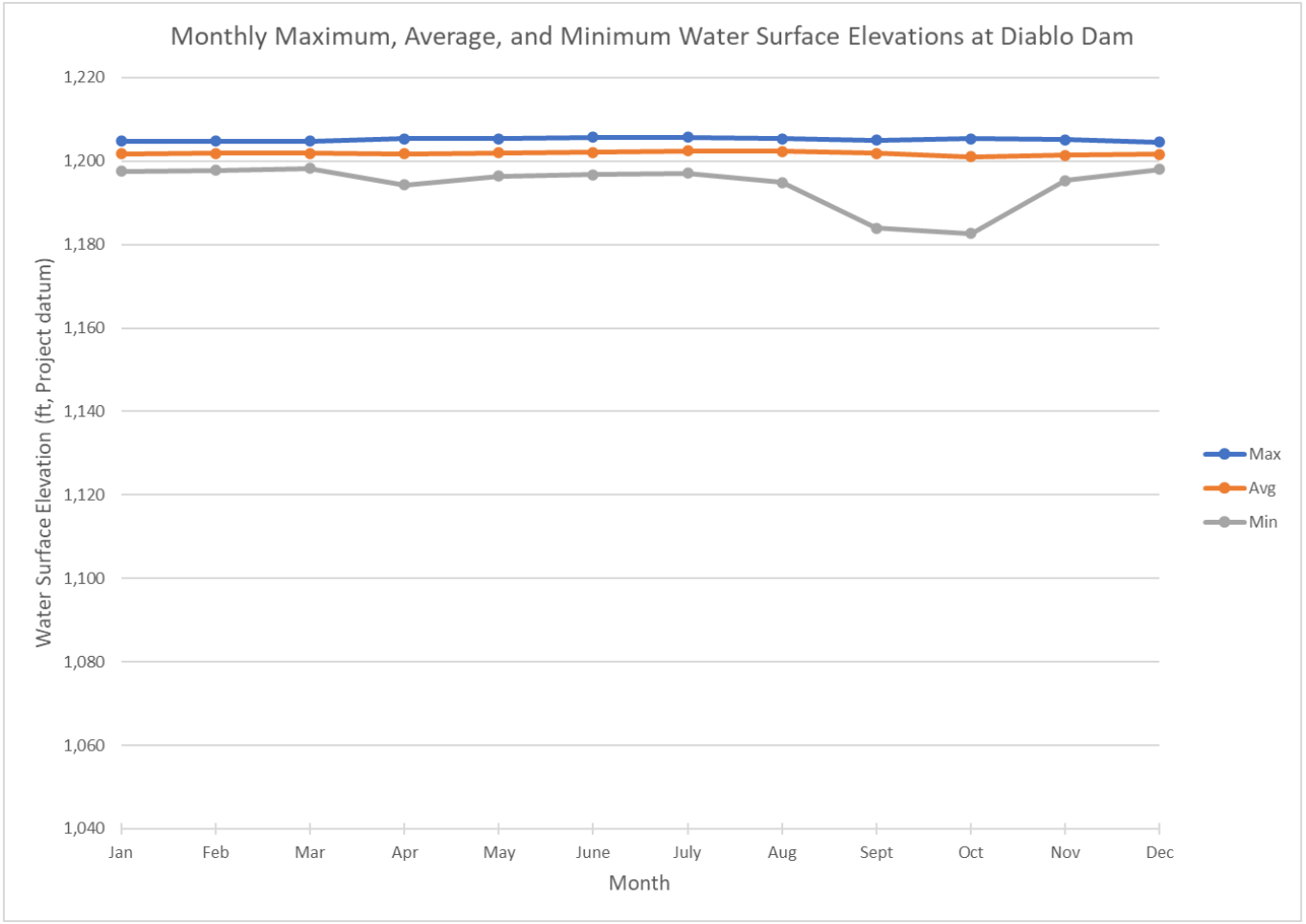


EXAMPLE APPLICATION OF RESERVOIR FLUCTUATION ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Ross Reservoir stage fluctuation during anticipated migration periods
- Upstream (Jan – Dec)
  - Min WSELEV – 1,467.1 feet (Project Datum)
  - Max WSELEV – 1,602.5 feet (Project Datum)
  - Total WSELEV Fluctuation – 135.4 feet
- Downstream (Jan – Sept)
  - Min WSELEV – 1,467.1 feet (Project Datum)
  - Max WSELEV – 1,602.5 feet (Project Datum)
  - Total WSELEV Fluctuation – 135.4 feet

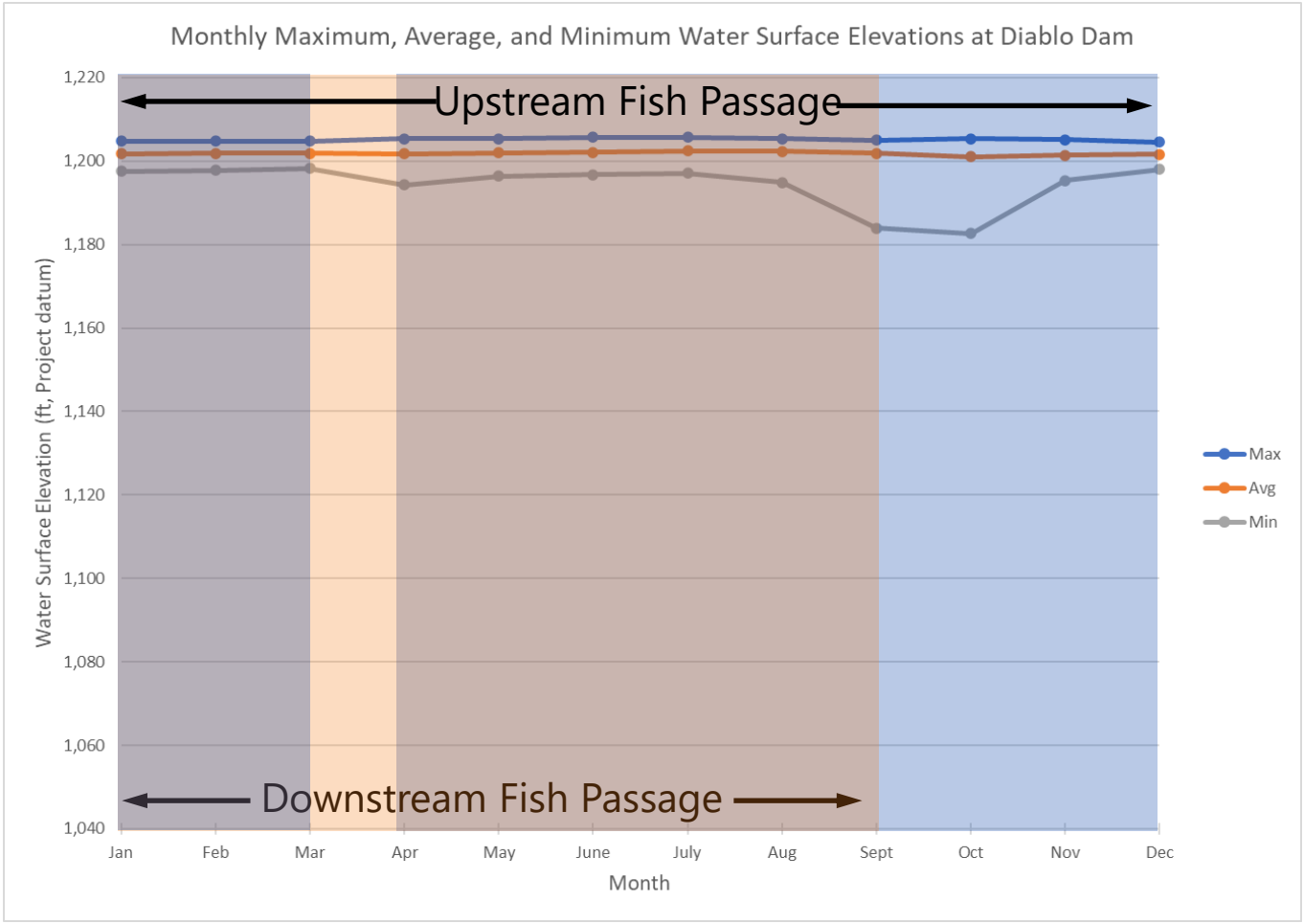
EXAMPLE APPLICATION OF RESERVOIR FLUCTUATION ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Diablo Reservoir - Monthly Max, Min, and Average Stage (ft)



EXAMPLE APPLICATION OF RESERVOIR FLUCTUATION ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Diablo Reservoir - Monthly Max, Min, and Average Stage (ft)

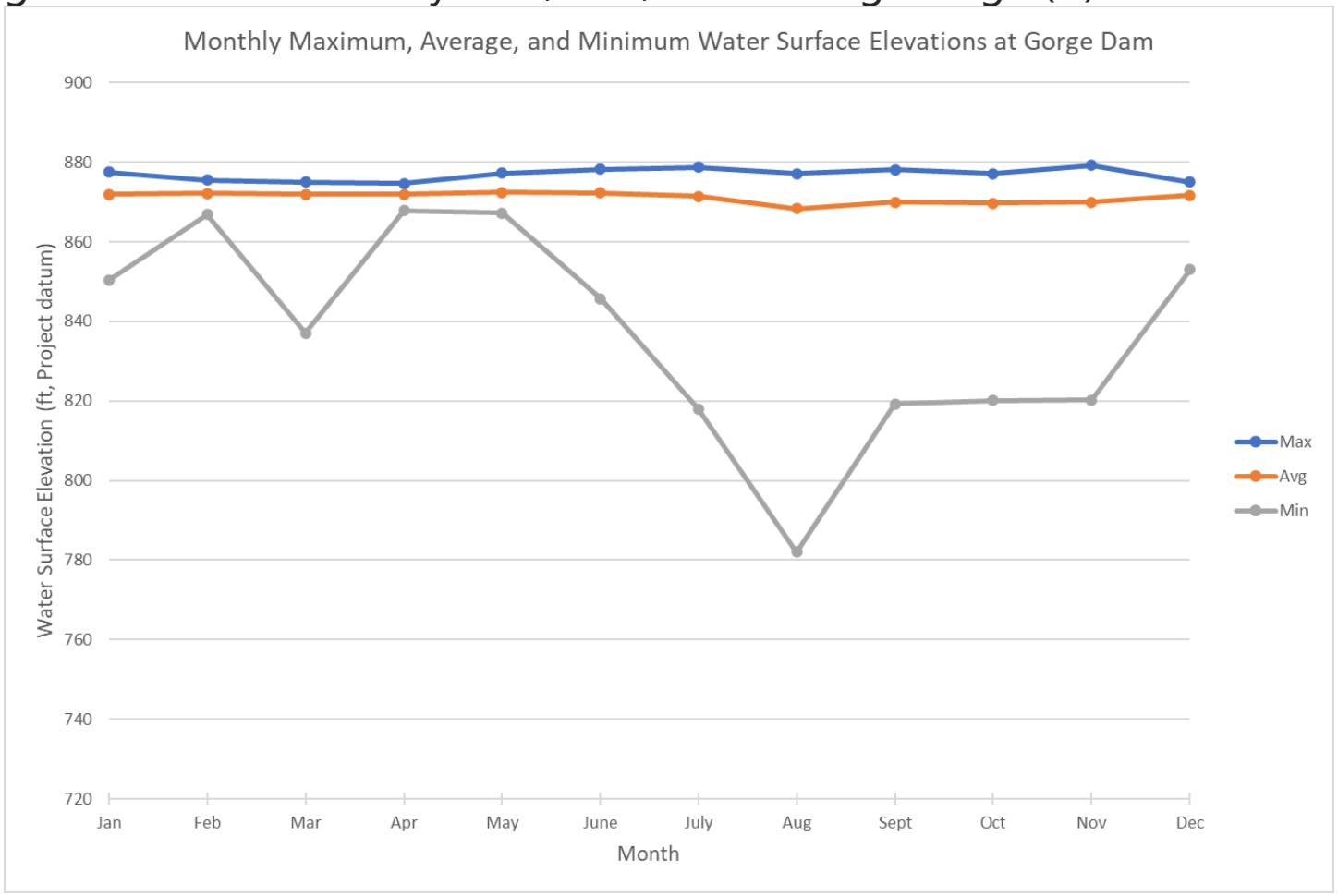


PRELIMINARY CONSIDERATIONS AND CRITERIA – RESERVOIR OPERATIONS & STAGE FLUCTUATION

- Diablo Reservoir stage fluctuation during anticipated migration periods
- Upstream (Jan – Dec)
  - Min WSELEV – 1,182.7 feet (Project Datum)
  - Max WSELEV – 1,205.7 feet (Project Datum)
  - Total WSELEV Fluctuation – 23 feet
- Downstream (Jan – Sept)
  - Min WSELEV – 1,183.9 feet (Project Datum)
  - Max WSELEV – 1,205.7 feet (Project Datum)
  - Total WSELEV Fluctuation – 21.8 feet

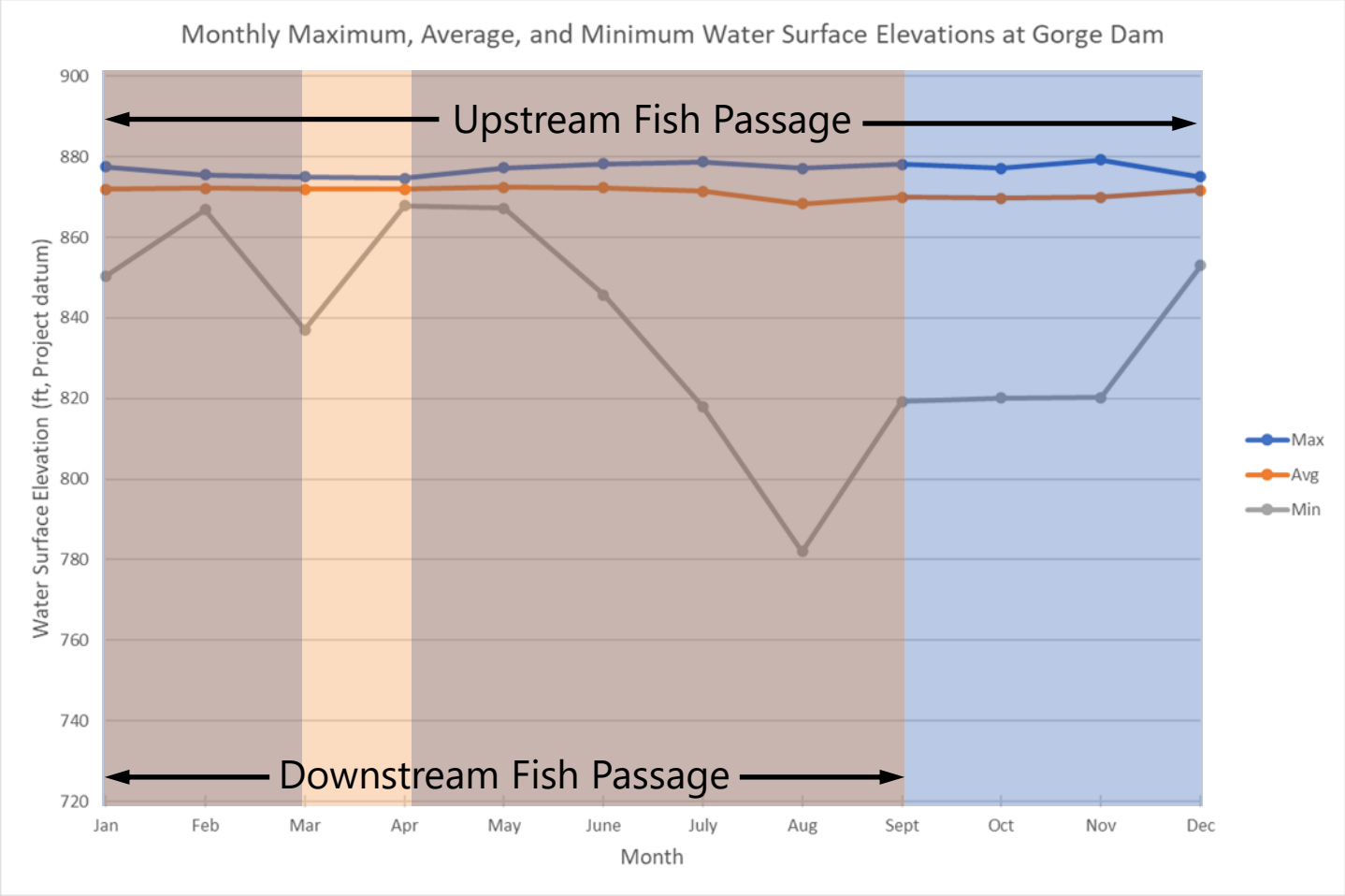
EXAMPLE APPLICATION OF RESERVOIR FLUCTUATION ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Gorge Reservoir - Monthly Max, Min, and Average Stage (ft)



EXAMPLE APPLICATION OF RESERVOIR FLUCTUATION ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Gorge Reservoir - Monthly Max, Min, and Average Stage (ft)

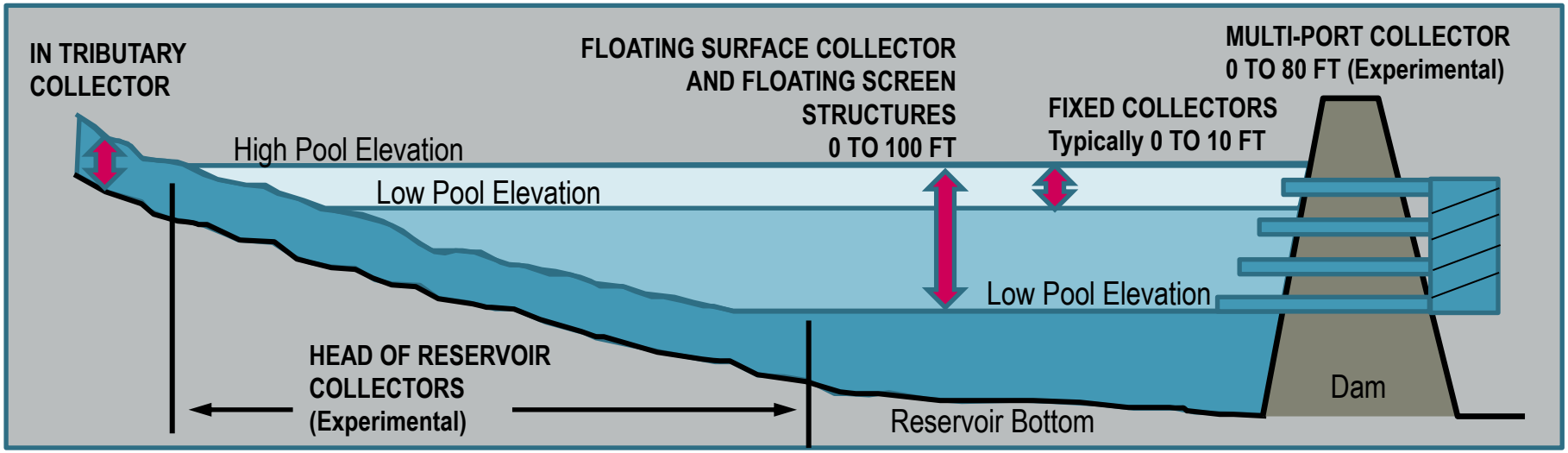


EXAMPLE APPLICATION OF RESERVOIR FLUCTUATION ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Gorge Reservoir stage fluctuation during anticipated migration periods
- Upstream (Jan – Dec)
  - Min WSELEV – 782 feet (Project Datum)
  - Max WSELEV – 879.3 feet (Project Datum)
  - Total WSELEV Fluctuation – 97.3 feet
- Downstream (Jan – Sept)
  - Min WSELEV – 782 feet (Project Datum)
  - Max WSELEV – 878.8 feet (Project Datum)
  - Total WSELEV Fluctuation – 96.8 feet

EXAMPLE APPLICATION OF RESERVOIR FLUCTUATION ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Seasonal changes in pool elevation influence downstream technology selection
  - Baker FSC – 60 ft of seasonal water level change
  - Swift FSC - 100 ft of seasonal water level change
  - Cougar FSS (concept) – 160 ft of elevation change (up to +57 ft or -22 ft per day during flood control operations)
  - River Mill Fixed Collector – Normally regulated with 2 ft of variation, can be up to 6 ft
  - Pelton Round Butte – Normally regulated with 1 ft of variation



EXAMPLE APPLICATION OF RESERVOIR FLUCTUATION ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Applicable Example Technology - Floating Surface Collectors
  - Large collection barge floating on the reservoir surface (60 to 70 feet wide x 120 to 170 ft long)
  - Reservoir fluctuation range of 2 to 100 vertical feet (North Fork vs. Swift)
  - Typical attraction flow capacity 250 to 1,000 cfs
  - Net Transition Structure (NTS) gradually transitions from net barrier/guidance to dewatering screens
  - Capture strategy – FSC and NTS
  - Fish transfer via trap and transport or passive bypass conduit (less common)
  - Five full scale examples currently in operation – numerous in the conceptual stage of development


Swift FSC (photo by PacifiCorps)

Swift FSC (photo by PacifiCorps)

PRELIMINARY CONSIDERATIONS AND CRITERIA – EXAMPLE APPLICATION OF RESERVOIR FLUCTUATION ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Applicable Example Technology - Floating Surface Collectors
- Collection inlet and dewatering screens fixed in vertical and horizontal position
- Reservoir fluctuation range:
  - Single inlet – 10 feet
  - Multi-Port Inlet – 80 feet
- Capture strategy like FSCs - Similar in configuration to run-of-river bypass facilities on Columbia River
- Examples
  - River Mill
  - Pelton-Round Butte
  - Cle Elum (experimental)

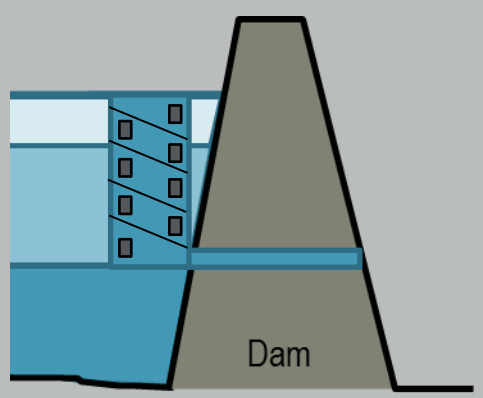

River Mill Fixed Inlet (photo by HDR)


River Mill bypass outfall (photo by HDR)

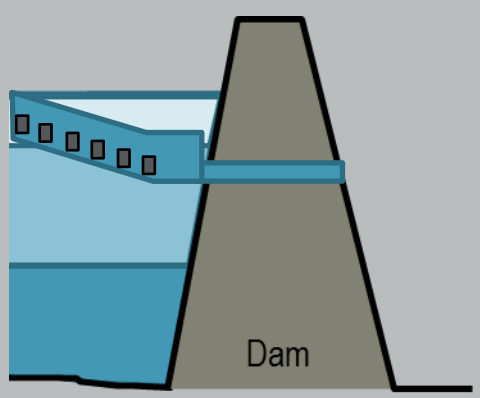
EXAMPLE APPLICATION OF RESERVOIR FLUCTUATION ON FACILITY TYPE, SIZE, AND COMPLEXITY

- Seasonal changes in pool elevations influence fish ladder feasibility
  - Soda Springs accommodates roughly 16 feet of fluctuation
  - North Fork was able to accommodate up to 20 feet of fluctuation prior to reservoir operational changes
  - All fish ladder exit concepts at high dams are relatively experimental with little to no record of performance

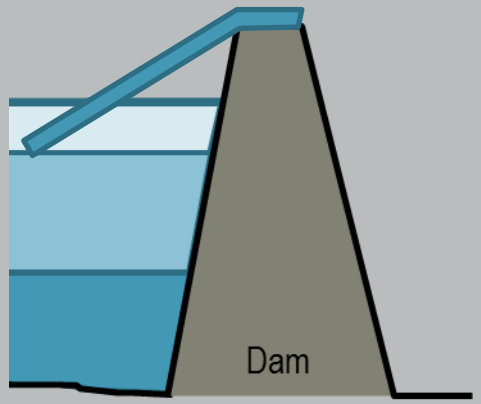
Fish Ladder Exit Concepts to Accommodate Large Reservoir Fluctuation



Helical Multi-Port Exit



Linear Multi-Port Exit



Return Flume

EXAMPLE APPLICATION OF RESERVOIR FLUCTUATION ON FACILITY TYPE, SIZE, AND COMPLEXITY

- North Fork Fish Ladder can accommodate hydraulic connection throughout 20 feet of reservoir fluctuation using a linear multi-port gated exit.

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BREAK

15 minutes

Seattle City Light

EXAMPLES OF POTENTIAL FISH PASSAGE STRATEGIES

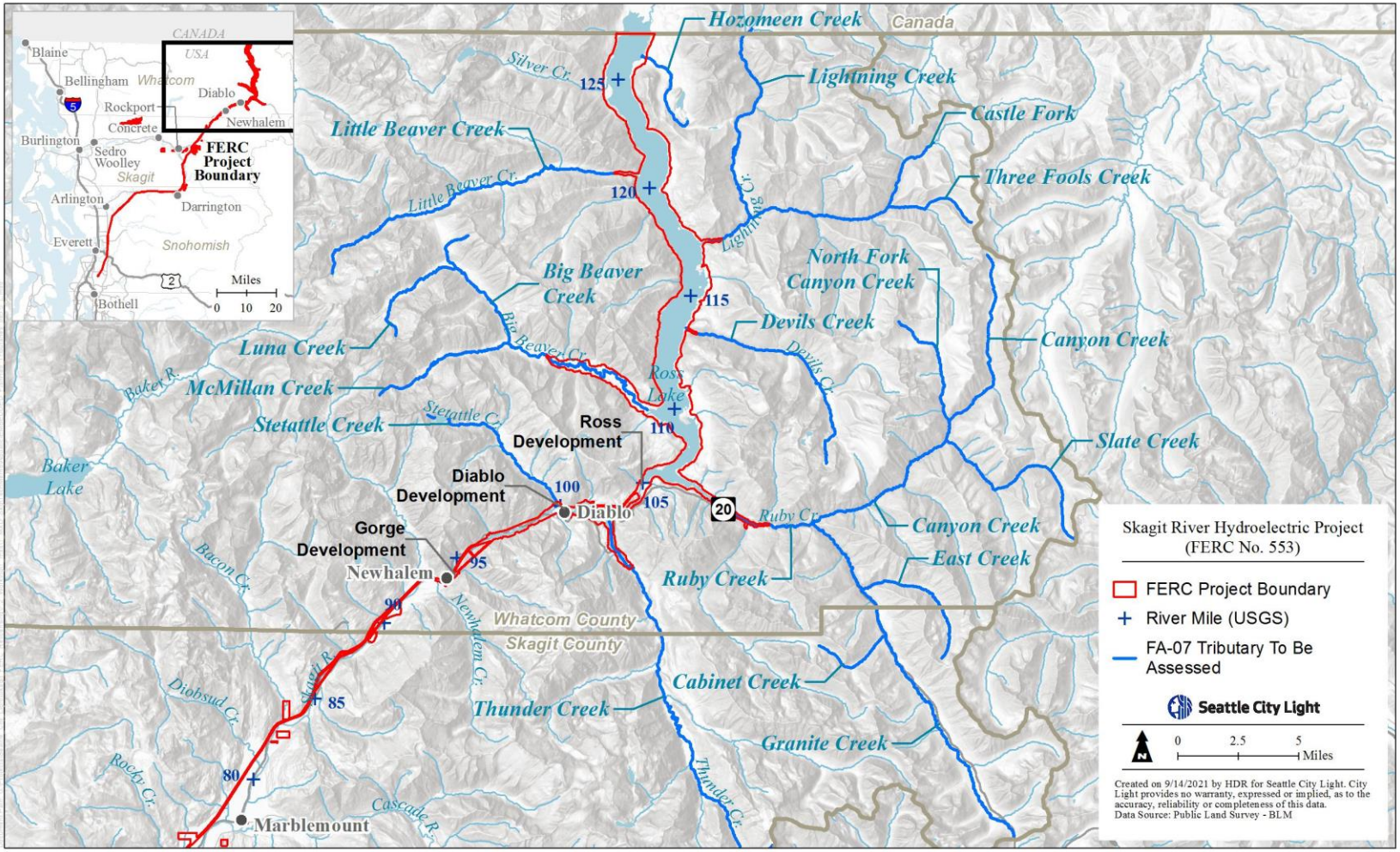
DEFINITION OF FISH PASSAGE STRATEGY AND TECHNOLOGY

- Fish Passage Strategies
  - Assembly of facilities to achieve a specific biological, management, and operation goal
- Fish Passage Technologies
  - Individual facility and associated elements required to operate at a specific location
  - Unique to a specific operating environment
- To be combined at a later stage of study to formulate concept alternatives based upon biological goals and objectives

OVERVIEW OF POTENTIAL FISH PASSAGE STRATEGIES

- Initial example strategies
- To be developed further in subsequent drafts of the DCD and after additional discussion with LPs
- Upstream/Downstream Fish Passage Strategies
  - Reservoir Bypass Strategy
  - Reservoir Tributary Strategy
  - Reservoir Transit Strategy
  - Option: Circumvent Gorge Bypass Reach

OVERVIEW OF UPPER SKAGIT SYSTEM

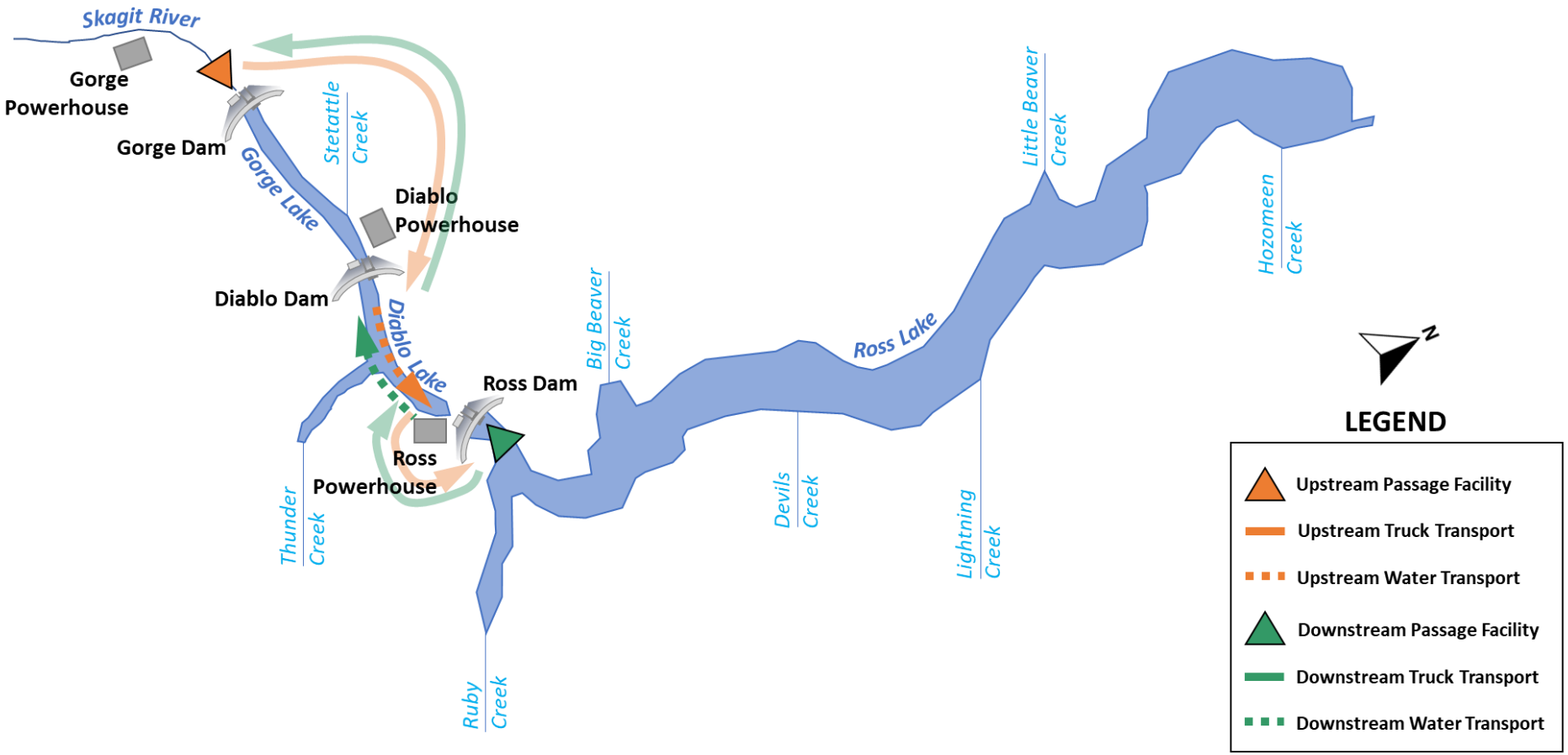


OVERVIEW OF POTENTIAL FISH PASSAGE STRATEGIES

- Reservoir Bypass Strategy
  - Upstream
    - Fish passage collection at the base of Gorge Dam
    - Transport fish upstream via truck to Diablo, then to Ross via barge
    - Release of fish at a designated recovery facility at Ross Lake
  - Downstream
    - Fish passage collection at the face of Ross Dam
    - Transport fish, in reverse order, to a recovery/release facility downstream of Gorge Dam

OVERVIEW OF POTENTIAL FISH PASSAGE STRATEGIES

- Reservoir Bypass Strategy

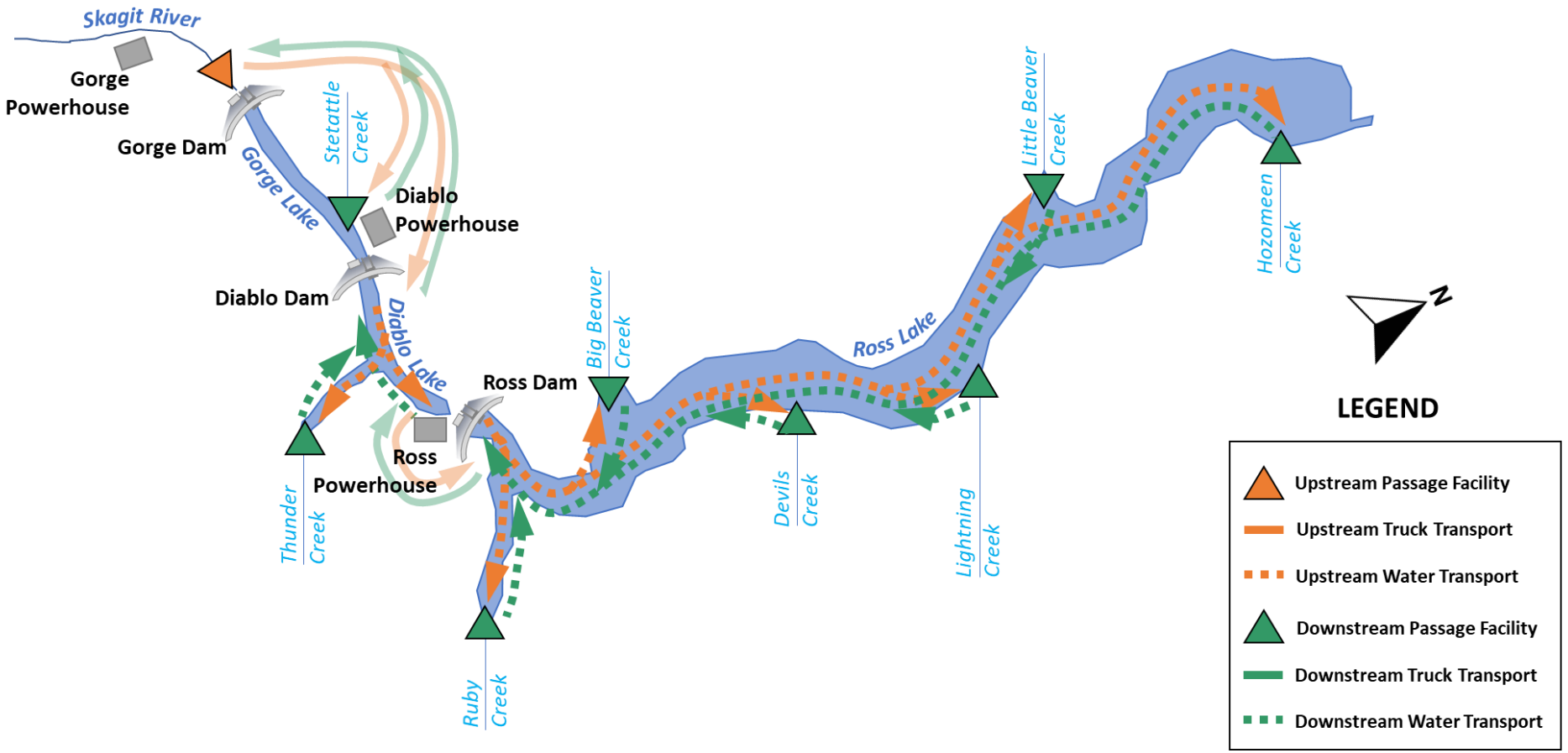


OVERVIEW OF POTENTIAL FISH PASSAGE STRATEGIES

- Reservoir Tributary Strategy
  - Upstream
    - Fish passage collection at the base of Gorge Dam
    - Transport fish upstream via truck to Diablo, then to Ross via barge
    - Barge transport to each selected tributary fish-release facility
  - Downstream
    - Fish passage collection near the mouth of each tributary selected
    - Transport fish, in reverse order, to a recovery/release facility downstream of Gorge Dam

OVERVIEW OF POTENTIAL FISH PASSAGE STRATEGIES

- Reservoir Tributary Strategy

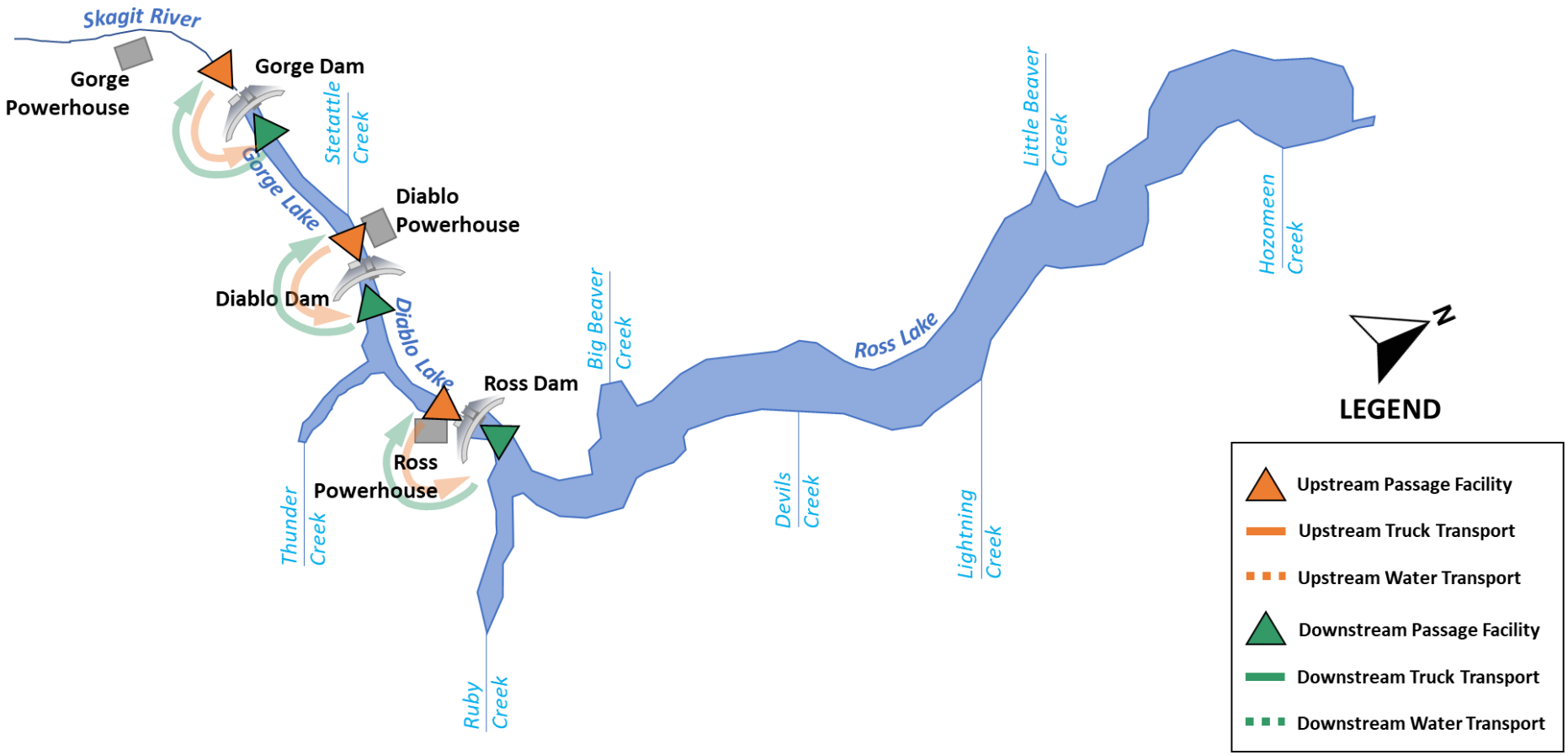


OVERVIEW OF POTENTIAL FISH PASSAGE STRATEGIES

- Reservoir Transit Strategy
  - Upstream
    - Fish passage collection at the base of Gorge Dam, the Diablo Powerhouse tailrace, and the Ross Powerhouse tailrace
    - Adult fish transported above each dam and released into the next adjoining reservoir
    - Adult fish transit Gorge, Diablo, and Ross Lakes to the next fish passage facility or spawning habitat
  - Downstream
    - Fish passage facilities located near the intake structures for Ross, Diablo, and Gorge Power Developments
    - After collection, fish would be transported downstream to adjacent "head of reservoir" or powerhouse tailrace
    - Fish transit Ross, Diablo, and Gorge Lakes and are ultimately collected at Gorge Dam and transported downstream to a recovery/release facility

OVERVIEW OF POTENTIAL FISH PASSAGE STRATEGIES

- Reservoir Transit Strategy

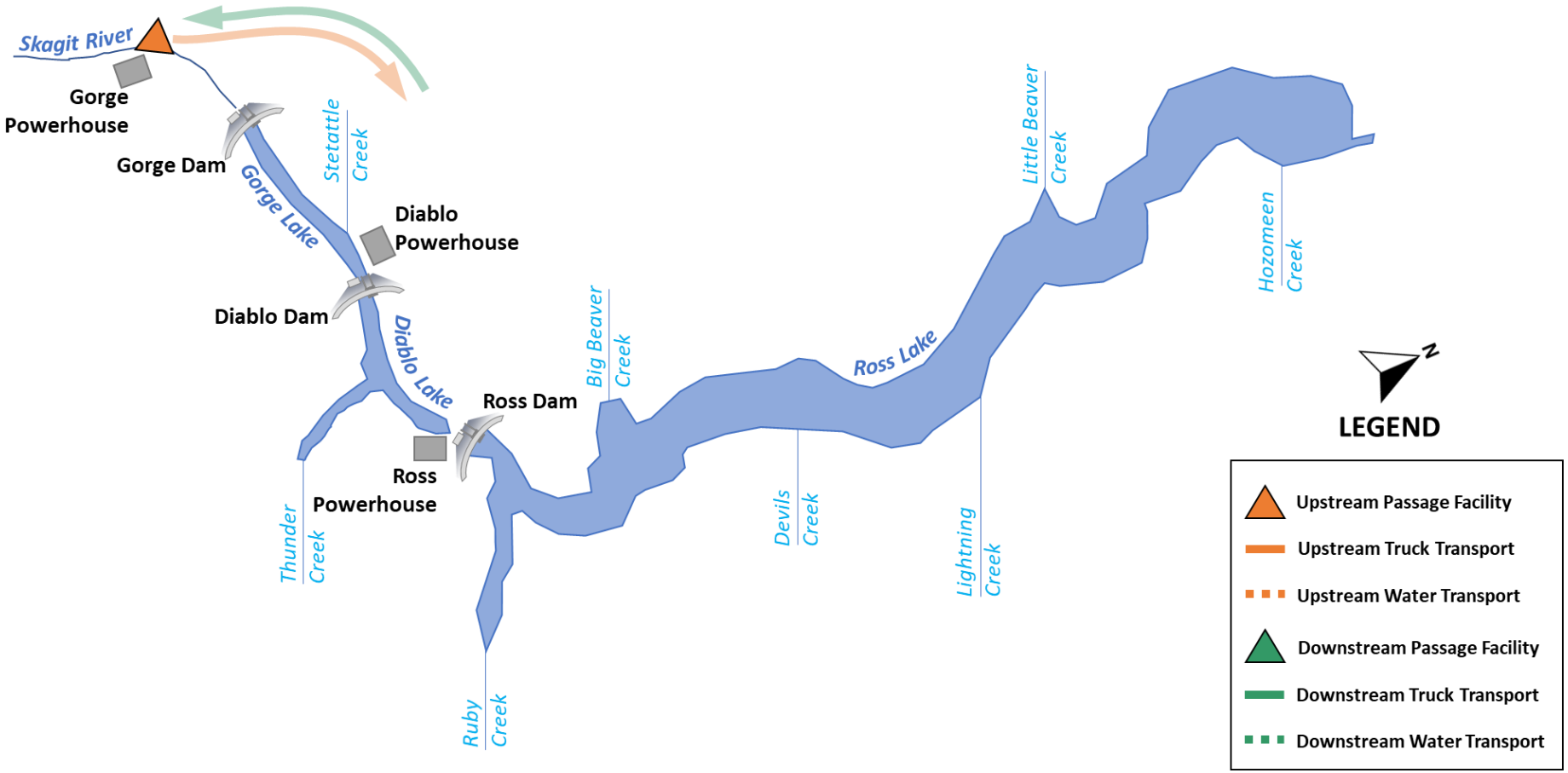


OVERVIEW OF POTENTIAL FISH PASSAGE STRATEGIES

- Optional Exclusion of Gorge Bypass Reach
  - Add point of collection for upstream fish passage at Gorge Powerhouse
  - Eliminates navigation of bypass reach to accomplish upstream fish passage.

OVERVIEW OF POTENTIAL FISH PASSAGE STRATEGIES

- Optional Exclusion of Gorge Bypass Reach



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EXAMPLES OF POTENTIAL FISH PASSAGE STRATEGIES

FISH PASSAGE FACILITY DESIGN

- What technologies and components do fish passage facilities need to consider?

FISH PASSAGE FACILITY DESIGN

- Block fish
- Guide fish
- Attract fish
- Collect fish
- Crowd fish
- Sort fish
- Lift fish
- Convey fish
- Measure fish
- Tag fish
- Transport fish
- Release fish

A complete system of design elements that work together to accomplish a biological/ecological driven objective given unique operational environment…

DIRECTIVE VS NON-DIRECTIVE FISH PASSAGE

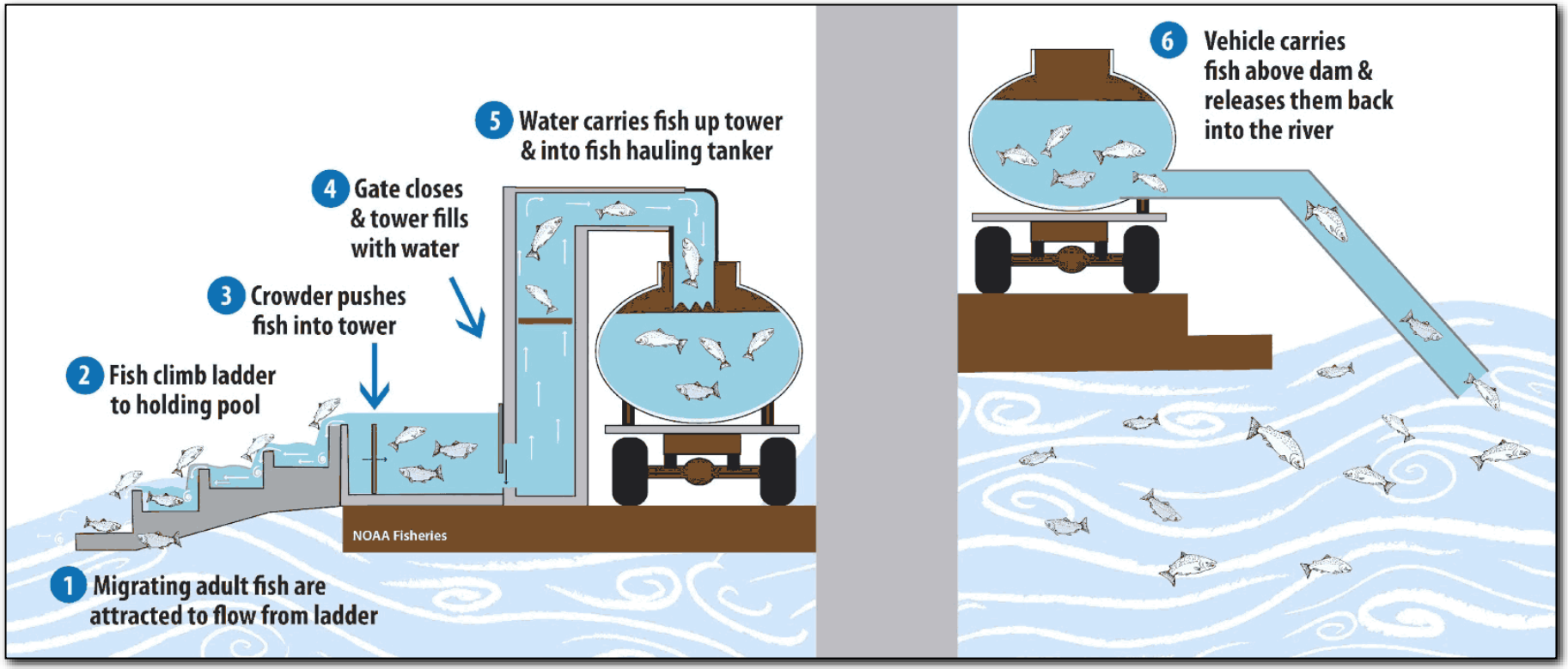
- Directive Fish Passage Technologies
  - Requires a high level of human intervention (e.g., trap and transport)
- Non-Directive Fish Passage Technologies
  - Fish may volitionally pass without human intervention (e.g., technical fish ladder or nature-like fishway)

OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES

- Potential Upstream Technologies
  - Trap and Transport
  - Fish Ladders/Fishways
    - Technical Fish Ladders
    - Nature-like fishways
  - Fish Passes
    - Fish elevators, lifts, and locks
    - Pneumatic Fish Transport Tube System (“Whooshh”)

OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES – UPSTREAM

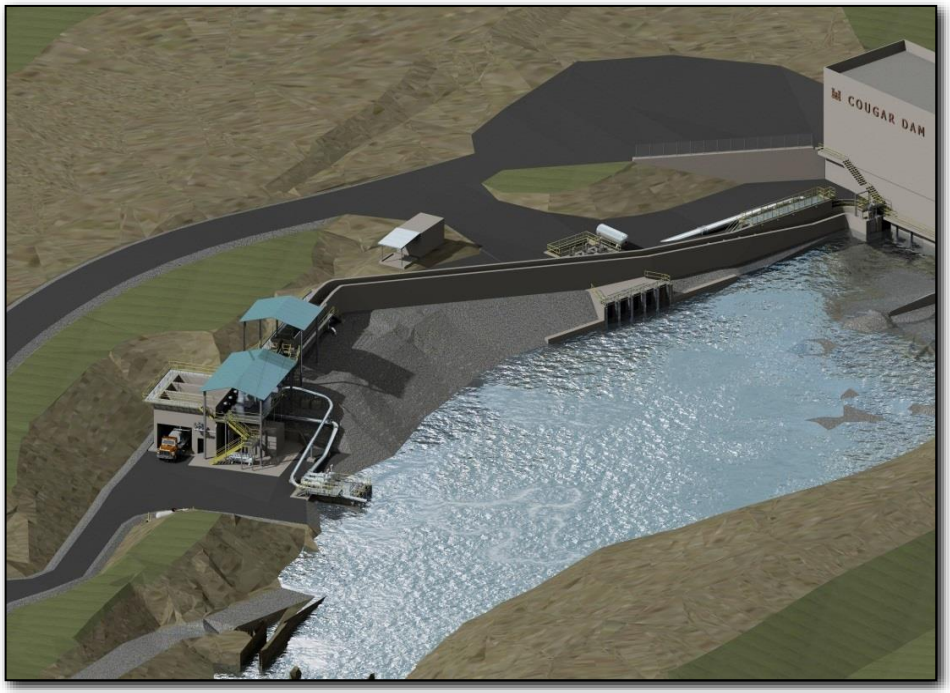
- Trap and Transport



Source: NMFS

OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES – UPSTREAM

- Trap and Transport



Cougar Dam Adult Fish Collection Facility
S. Fork McKenzie River, OR
(rendering by USACE)

Lower Granite Dam Adult Collection Facility
Snake River, WA

OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES – UPSTREAM

- Fish Ladders/Fishways – Technical Fish Ladders

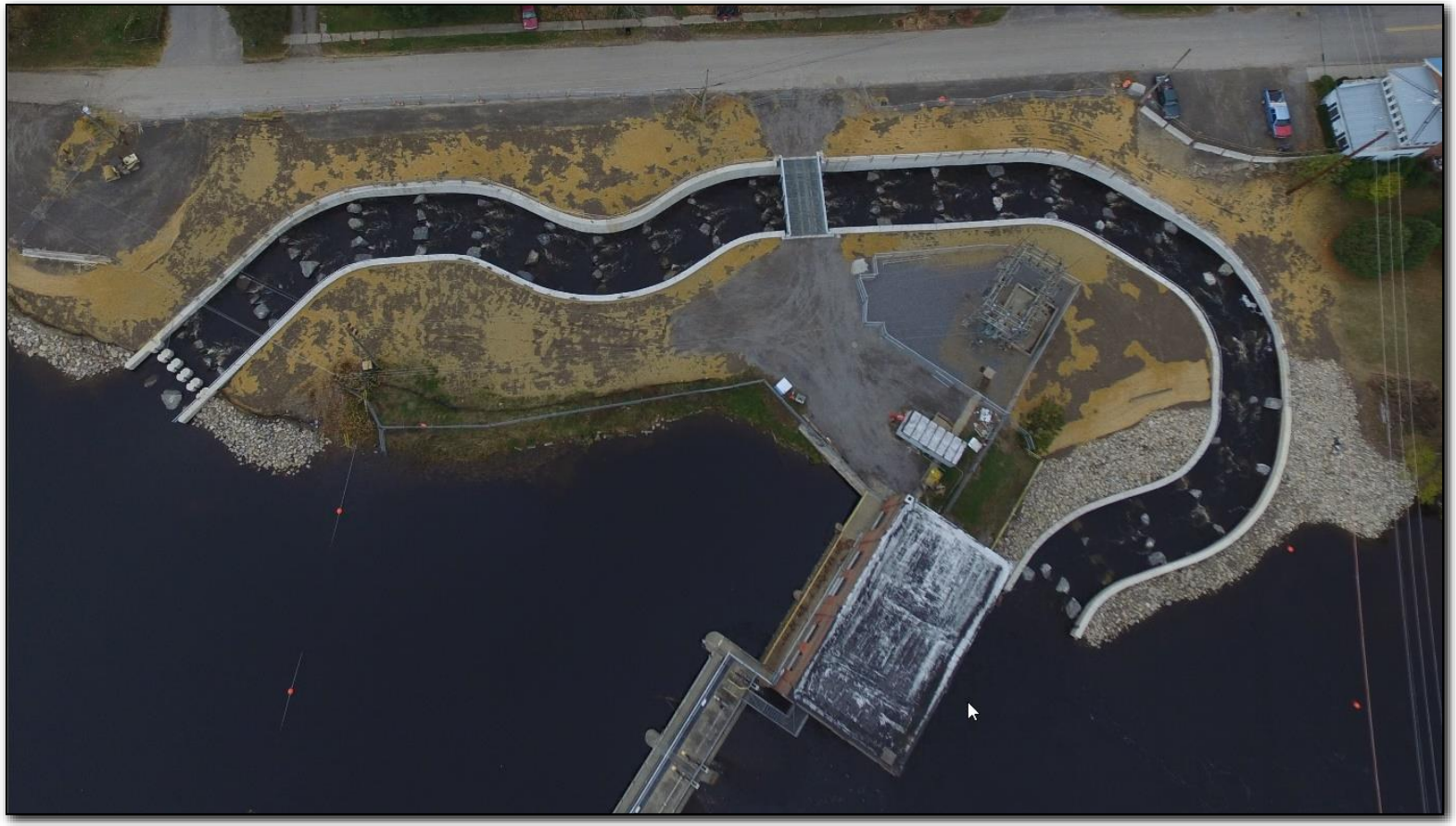
Crooked River central vertical slot fishway near Prineville, Oregon (Source: ODFW)

Half Ice-Harbor baffle (pool, weir, and orifice) fish ladder at River Mill Dam.

2.1 mile long half, Ice-Harbor baffle (pool, weir, and orifice) fish ladder at the Faraday Diversion Dam and North Fork Dam.

OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES – UPSTREAM

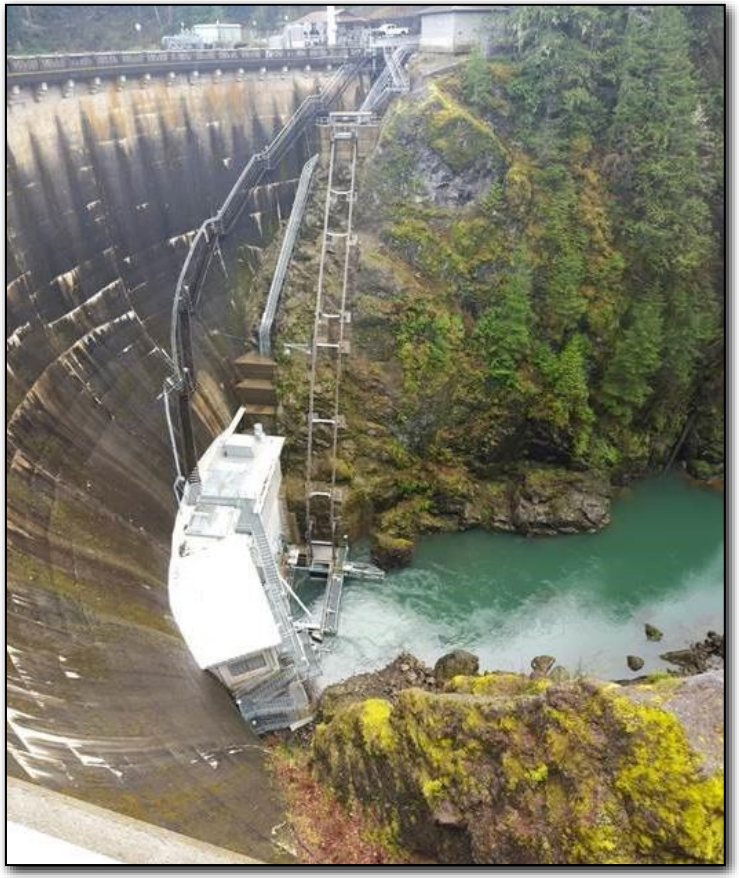
- Fish Ladders/Fishways – Nature-like fishways



Heuvelton nature-like fishway on the Oswegatchie River in New York.

OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES – UPSTREAM

- Fish Passes – Fish elevators, lifts, and locks



Skokomish Dam No. 2 Adult Collection Facility fish lift

Fish lock at the trap and transport facility on Lower Baker River

OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES – UPSTREAM

- Fish Passes – Pneumatic Fish Transport Tube System ("Whooshh")

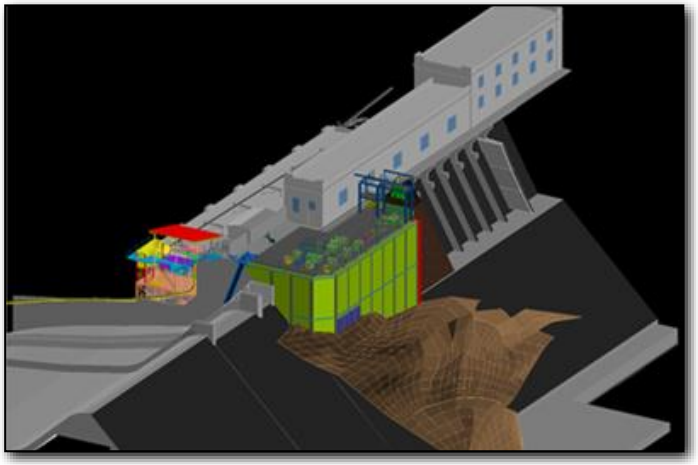
Six-lane pneumatic fish transport tube system (also known as "Whooshh") at the Big Bar emergency fish transport site, Frasier River, British Columbia.

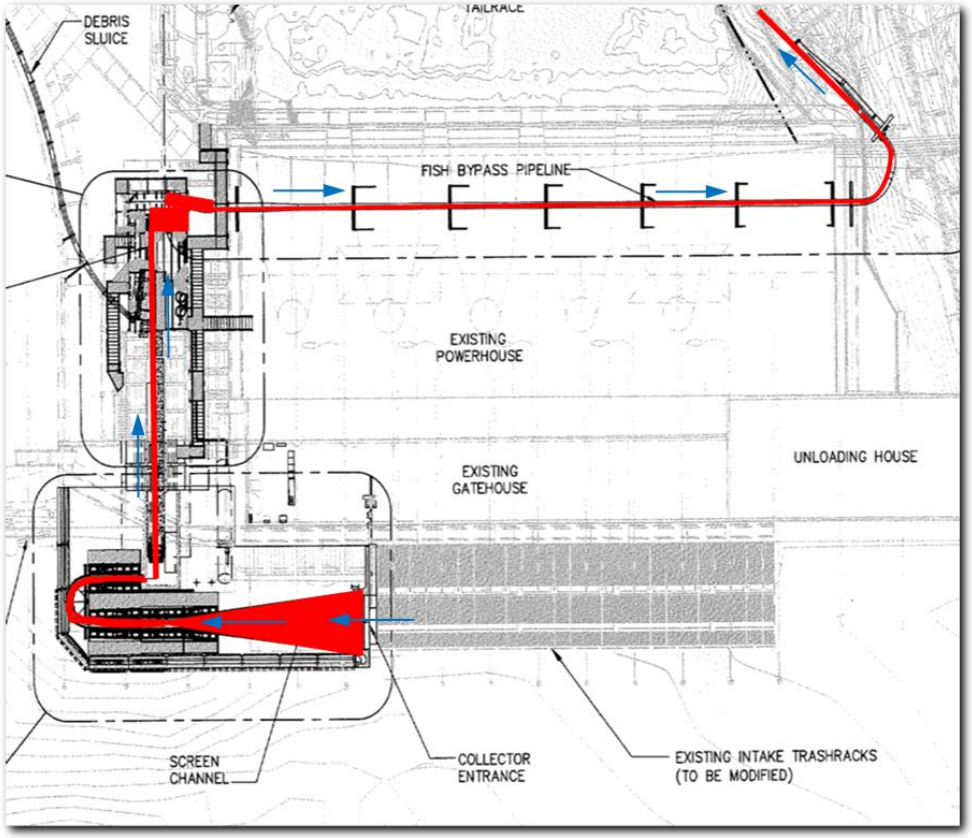
OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES

- Potential Downstream Technologies
  - Forebay Collectors
    - Fixed Inlet Collectors
    - Floating Surface Collectors
    - Floating Screen Structures
  - Head of Reservoir Collection
    - Floating Surface Collectors
    - Passive Collectors
    - In-River or Tributary Collectors
  - Turbine Passage
  - Surface Spill
  - Bypass Systems
  - Reservoir drawdown

OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES – DOWNSTREAM

- Forebay Collectors – Fixed Inlet Collectors

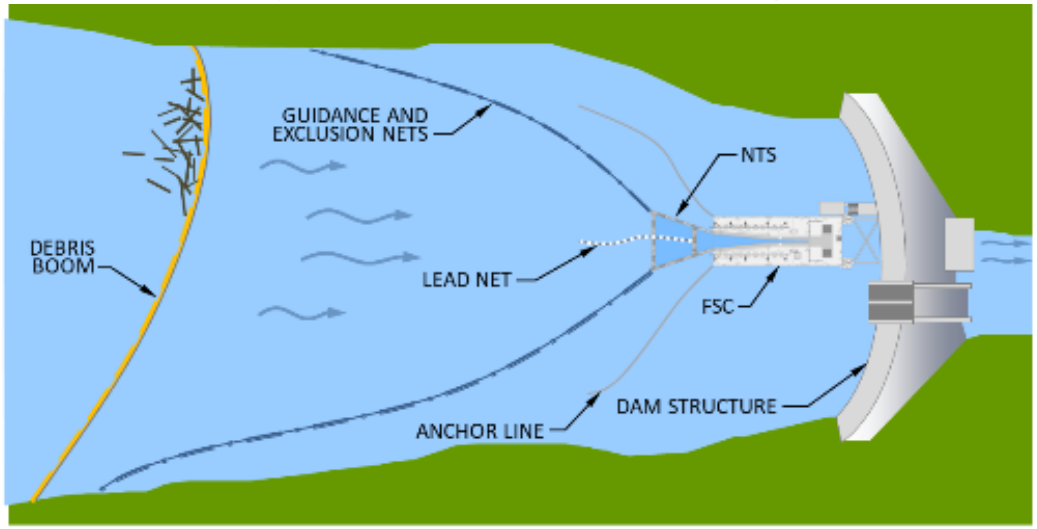


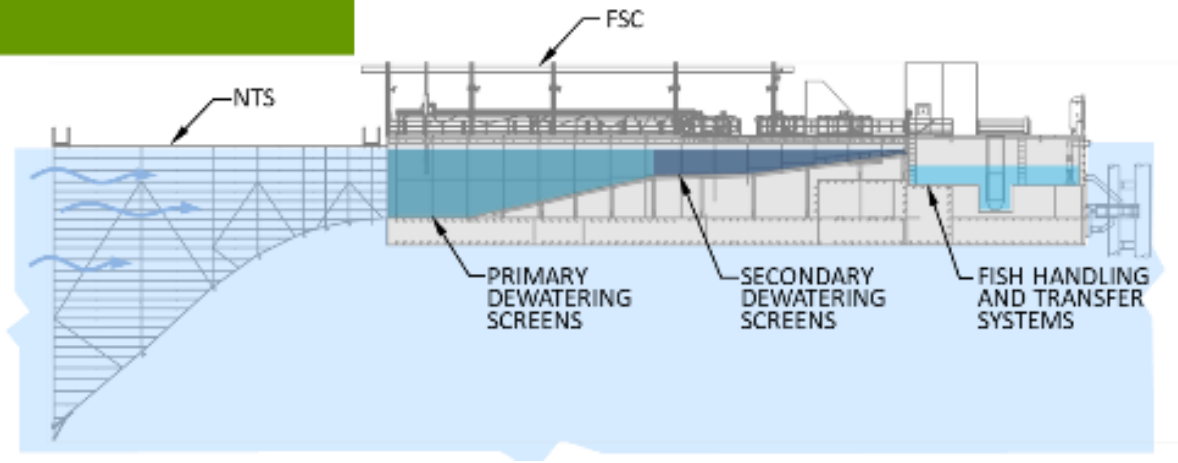


River Mill Hydroelectric Project

OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES – DOWNSTREAM

- Forebay Collectors – Floating Surface Collectors





OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES – DOWNSTREAM

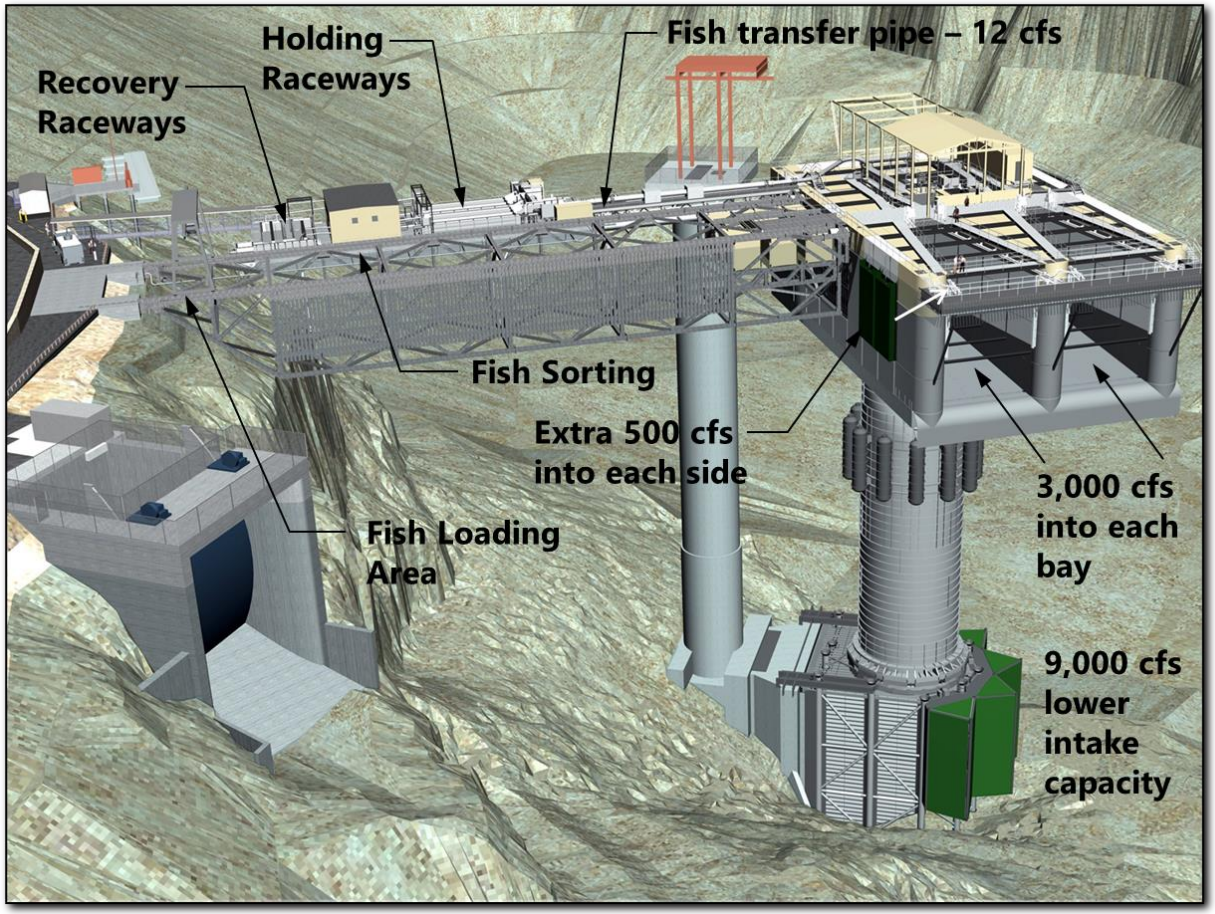
- Forebay Collectors – Floating Surface Collectors

Floating Surface Collector (FSC)
Upper Baker Dam, WA
(photo by PSE)

Upper Baker FSC
Net Transition Structure (NTS)
(photo by PSE)

OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES – DOWNSTREAM

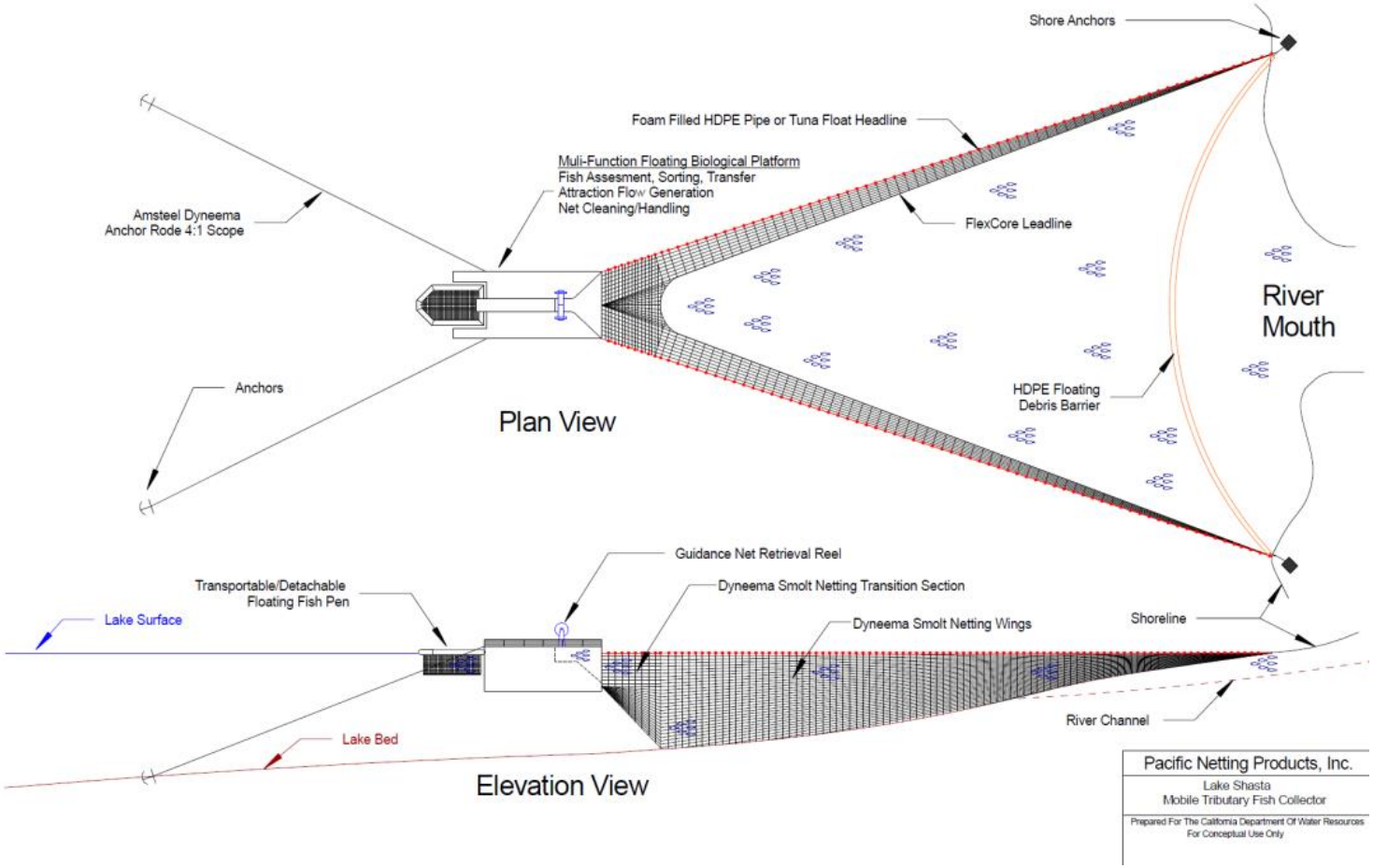
- Forebay Collectors – Floating Screen Structures



Pelton Round-Butte Fixed Collector (rendering by PGE)

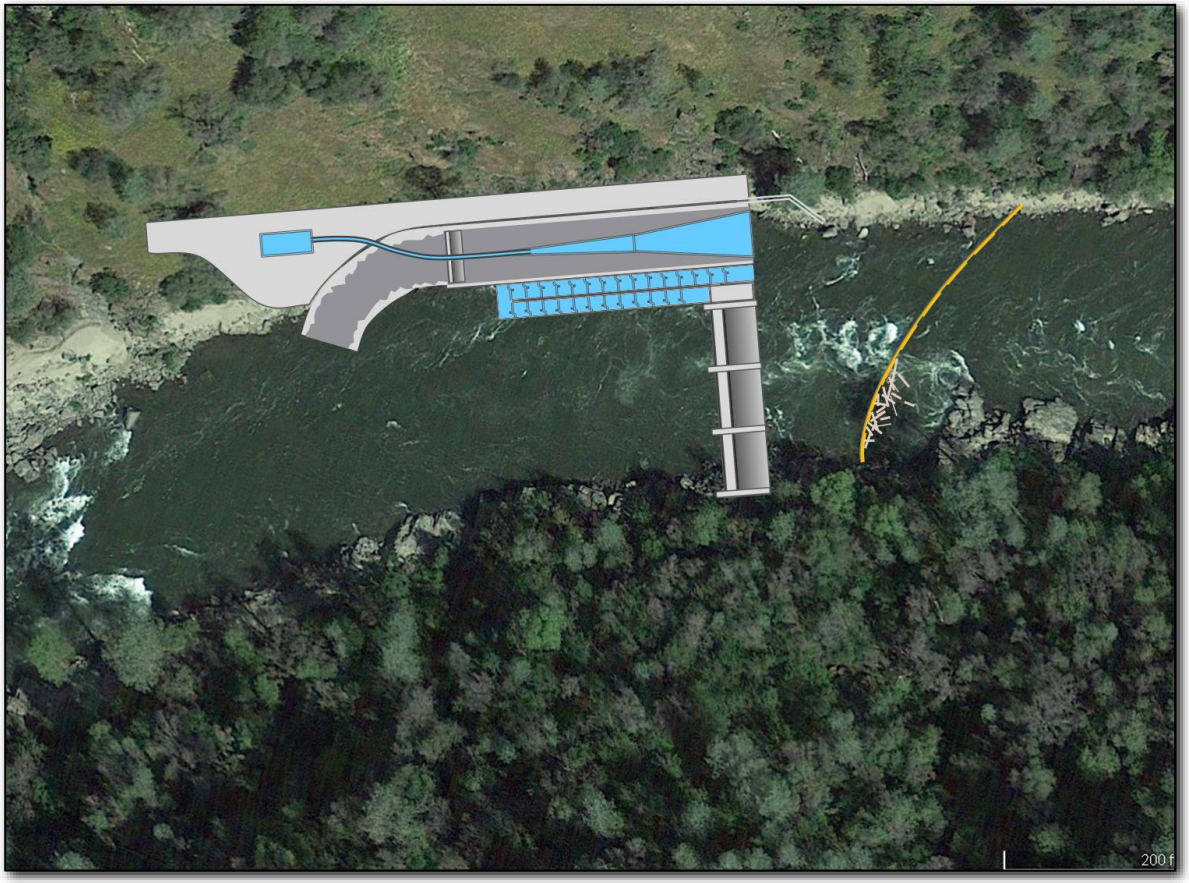
OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES – DOWNSTREAM

- Head of Reservoir Collection



OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES – DOWNSTREAM

- In-River Tributary Collectors



- Components
  - Holding Gallery and Transport Hopper
  - River Return Screens
  - Debris Boom
  - Abutment
  - Obermeyer Weir
  - Fish Screens
  - Fish ladder
  - Fish bypass pipe

OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES – DOWNSTREAM

- Turbine Passage

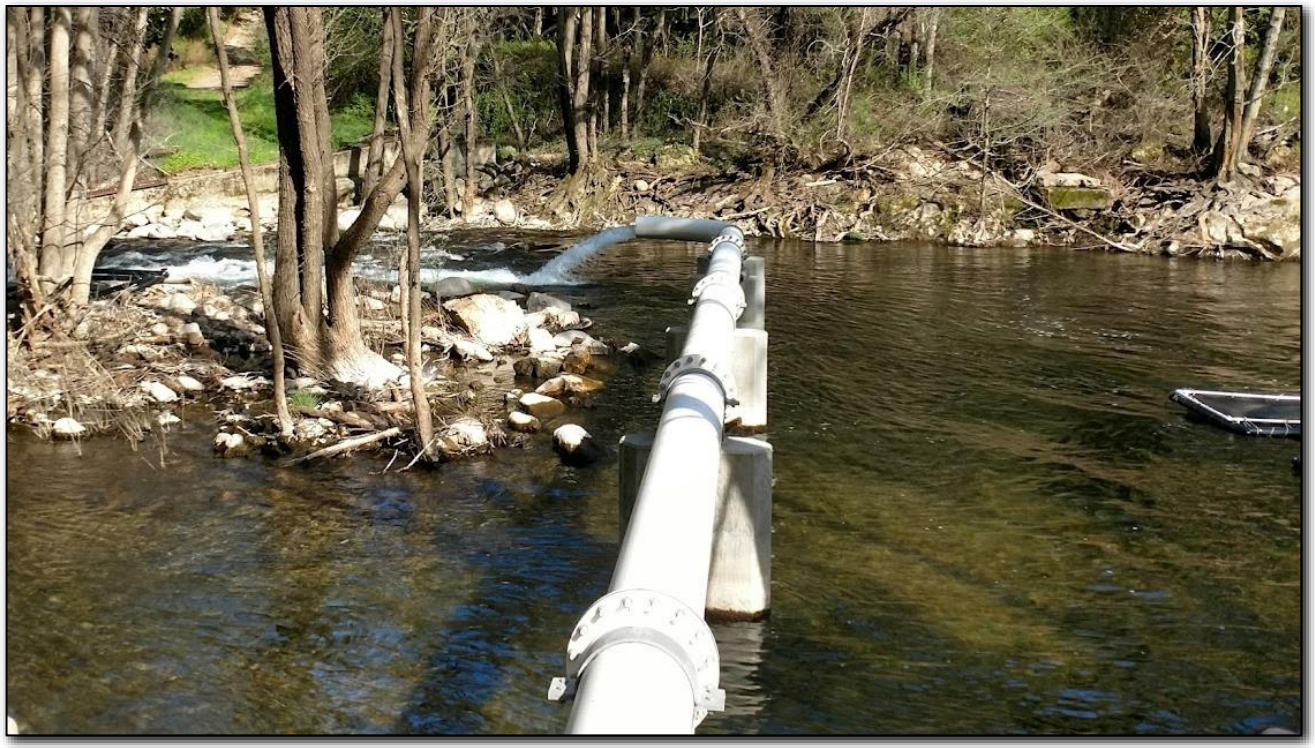
Fish-friendly turbine used on the Ice Harbor Dam in Eastern Washington.

OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES – DOWNSTREAM

- Surface Spill Facilities

OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES – DOWNSTREAM

- Bypass Systems



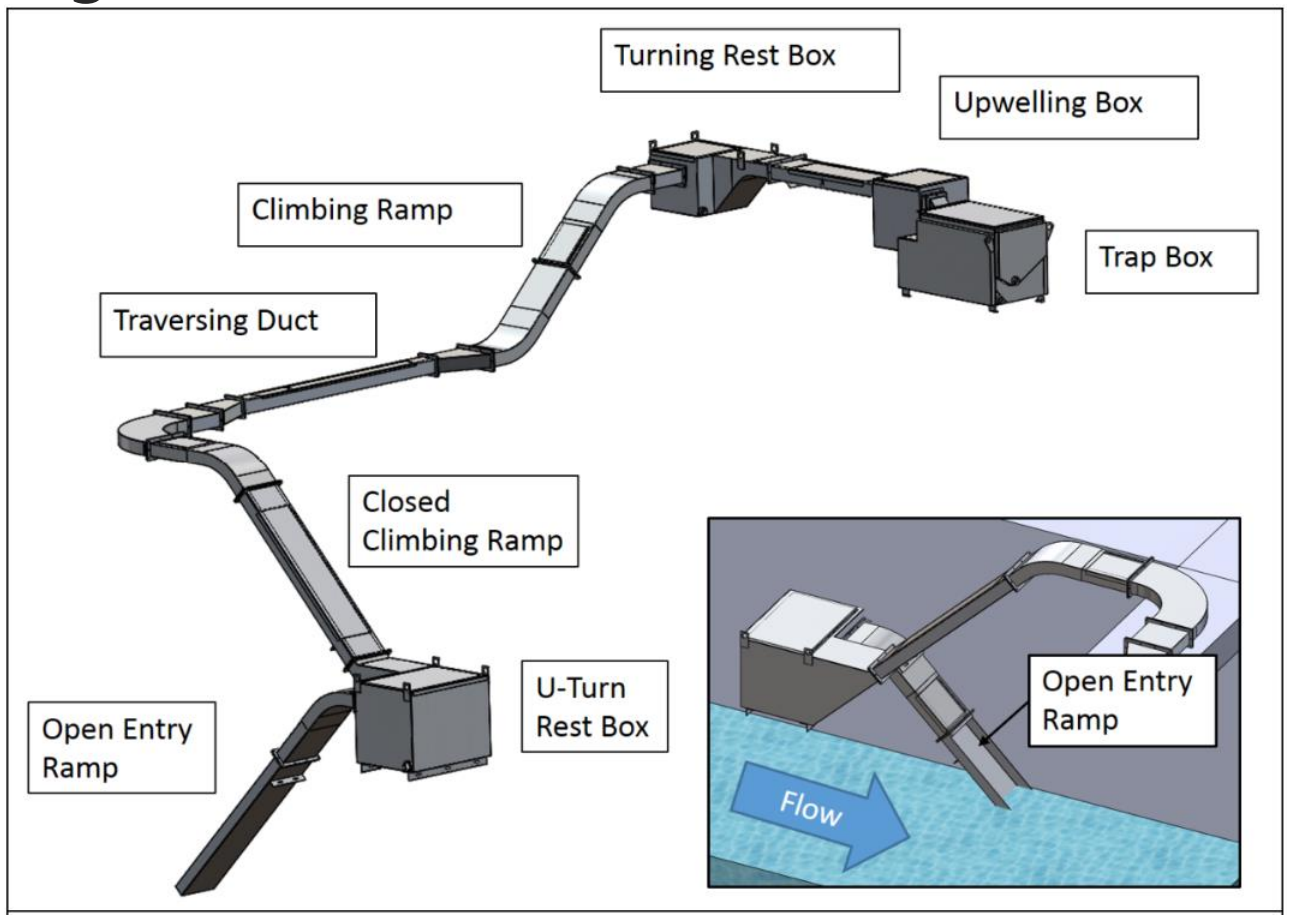
OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES – DOWNSTREAM

- Project Operational Changes – Reservoir drawdown

Ross Lake under winter drawdown conditions

OVERVIEW OF POTENTIAL FISH PASSAGE TECHNOLOGIES

- Lamprey Passage



Zabott et al. 2015. Design Guidelines for Pacific Lamprey Passage Structures.

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BIOLOGICAL PERFORMANCE OF EXISTING FACILITIES AND DEVELOPMENT OF PERFORMANCE CRITERIA

DEVELOPMENT OF PERFORMANCE CRITERIA FOR PROJECT

- Measurable Fish Passage Program Objectives
  - Number transported upstream & downstream at points of collection
- Fish Program Performance Standards – Definition of Success
  - Upstream: Passage efficiency: 75-95%; Survival: 95-98%
  - Downstream: Overall Efficiency = R x C x S
    - Reservoir passage: 75-85%
    - Collection efficiency: 95%
    - Survival: 98-99%
- Standards for experimental populations

BIOLOGICAL PERFORMANCE OF EXISTING PNW FISH PASSAGE FACILITIES

- Upstream Fish Passage Performance

Facility	Species	Collection Efficiency (Percentage)	Survival Percentage
Merwin Dam	Coho	73	99.7
	Spring Chinook	90	94.5
	Winter Steelhead	86-99	99.8

BIOLOGICAL PERFORMANCE OF EXISTING PNW FISH PASSAGE FACILITIES

- Adults Transported Annually

Location	Species Transported	Adults Transported Annually
Baker River (WA)	Sock, Coho	10,000s
Cowlitz River	Sthd, Chin, Coho, Cutthroat	10,000s
Lewis River	Sthd, Chin, Coho, Cutt	10,000s
McKenzie River	Chin, BT, RBT, Cutt	100s
M.F. Willamette River	Chin	1,000s
North Santiam River	Chin	1,000s
S.F. Skykomish River	Sthd, Coho, Sock, Chin, Cutt, Pink, BT	10,000s
Wynoochee River	Sthd, Coho, Chin	1,000s
White River	Chin, Sthd, Coho, Pink BT	100,000s

BIOLOGICAL PERFORMANCE OF EXISTING PNW FISH PASSAGE FACILITIES

Site	Species	Reservoir Passage[1]	Fish Collection Efficiency[2, 3]	Overall Efficiency[4]
Upper Baker Dam	Coho	---	83-99%	---
Upper Baker Dam	Sockeye	---	69-95%	---
Lower Baker Dam	Coho	---	88-96%	---
Lower Baker Dam	Sockeye	---	83-99%	---
Cushman Dam	Coho	20%	33-61%	19-48%
Cushman Dam	Sockeye	43%	39-66%	24-43%
Swift Dam	Coho	62%	39%	20%
Swift Dam	Chinook	58%	44%	17%
Swift Dam	Steelhead	73%	42%	10%
North Fork Dam	Coho	---	94-96%	95%[6]
North Fork Dam	Chinook	---	78-90%	92%
North Fork Dam	Steelhead	---	92-97%	97%
River Mill Dam	Coho	---	99%	---
River Mill Dam	Chinook	---	98%	---
River Mill Dam	Steelhead	---	96%	---
Pelton Round Butte Dam	Chinook	22-29% (Natural)	---	---
Pelton Round Butte Dam	Steelhead	6-20% (Natural)	---	---
Cougar Dam	Chinook	94%	96%	<1%

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ACTION ITEMS AND NEXT STEPS

ACTION ITEMS AND NEXT STEPS

- Review action items
- Next steps
  - Continue gathering and synthesizing data to address remaining data gaps
  - Establish preliminary technical, operational, and biological goals, criteria, and constraints
  - Continue developing Draft Fish Passage Facilities Design Criteria Document

OUR MISSION

Seattle City Light is dedicated to delivering customers affordable, reliable and environmentally responsible electricity services.

OUR VISION

We resolve to provide a positive, fulfilling and engaging experience for our employees. We will expect and reinforce leadership behaviors that contribute to that culture. Our workforce is the foundation upon which we achieve our public service goals and will reflect the diversity of the community we serve.

We strive to improve quality of life by understanding and answering the needs of our customers. We aim to provide more opportunities to those with fewer resources and will protect the well-being and safety of the public.

We aspire to be the nation's greenest utility by fulfilling our mission in an environmentally and socially responsible manner.

OUR VALUES

Safety, Environmental Stewardship, Innovation, Excellence, Customer Care

THE NATION'S GREENEST UTILITY
SINCE 1905
SEATTLE CITY LIGHT

Seattle City Light

Skagit River Hydroelectric Project
Seattle City Light (City Light)
FA-04 Fish Passage Workshop No. 2
September 23, 2021, 12:00pm – 4:00pm

DRAFT Meeting Summary

Disclaimer: These notes serve as a high-level summary of the meeting and as a communication tool for the benefit of committee continuity. They are not intended as a formal record of the meeting.

Attendance

Licensing Participants (LPs):
Alphabetical by last name

Brock Applegate, Washington Department of Fish and Wildlife (WDFW)
Stuart Beck, Swinomish Tribal Community
Blaine Chesterfield, City of Mount Vernon
Steve Copps, National Marine Fisheries Service (NMFS)
Jeff Garnett, United States Fish and Wildlife Services (USFWS)
Rick Hartson, Upper Skagit Indian Tribe USIT (Upper Skagit Indian Tribe)
Damodar Khadka, Ts'elxwéyeqw (Chilliwack) Tribe
Grant Kirby, Sauk-Suiattle Indian Tribe
Keith Kirkendall, NMFS
Jonathan Kohr, WDFW
Brian Lanouette, USIT
Stephen Lewis, NMFS (I'm with USFWS...S. Lewis comment)
Jim Meyers, NMFS
Logan Negherbon, NMFS
Jim Pacheco, Washington Department of Ecology (Ecology)
Duncan Pfeifer, WDFW
Dave Price, NMFS
Ashley Rawhouser, National Park Service (NPS)
Dudley Reiser, Swinomish Tribal Community
Kara Symonds, Skagit County
Erik Young, Skagit Fisheries Enhancement Group (SFEG)

Seattle City Light (City Light):
Andrew Bearlin, City Light
Erin Lowrey, City Light
Chris Townsend, City Light
Matt Love, Cascadia Law Group (Legal Counsel)

Consultant Team:
Jenna Borovansky, Consultant Team
Mike Garello, Consultant Team
Becky Holloway, Consultant Team
Bao Le, Consultant Team
Nicole Loo, Consultant Team
Theo Malone, Consultant Team
Jacob Vernard, Consultant Team
Matt Wiggs, Consultant Team

Facilitation Team:
Betsy Daniels, Facilitation Team
Greer Maier, Facilitation Team
Olivia Smith, Facilitation Team

Meeting Materials

Materials were sent in advance (available upon request):

- FA-04 Fish Passage meeting agenda
- FA-04 Fish Passage presentation
- FA-04 Preliminary Draft Fish Passage Conceptual Design Criteria Document (DCD)

Action Items

Action	Responsibility	Deadline
Licensing Participants (LP) Action Items		
LPs to reach out to Becky Holloway (becky.holloway@hdrinc.com) if interested in joining bi-weekly Agency Work Session (AWGS) meetings. LPs can also review AWS	LPs	Ongoing

meeting materials in the Triangle folder on the project SharePoint site.		
LPs to provide one set of consolidated comments by organization or agency on the Design Criteria Document (DCD) (with an emphasis on high level issues/flags for further discussion). Upload comments to the Triangle SharePoint by Oct. 7. • [*PDF of DCD sent out 9/18; Word version available by request*]. • Email Greer Maier (gmaier@triangleassociates.com) if you are unable to access the SharePoint upload function.	LPs	October 7th
LPs to update the Consultant Team [Becky Holloway - Becky.Holloway@hdrinc.com] if their organization/agency will not be able to meet the Oct. 7th deadline. Please indicate when you expect to have comments complete.	LPs	October 7th
Facilitation Team Action Items		
Discuss future meeting topics listed below with CL and HDR to get necessary workshops/meetings on the calendar.	Triangle	Week of October 4th
Prepare draft meeting summary and send to participating LPs, City Light, and other attendees for review.	Triangle	October 7th
Topics for Future Meetings or Workshops		
Management of the upper basin as a single panmictic population or multiple populations. Note this topic to be discussed at future AWS bi-weekly meetings.		
~~CFD/hydraulics/3D modeling to look at reservoir/forebay flow dynamics in support of design.~~		
Relationship to other studies- Specifically FA-07 (Tributary Habitat Assessment) and FA-03 (Reservoir Fish Stranding and Trapping Risk) among others.		
Downstream adult movement of bull trout and steelhead and implications for design		
Adequacy and appropriate use of fish data in development of goals, objectives, and alternatives.		
Evaluating how other systems responded before and after fish passage (e.g., Elwha).		

Commented [GU1]: This item can be deleted given that it was addressed in the workshop and at the first AWS meeting. CFD modeling and reservoir hydraulics will not be a part of this phase of study. It may be recommended as a course of action should any of the fish passage measures be determined feasible and move forward into further concept development.

Summary of Issues Discussed, Action Items, and Decisions

Welcome, Introductions, Meeting Objectives and Agenda Overview

Greer Maier, Triangle Associates, introduced herself as the new facilitator for the Fish Passage group meeting. Mike Garello, HDR, introduced the City Light and Consultant Team and reviewed the meeting agenda. Mike explained that the purpose of this meeting was to discuss the design basis and criteria needed to begin development of upstream and downstream passage facility alternatives to the concept level and to begin discussing any initial feedback on the first FA-04 Study deliverable: *Preliminary Draft Fish Passage Conceptual Design Criteria*

Document (DCD) (slides 4-5*)*. Mike gave a general overview of the FA-04 Fish Passage Study schedule highlighting where we are in the process and noting which meetings have already occurred, including bi-weekly Agency Working Sessions (AWS) and FA-04 Workshop #1.

Overview of Preliminary DCD

The *Preliminary Draft Fish Passage Conceptual Design Criteria Document (DCD)* was sent a week prior to this meeting on Friday September 17th. Mike Garello, HDR, explained the timeline for finalizing the draft document. After this initial draft and review process there will be a revised draft released in December 2021 and final draft DCD is due January 2022 (slides 7-8).

Next, Mike reviewed the process for developing the fish passage facilitates assessment overall. Workshop #1 was focused on gathering information, and the study is now moving to the defining objectives phase. After that it will move to exploring strategies, formulating alternatives, and evaluating and developing concepts. As part of the feasibility and design process, the FA-04 study team is looking to the ~~Fish Passage Work Group~~LPs that participate in the AWS to establish the initial range of goals, objectives, criteria, and expectations (slides 9-10). Further iterations of the Design Criteria Document outlining the initial goals developed with the AWS will be submitted to the larger group of LPs at the study milestone dates established for the FA-04 study.

The goal of the DCD is to document key factors describing the existing ~~Project~~ operating environment for potential fish passage facilities, formulate a range of potential fish passage goals, objectives, and alternatives, and provide~~as~~ a vehicle to share information with LPs throughout the FA-04 study. Mike also shared the list of objectives for development of the DCD and gave an overview of the content included in the first/preliminary draft (slide 13-14). He walked through in detail each section included in the draft – physical setting, biological setting, technical design criteria and guidelines, design criteria for concept development, performance of PNW fish passage facilities at high head dams, and an overview of potential fish passage strategies and technologies to be used in alternative formulation. Lastly, he shared how this group will provide feedback, comments, and suggestions to be incorporated into the revised DCD.

- In response to a comment about the short time frame to agree on goals and objectives (December-January), Mike explained how feedback is happening in the bi-weekly AWS meetings (USIT, Swinomish, Skagit River System Cooperative) and resource~~Fish A~~ agencies (USFWS, NOAA, NPS, WDFW). Mike added they will hopefully have information to share at the next Fish Passage Workshop ~~Group meeting~~ and will collect any remaining feedback for the next iteration of the DCD. Even if feedback is provided on the final version of the DCD, the study team can incorporate it into the next stage of Fish Passage evaluation in the RSP. They will incorporate data as it becomes available from other studies and adjust as needed.
- In response to a request for clarity on the project boundaries, Mike showed the overview of the Upper Skagit system map (slide 75) and explained how the boundary is shown in the red line and extends from Gorge Dam into the Upper Ross Reservoir and British Columbia. The project area includes the tributaries that feed into the Ross, Diablo and Gorge Lakes. Mike added the FA-07 Trib. Habitat & Food Web study is happening concurrently. Any future tributary habitat sampling in Canada will require collaboration with Canadian entities. ~~to study habitat in Canadian tributaries and the mainstem Skagit into Canada.~~
- There was a question about how FA-07 will address fish passage impediments and tributary barriers at the mouth of Ross Lake based on current project operations. Mike responded that this falls under the Reservoir Work Group and will be considered under evaluation of fish habitat potential.
- A suggestion was made to look at how reservoir bathymetry and changes in reservoir geomorphology limits fish passage in migration corridors.
- Given the discussion a discussion topic related to integrated between FA-07 and FA-04 was noted.
- There was general discussion about how this study and the reservoir studies (FA-03 and FA-07) address habitat in Canada. The consultant group and City Light responded that these studies ~~do~~will address Canadian tributaries and fish habitat to some extent and the future of assessments in these areas will be evaluated after initial data collection.
- In response to a question about Section 5.0 in the DCD, specifically about reservoir operations and stage fluctuation and 3D modeling (CFD) to understand fluid dynamics, Mike responded this is an important topic, but they had not scoped doing CFD ~~from a modeling standpoint~~ modeling within the reservoirs at

this stage of study. He added that concepts are being developed based on existing knowledge of where major outflows/intakes of facilities are. CFD modeling would be a recommended activity if fish passage was identified as technically feasible and moved forward to the next phase of planning and design at some point beyond the conclusion of this study.

- There was a brief discussion about using CE-QUAL W2 modeling as part of FA-01. Andrew Bearlin commented that this ~~level of modeling is not appropriate at this time~~model would not provide similar results on CFD or reservoir hydraulics and would only provide insight on water quality parameters.
- In response to a question about data availability for completion of the DCD, Mike responded this is a common topic in AWS meetings. Some information may not be available for FA-04 until later in 2022, but the Consultant Team is committed to circling back frequently to incorporate available information, evaluate what is still needed, and adjust the DCD.
- In response to a question about downstream adult passage for steelhead kelts and bull trout, Mike responded that downstream adult passage ~~is not currently evaluated but could~~would be included if that ~~is an objective~~is identified as part of the goal and objective setting process.
- There was a brief discussion about periodicity and migration timing. Periodicity results from habitat suitability curve (HSC) meetings will need to feed into this study when they are available (expected November). Mike added this is part of the biological information data needed, and they are currently relying on general Skagit information.
- In response to a question about if there will be characterization of swimming and leaping of different species, Mike responded that that information is related to the second half of the study related to evaluation of potential fish passage in the Gorge Bypass Reach and would be included in that portion of the study documentation.

Action item: LPs to reach out to Becky Holloway (becky.holloway@hdrinc.com) if interested in joining bi-weekly Agency Work Session (AW~~G~~S) meetings. LPs can also review AWS meeting materials in the Triangle folder on the project SharePoint site.

Discuss Data Gaps and Identify Data Sources and Timeline to Receive

Mike Garello, HDR, led a discussion of data gaps and information needs related to development of the DCD. He reviewed the Request for Information (RFI) that was sent out and related Tracking Table for three categories of data: biological factors, operational requirements, and physical characteristics. He then gave an overview of the data collected and information needs (slides 25-26).

- A suggestion was made to contact the regional WDFW office to see if they have additional data related to stock assessment.
- In response to a question about including summer steelhead in the assessment, Mike responded they are using annual data, which are summarized in Section 3 of the DCD, and are focusing on closing data gaps before moving into setting goals and objectives. Mike added once data gaps, goals, and objectives are outlined the discussion will move into bracketing metapopulations and will incorporate data like this from FA-07 as it becomes available.
- In response to a question about incorporating data from FA-07 to inform target size and number of species, Mike responded yes that is their plan and information from FA-07 will help to shape the objectives.
- In response to a question about the source of bull trout abundance data, Erin Lowery responded the bull trout estimate was from February 2008 and is not a population estimate, but wintertime standing stock.

Next, Mike reviewed next steps for DCD development, which will include feedback on the draft preliminary DCD and discussion on a range of different topics to inform future drafts. Comments on the preliminary DCD are due by October 7th (slides 27-28).

Action item: LPs to provide comments by organization or agency on the Design Criteria Document (DCD) (with an emphasis on high level issues/flags for further discussion). Upload comments to the Triangle SharePoint by Oct. 7.

- [*PDF of DCD sent out 9/18; Word version available by request*].
- Email Greer Maier (gmaier@triangleassociates.com) if you are unable to access the SharePoint upload function.

Action item: LPs to update the Consultant Team [Becky Holloway -Becky.Holloway@hdrinc.com] if their organization/agency will not be able to meet the Oct. 7th deadline. Please indicate when you expect to have comments complete.

Jacob Vernard, HDR, went into more detail on what additional data is needed, including estimated adult and juvenile run sizes, and run timing, abundance information (including placeholders for future data to be obtained from other studies), and fish size and condition factors. Jacob went into detail on the type of data that is being used in the assessment and how it informs design criteria (e.g., application of reservoir fluctuation on fish passage facility type, size, and complexity). He presented on upstream and downstream passage efficiency requirements, and other design criteria necessary to assist with the layout and configuration of concept-level alternatives (see slides 40-70).

- In response to a question about how the team is planning to break the data up, i.e., by drainage, Mike shared they are trying to obtain high level production data to help guide how to best break up the data by different areas and basins.
- In response to a question on how the team envisions using existing abundance data below the dams, Mike responded the annual basin-wide information is not very informative and there are a lot of scientists currently working to understand the stock. Mike suggested using an estimate for the range that may occur as a reasonable way to bracket when extrapolation is necessary.
- In response to a question about how information on fish response to fish passage from other systems could be used, Mike replied that that could be incorporated.
- In response to a question about looking at production potential in the Upper Basin, Jacob Vernard reiterated that data from FA-07 will be key to answering this question when it is available.
- A suggestion was made to look at the data on Bull Trout and Summer Steelhead in the Elwha River.

Review and Assemble Potential Range of Fish Passage Strategies and Technologies that May be Considered for Evaluation

Mike Garello, HDR, gave an overview of potential fish passage strategies and technologies, and how they will be combined at a later stage of the study to formulate concept alternatives based upon biological goals and objectives.

Mike went into detail on several potential fish passage strategies and discussed how they will be refined further through future goal setting discussions. In the last phase of the study they will take the selected alternatives and develop basic illustrations and drawings, map out the costs, outline lifecycles, and plan implementation strategies (slides 73-83).

- An LP posed the question whether one wants to manage the Upper Basin as a single panmictic population or multiple populations, several members of the consultant team agreed this will need to be addressed and inform goal setting. This discussion topic was added to the discussion tracking document.

Mike then gave a broad overview on several types of fish passage technologies - including both directive (requires a high level of human intervention like trap and transport) and non-directive technologies (fish my volitionally pass without human intervention like fish ladders or nature-like fishways) (slides 85-106).

- In response to a question about the vertical heigh of the "Whooshh" system being used in the Big Bar slide area of British Columbia, Canada, Mike shared that particular system was designed for ~30 feet, about 9 vertical meters, and the actual transport length was over 1,100 ft.

Existing Biological Performance Information at PNW Fish Passage Facilities and Discussion on the Development of Performance Criteria for Project

The last part of the meeting was dedicated to a review of the biological performance of existing facilities and a brief discussion of how this informs the development of potential performance criteria for the Skagit. Mike Garello, HDR, shared how performance criteria can be developed from measurable fish passage program objectives, fish program performance standards, and standards for experimental populations. He showed the types and range of existing data on biological performance indicators (e.g. adults transported, upstream and downstream passage survival, and collection efficiency) from different facilities (slides 109-111).

Action Items, Next Steps

After comments are received on the preliminary DCD document the Consultant Team will evaluate the need for a meeting on October 28th to discuss comments received. ~~C~~High-level comments will also be discussed at the bi-weekly AWS meetings. The November meeting may be cancelled, and the December meeting will need to shift.

***Action Item*:** Triangle to discuss future meeting topics listed below with CL and HDR to get necessary workshops/meetings on the calendar.
***Action Item*:** Triangle to prepare draft meeting summary and send to participating LPs, City Light, and other attendees for review.

FISH PASSAGE TECHNICAL STUDIES INTERIM REPORT

ATTACHMENT C

FA-04 FISH PASSAGE STUDY WORKSHOP NO. 3 MEETING MATERIALS

Seattle City Light

MEETING AGENDA

Skagit Hydroelectric Project Relicensing Meeting

FA-04 Fish Passage Workshop No. 3

December 16, 2021: 12:30pm – 4:30pm

WebEx Meeting: [LINK]

Conference Call: +1-510-338-9438 USA Toll

Meeting ID/Access Code: 2554 114 4299

Password: 3C9Mw3HxhaF (32969349 from phones and video systems)

MEETING PURPOSE

The intent of this workshop is to develop the list of potential fish passage alternatives that will be carried forward into the next stage of the Fish Passage Facilities Alternatives Assessment, as defined in the Revised Study Plan for FA-04. The next stage of the assessment includes the development of concept designs and cost estimates for each alternative. Specific objectives include:

- Inform LPs regarding the status of the *Fish Passage Assessment of Existing Features in the Bypass Reach* study and report
- Inform LPs about how comments on the Preliminary Draft Design Criteria Document (DCD) were responded to and incorporated into the Revised Draft DCD
- Inform LPs regarding development of passage alternative options for each development as discussed during Agency Work Sessions (AWS)
- Discuss factors influencing fish passage facility technical feasibility
- Request concurrence on which fish passage alternatives will be carried forward into the Concept Development Report (Stage 2 of the Fish Passage Facilities Alternatives Assessment)

MEETING RESOURCES

- NOA Commitments
- Agency Work Session Meeting Notes
- Fish Passage Work Group Discussion Tracker

AGENDA

12:30 – 12:40 pm (10 min)	**Introductions** – *Greer Maier, Facilitator, Triangle Associates* • Roll call introduction • Review meeting context and previous summary and action items
12:40 – 12:45 pm (5 min)	**Meeting Objectives and Agenda Overview** – *Becky Holloway (HDR)* ***(I)*** • Review meeting agenda and discussion topics.
12:45 – 12:55 pm (10 min)	**Fish Passage Assessment of Existing Features in the Bypass Reach** – *Mike Garello (HDR), presenter* ***(I)*** • Discuss the status of the *Fish Passage Assessment of Existing Features in the Bypass Reach* study and report

12:55 – 1:25 pm (30 min)	**Overview of Revised Draft DCD –** *Becky Holloway, presenter/Mike Garello (HDR), technical support* ***(I)*** • Provide overview of changes incorporated into the Revised Draft Design Criteria Document (DCD) based on LP comments on the Preliminary Draft DCD • Discuss Comment Matrix
1:25 – 2:10pm (45 min)	**Development of Fish Passage Options –** *Theo Malone, presenter; Mike Garello, Technical Support* ***(I and A)*** • Provide summary of brainstorming process conducted at AWS meetings • Overview and discussion of potential options and suitability of fish passage technologies at each development
2:10 – 2:20pm (10 min)	**Break**
2:20 – 2:55pm (35 min)	**Discuss Factors Influencing Fish Passage Facility Technical Feasibility –** *Mike Garello, HDR* ***(I)*** • Discussion of feasibility for passage options • Overview of factors to be considered: o Factor 1 – Ability to Meet Engineering, Constructability, and Operational Constraints o Factor 2 – Ability to Operate in conjunction with Existing Uses o Factor 3 – Ability to Meet typical Criteria for Fish Passage Performance Standards o Factor 4 – Ability to retain flexibility to incorporate future biological and management strategies to be established by resource agencies and co-managers
2:55 – 4:25 pm (90 min)	**Proposed List of Alternatives for Further Evaluation –** *Mike Garello (HDR), presenter and technical lead* ***(I and C)*** • Consider brainstorming options and factors influencing passage feasibility • Discuss proposed list of concept fish passage alternatives to advance to next stage of study
4:25 – 4:30 pm (5 min)	**Action Items, Next Steps** – *Facilitator and meeting participants* • Review action items • Next meeting date & future topics
4:30pm (End time)	**Meeting Adjourned**

Agenda Topic Goals: I=Information, A=Advise, C=Concurrence

FA-04 FISH PASSAGE TECHNICAL STUDIES

Workshop 3

December 16, 2021

INTRODUCTIONS

- Roll Call
- Introductions

Seattle City Light

OBJECTIVES AND SCHEDULE/AGENDA OVERVIEW

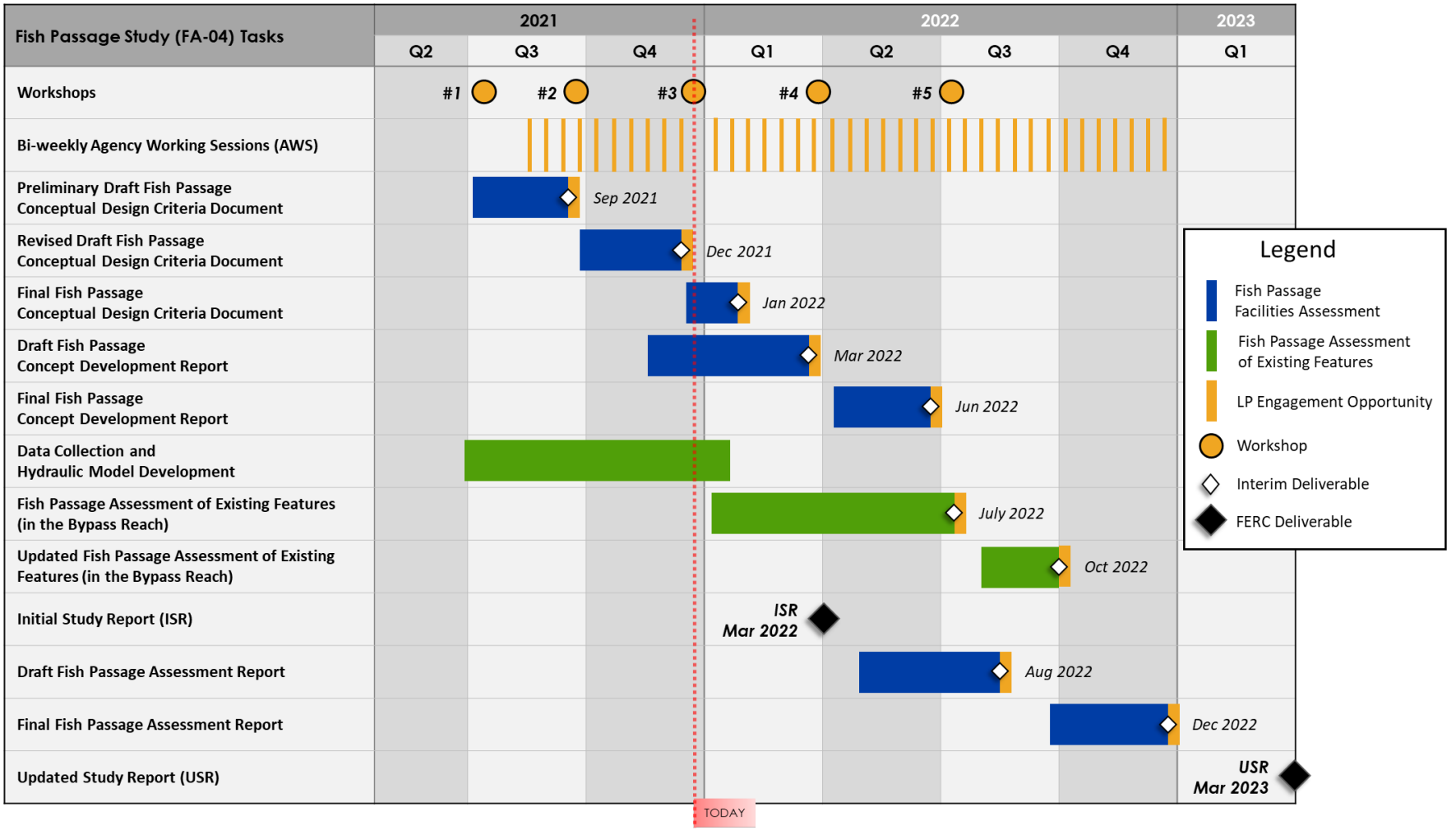
MEETING AGENDA

Schedule	Topic
12:30 – 12:40	Introductions
12:40 – 12:45	Meeting Objectives and Schedule/Agenda Overview
12:45 – 12:55	Fish Passage Assessment of Existing Features in the Bypass Reach
12:55 – 1:25	Overview of Revised Draft DCD
1:25 – 2:10	Development of Fish Passage Options
2:10 – 2:20	Break
2:20 – 2:55	Discuss Factors Influencing Fish Passage Facility Technical Feasibility
2:55 – 4:25	Proposed List of Alternatives for Further Evaluation
4:25 – 4:30	Action Items and Next Steps
4:30	Meeting Adjourned

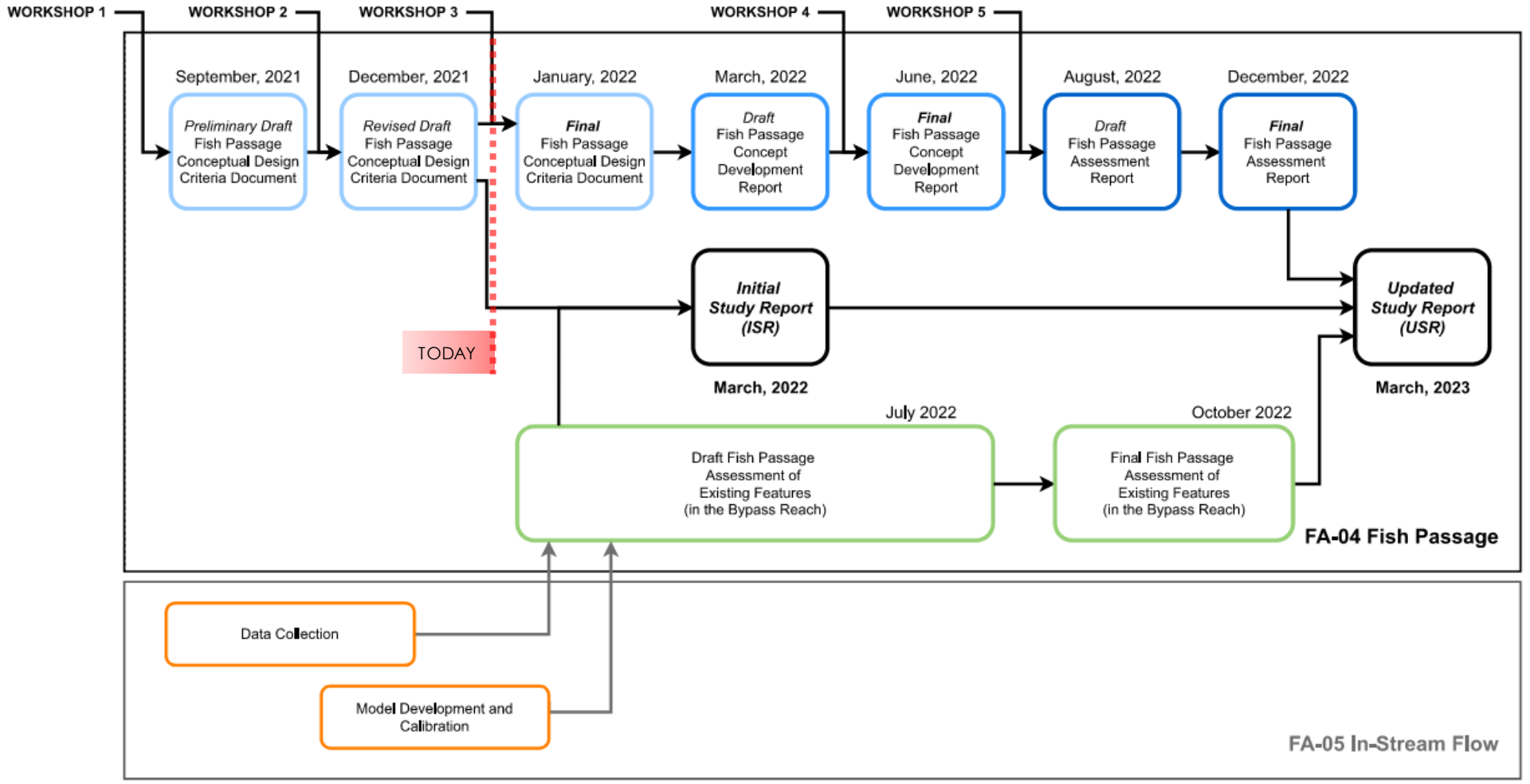
Seattle City Light

WORKSHOP OBJECTIVES AND OVERVIEW

SCHEDULE OVERVIEW



FISH PASSAGE STUDY – PROCESS FLOWCHART



KEY MEETING OBJECTIVE

- Determine the list of potential fish passage options that will be carried forward into the next stage of the Fish Passage Facilities Alternatives Assessment
  - Workshop discussions will inform development of Final DCD
  - Final DCD will inform the next stage of the assessment, which includes the development of concept designs and cost estimates for each passage option

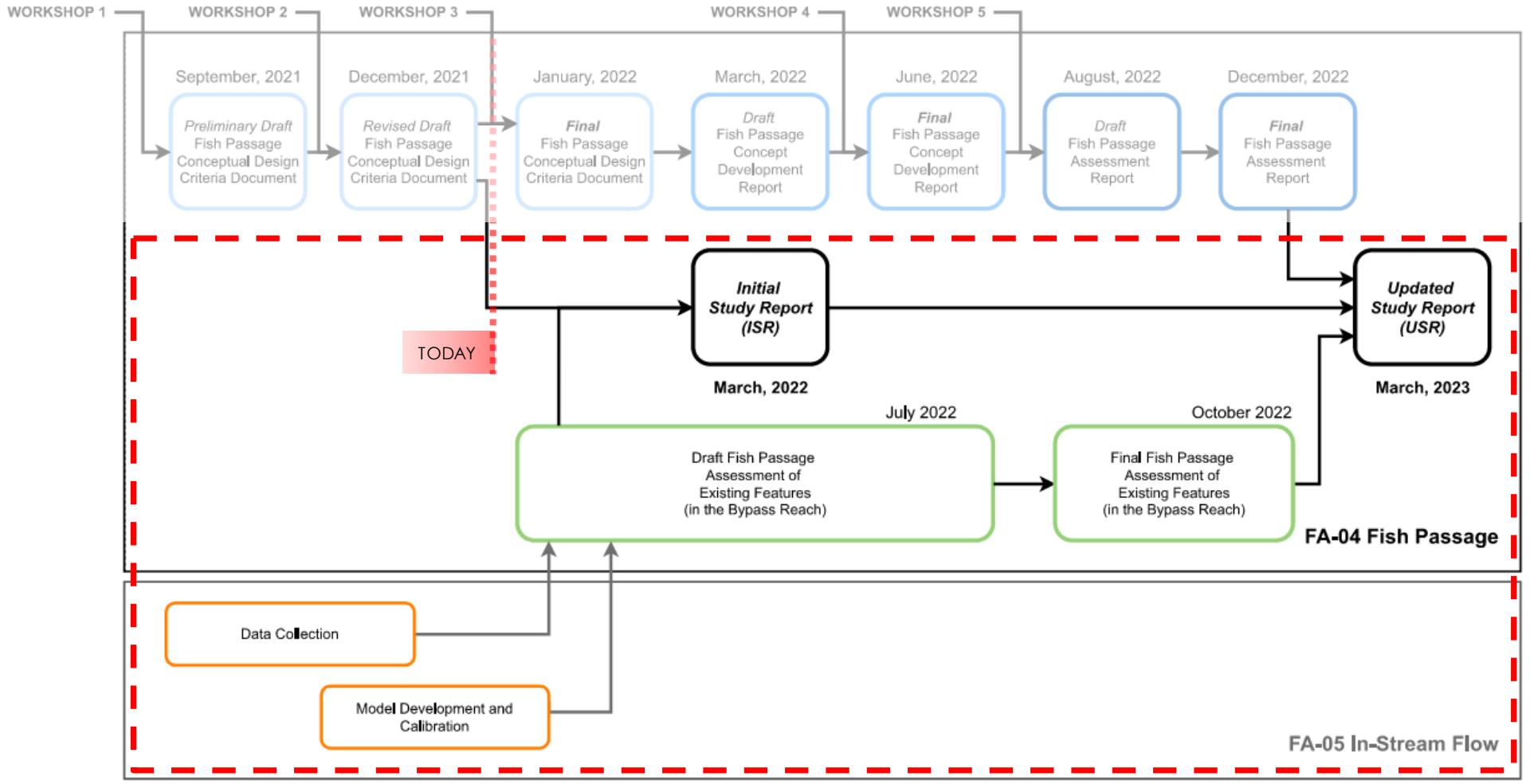
MEETING OBJECTIVES

- Inform LPs regarding the status of the *Fish Passage Assessment of Existing Features in the Bypass Reach* study and report
- Inform LPs about how comments on the Preliminary Draft Design Criteria Document (DCD) were responded to and incorporated into the Revised Draft
- Inform LPs regarding development of passage options for each development as discussed during Agency Work Sessions (AWS)
- Discuss factors influencing fish passage facility technical feasibility
- Request concurrence on which fish passage alternatives will be carried forward into the Concept Development Report (Stage 2 of the Fish Passage Facilities Alternatives Assessment)

Seattle City Light

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH

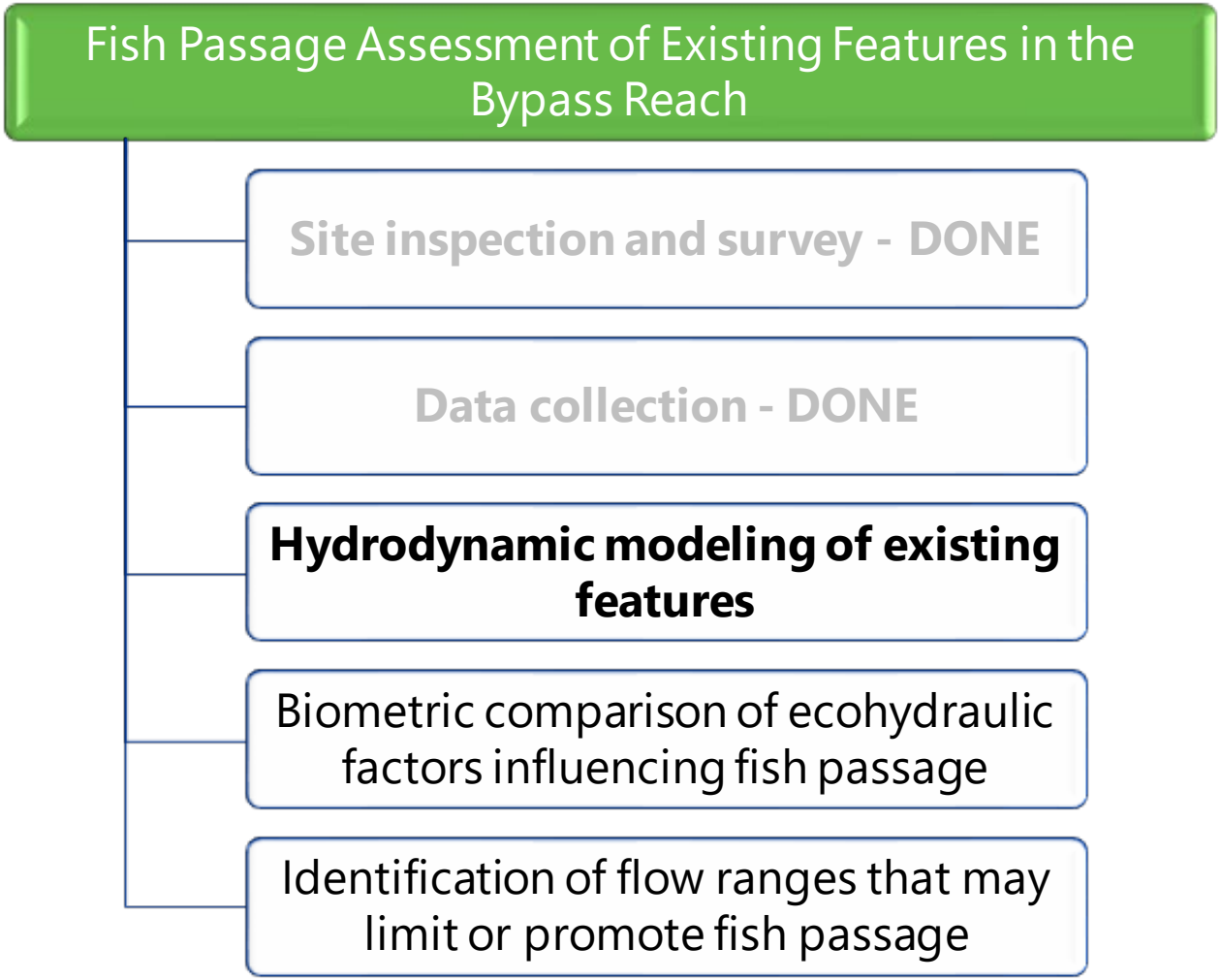
FISH PASSAGE STUDY – PROCESS FLOWCHART



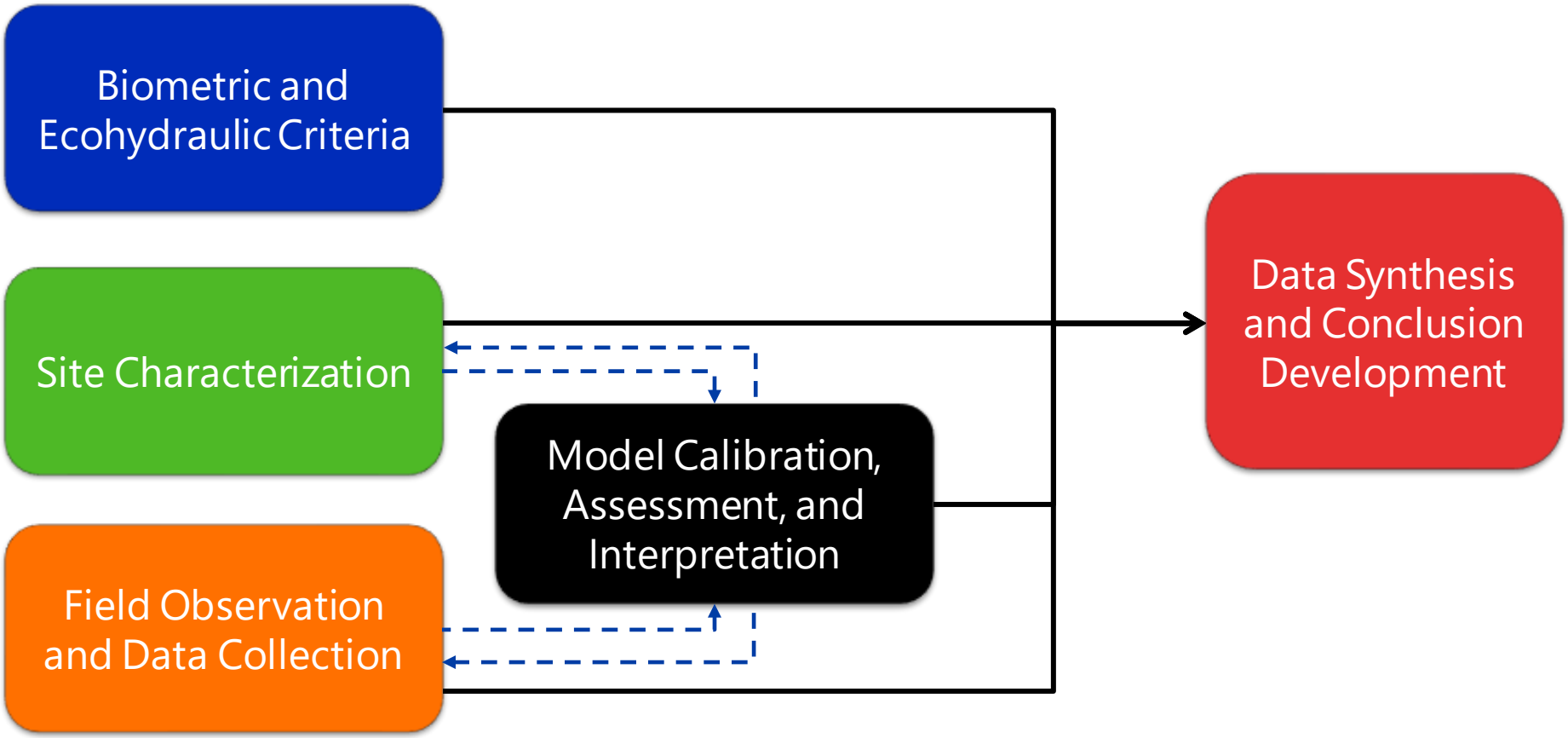
FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH – OBJECTIVES & OUTCOMES

- Objectives
  - Characterize and document the physical structure and hydraulic conditions of the existing features throughout a range of observed and/or modeled flows.
  - Identify ranges of hydraulic conditions where target fish species may ascend the Bypass Reach

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH – OBJECTIVES & OUTCOMES



FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH – PROCESS OVERVIEW

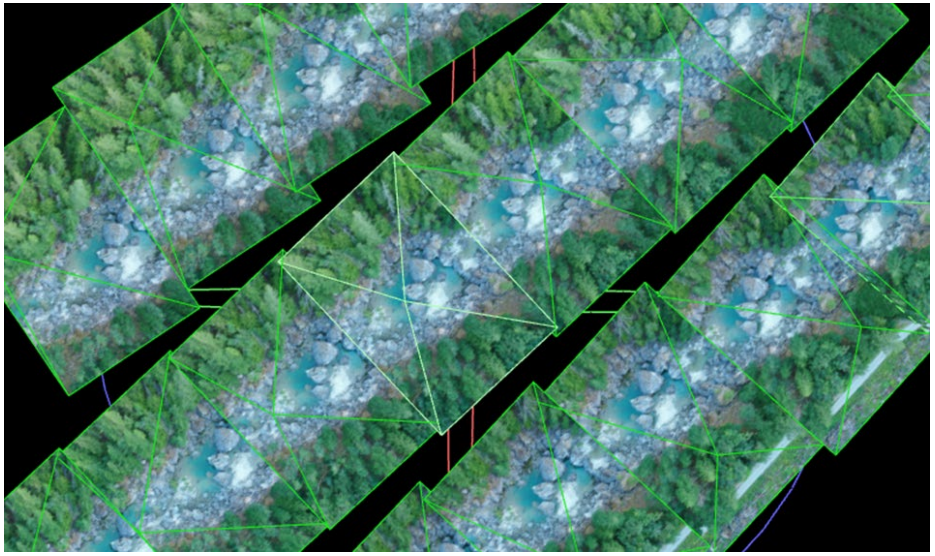


FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH – FA-05 FIELD WORK

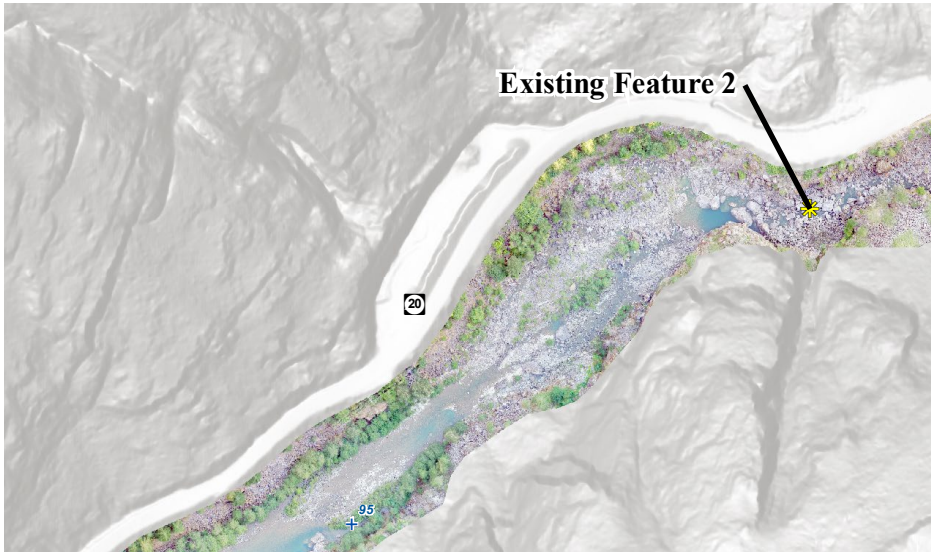
- Data Collection
  - UAV Imagery
  - Large Scale Particle Image Velocimetry (LSPIV)
  - Time Lapse Photography
  - Water Level Monitoring – Level Logger Deployment
- Controlled/Planned release events
  - 50 cfs
  - 250 cfs
  - 500 cfs
  - 1,200 cfs

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH – UAV IMAGERY

- UAV Imagery



Overlapping nadir photographs of Existing Feature 1



Composite orthomosaic image from July 30, UAV flight

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH – LSPIV STUDY

- LSPIV
  - Bark Chips
  - Buoyant
  - Good Contrast to Whitewater

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH – TIME-LAPSE PHOTOS

Baseflow (July 30)

Existing Feature 1 - Downstream

Existing Feature 2 - Upstream

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH – TIME-LAPSE PHOTOS

~60 cfs (July 29)

Existing Feature 1 - Downstream

Existing Feature 2 - Upstream

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH – TIME-LAPSE PHOTOS

~300 cfs (July 28)

Existing Feature 1 - Downstream

Existing Feature 2 - Upstream

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH – TIME-LAPSE PHOTOS

~500 cfs (July 27)

Existing Feature 1 - Downstream

Existing Feature 2 - Upstream

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH – TIME-LAPSE PHOTOS

~1,100 cfs (July 26)

Existing Feature 1 - Downstream

Existing Feature 2 - Upstream

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH – TIME-LAPSE PHOTOS

~2,200 cfs (June 28)

Existing Feature 1 - Downstream

Existing Feature 2 - Upstream

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH – TIME-LAPSE PHOTOS

~5,400 cfs (June 30)

Existing Feature 1 - Downstream
[overtopped and knocked off alignment]

Existing Feature 2 - Upstream

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH – TIME-LAPSE PHOTOS

~12,000cfs (November 14)

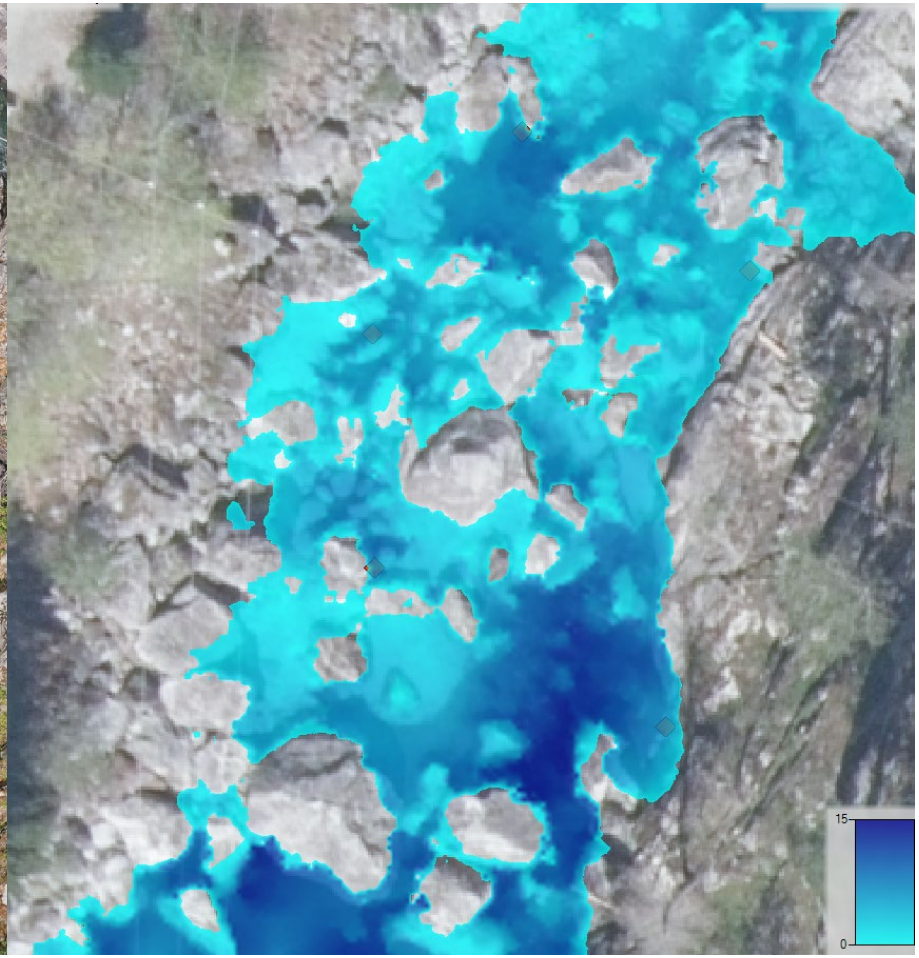
Existing Feature 1 - Downstream
[overtopped and mount destroyed]

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH – TIME-LAPSE PHOTOS

~24,000cfs (November 16)

Baseflow (for Context)

FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH – FA-05 MODELING



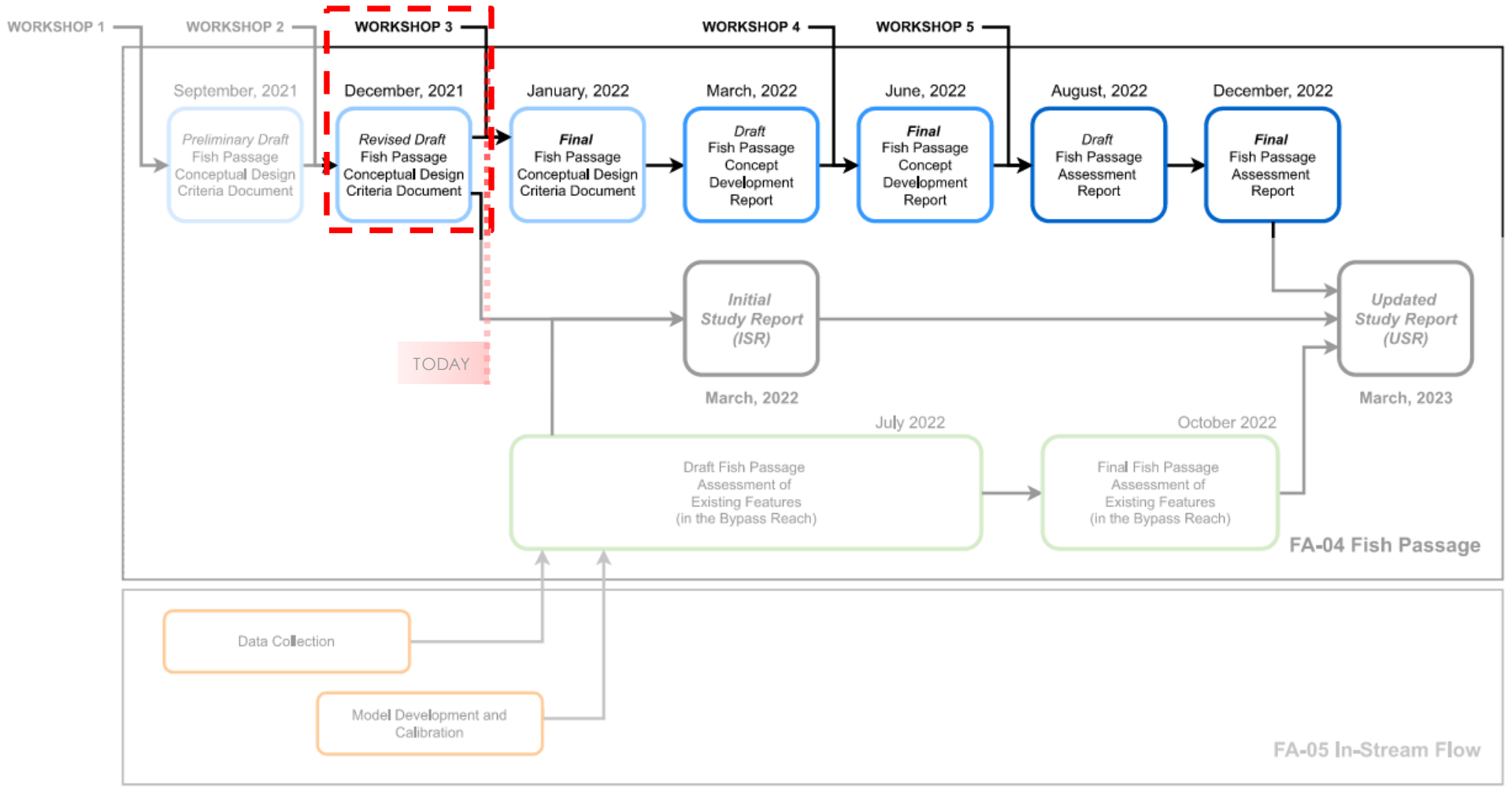
FISH PASSAGE ASSESSMENT OF EXISTING FEATURES IN THE BYPASS REACH – NEXT STEPS

- Using physical data, operational data, observations, and hydraulic model to assess fish passage potential for target species over range of flows in bypass reach
- Passage potential evaluated for each target species based on swim and endurance data for species and surrogates
- Identify ranges of flows that appear to provide opportunities for passage
- Draft Assessment Report – July 1, 2022

Seattle City Light

OVERVIEW OF REVISED DRAFT DCD

FISH PASSAGE STUDY – PROCESS FLOWCHART



FISH PASSAGE FACILITIES ALTERNATIVES ASSESSMENT – CONCEPTUAL DESIGN CRITERIA DOCUMENT

Conceptual Design Criteria Document
Preliminary Draft (9/17/2021)**, Revised Draft** (12/9/2021)**, Final** (1/30/2022)

- Photos, Maps, and Drawings of Existing Facilities
- Physical, Biological, and Operational data and information that inform the development of fish passage alternative concepts
- Conceptual Design Criteria
- Biological and Technical Performance Goals and Objectives
- Performance of PNW passage facilities at high-head dams
- **List of conceptual alternatives to be evaluated**

COMMENTS ON PRELIMINARY DRAFT DCD

- Preliminary Draft DCD issued to LPs September 17, 2021
- Comments received to date:
  - NMFS – October 14
  - USFWS – October 21
  - Upper Skagit Indian Tribe – October 29
  - Swinomish Tribe – November 5

COMMENTS ON PRELIMINARY DRAFT DCD

- Comments discussed at high level during bi-weekly AWS meetings
- Specific responses to comments are provided in comment response matrix, and, as applicable, responses have been incorporated into the text of the Revised Draft DCD

COMMENTS ON PRELIMINARY DRAFT DCD

- Common Theme of Comments (e.g., NMFS):
  - *This study is a technical feasibility assessment to identify and provide cost opinions for passage solutions at the Skagit River Hydroelectric Project. This is not intended to provide a recommended passage solution, but all solutions deemed technically feasible. Formulation of fish passage strategies first presupposes varied value of access to each reservoir in the system. Value of access is currently being determined through various other studies. Strategies may be assembled based on the technically feasible passage methodology/technology but will not be considered prior to exploration of passage facility assessments.*
  - City Light concurs and reiterates that the study focuses on technical feasibility of passage only.
  - **Biological and fish management goals to be developed by agencies and co-managers in future.**

COMMENTS ON PRELIMINARY DRAFT DCD

- Comment Response Matrix – Status of Comments

	Comment Status Codes
A	- Resolved
B	- Resolution pending
C	- Unresolved
D	- Rolled over to next submittal

- Majority of comments assigned an "A" status; however, some were deferred and will be addressed in the Final DCD, or in subsequent deliverables under the Fish Passage Study
- NOTE - Block at end of agenda topic for comment response discussion

COMMENTS ON PRELIMINARY DRAFT DCD

- Examples of comments deferred to future submittals:
  - Detailed metrics for physical setting (e.g., thermocline and reservoir flux) and influence on passage technologies, options, and efficiencies – tbd in next stage of study
  - Fish periodicity finalization
  - Incorporation of information from other studies (e.g., carrying capacity estimates from FA-07, tributary characteristics)

SUBSTANTIVE CHANGES FROM PRELIMINARY DRAFT TO REVISED DRAFT DCD

- Section 1: Introduction
  - Added summary of LP study coordination to date
- Section 2: Physical Setting
  - Provided profile schematics for each development
  - Provided more information on intake and spillways for each dam
  - Provided more information for Gorge bypass reach
- Section 3: Biological Setting
  - Updated target species periodicity table

SUBSTANTIVE CHANGES FROM PRELIMINARY DRAFT TO REVISED DRAFT DCD

- Section 5: Project-Specific Factors Influencing Fish Passage Facility Alternative Formulation
  - Reiterated that study will not develop biological goals and objectives or define passage strategies
  - Provided discussion on multi-dam passage performance and effects on survival
  - Provided information on reservoir ops and fluctuation for each development, with stage duration curves
  - Discussed reservoir transit considerations
  - Discussed intake and forebay configuration and associated entrainment potential

SUBSTANTIVE CHANGES FROM PRELIMINARY DRAFT TO REVISED DRAFT DCD

- Section 7: Overview of Potential Fish Passage Strategies and Technologies to be Used in Alternative Formulation
  - Provided additional information on lamprey passage technologies
  - Included information on floating screen structures
  - Added section on "Suitability of Fish Passage Technologies" for specific strategies or future management needs (e.g., volitional passage)
- Section 8: Potential Fish Passage Facility Options
  - New section summarizing passage options discussed for each dam during AWS meetings

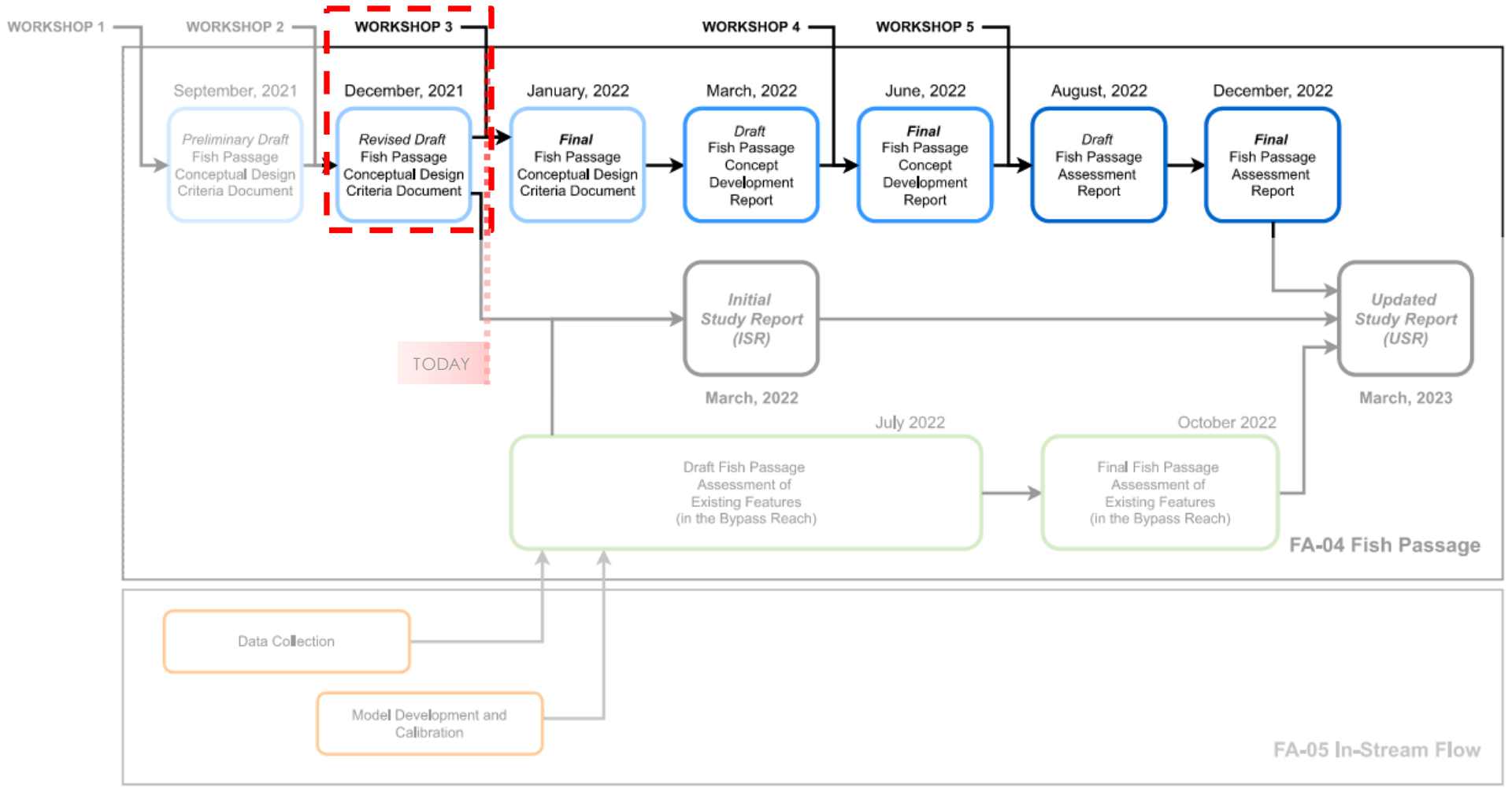
DISCUSSION ON COMMENT RESPONSE MATRIX

- Discussion and questions?

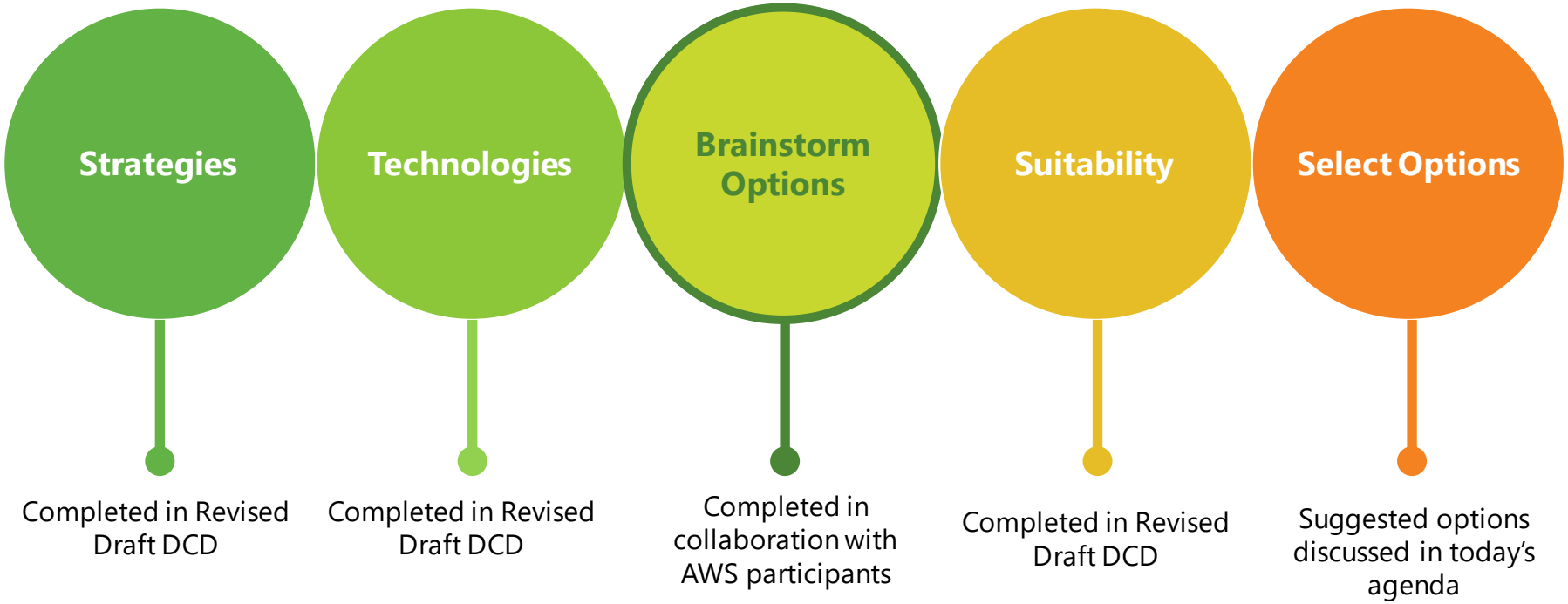
Seattle City Light

DEVELOPMENT OF FISH PASSAGE OPTIONS

FISH PASSAGE STUDY – PROCESS FLOWCHART



FISH PASSAGE OPTION DEVELOPMENT



FISH PASSAGE OPTION DEVELOPMENT – FISH PASSAGE GOALS AND OBJECTIVES

- Workshop No. 2 Discussed Goal-Setting Process to Inform Fish Passage Options
- Brainstorming Process on Goals Initiated in AWS Meeting No. 6, however:
  - AWS members expressed concerns with participating in the biological goal setting exercise—stated that comanagers in the basin need to have policy-level discussions before developing goals. Thus, goal setting should not occur as part of FA-04, but rather will be informed by concurrent studies and agency/tribal discussions in the future.

AWS BRAINSTORMING – FISH PASSAGE OPTIONS AT EACH DEVELOPMENT

- Brainstorming process pivoted focus from biological goals/objectives to suite of fish passage options
  - Consensus was that AWS group discussions should focus on the technical feasibility of fish passage and that the study outcome is "is fish passage feasible and by what methods"
- Three AWS Meetings
  - Nov 1 AWS – Gorge Development Brainstorming
  - Nov 15 AWS – Diablo Development Brainstorming
  - Nov 29 AWS – Ross Development Brainstorming

AWS BRAINSTORMING – FISH PASSAGE OPTIONS AT EACH DEVELOPMENT

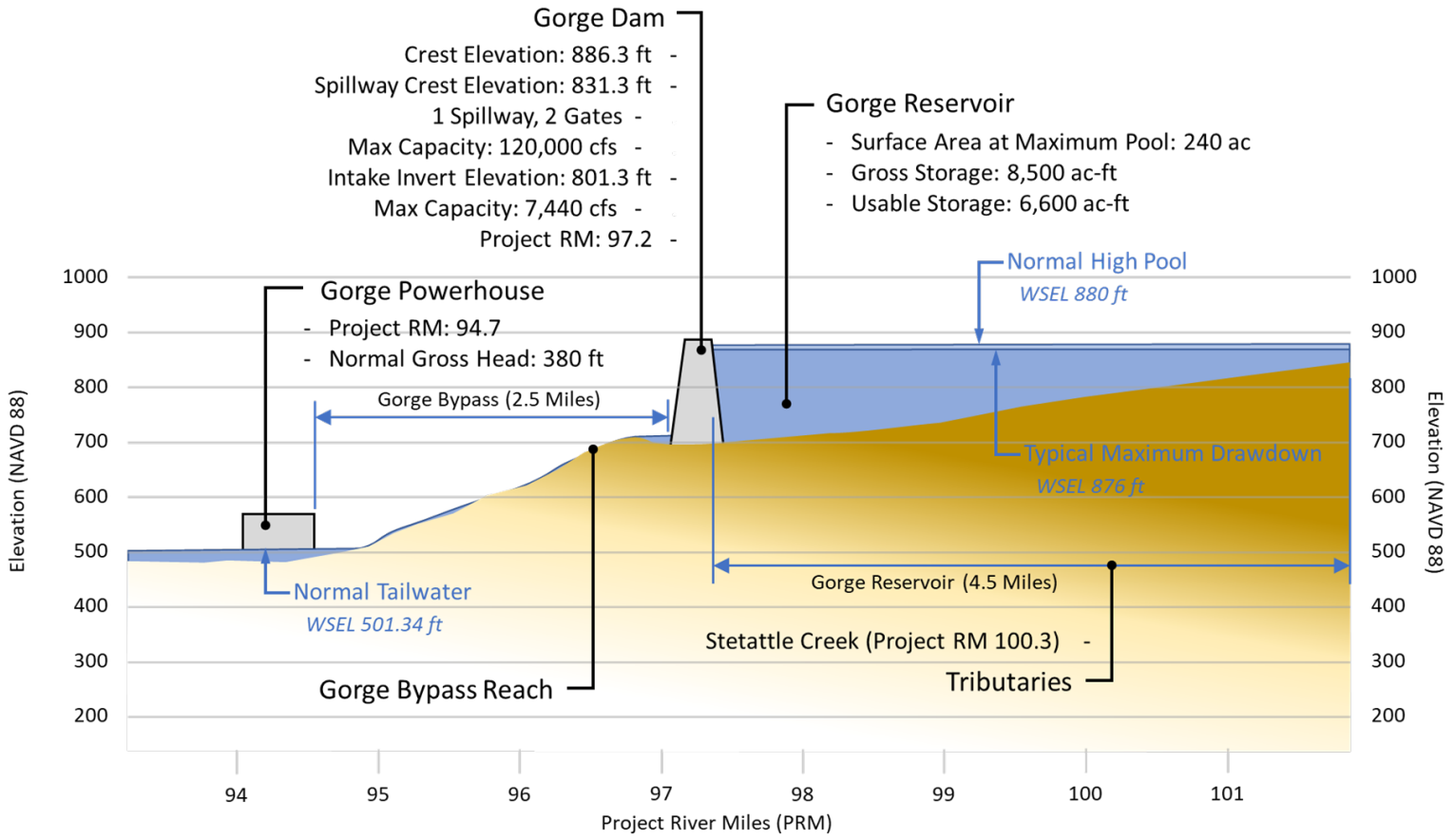
1. Review existing conditions and site-specific factors that influence the type, size, complexity, and location of potential fish passage facilities.
2. Summarize example strategies and technologies that could be considered as potential fish passage options
3. Facilitate brainstorming session and discussion of potential fish passage options using the interactive Mural platform.

Brainstorming topics included:

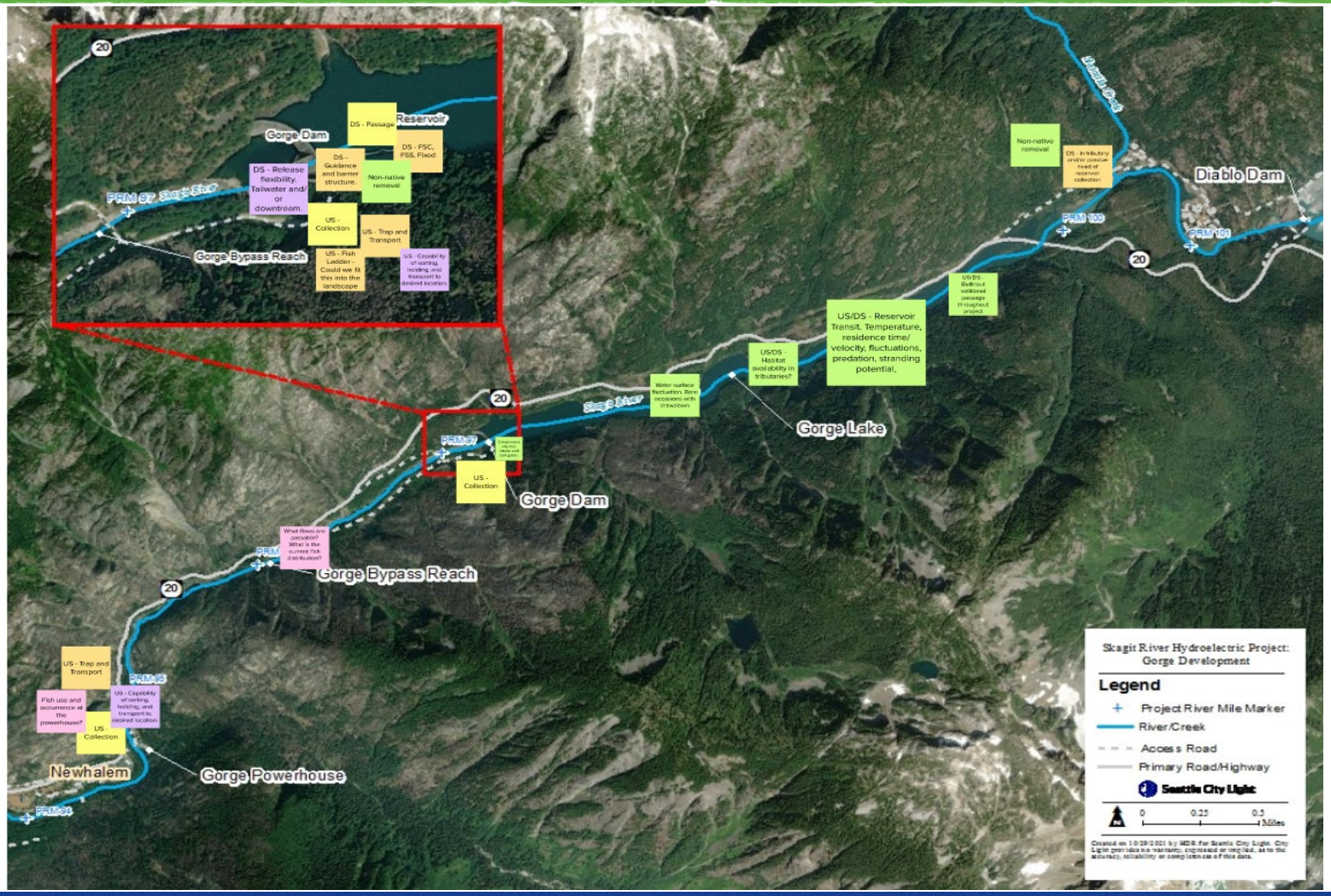
- Fish Collection/Entrance Locations (upstream/downstream)
- Fish Release/Exit Locations (upstream/downstream)
- Key Considerations (upstream/downstream)
- Risks or Concerns (upstream/downstream)
- Potential Technologies (upstream/downstream)
- Data Gaps
- Other

AWS BRAINSTORMING – MURAL PROCESS

AWS BRAINSTORMING – GORGE DEVELOPMENT



AWS BRAINSTORMING – GORGE DEVELOPMENT



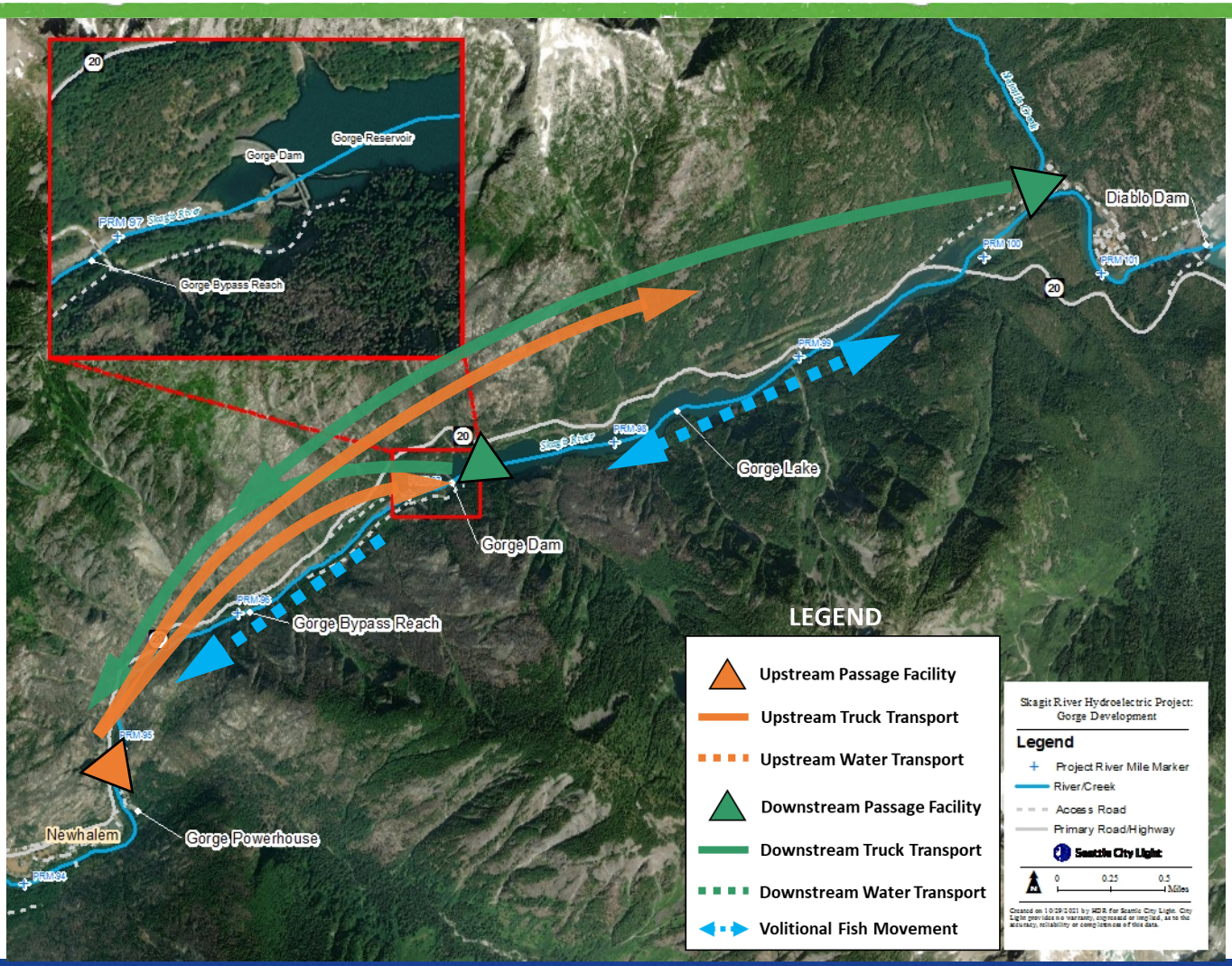
AWS BRAINSTORMING – GORGE DEVELOPMENT

Sticky Color	Brainstorming Topic	Comment
Green	Key Considerations	A key consideration for passage at Gorge Dam is the risk of entrainment into the intake and spill gates.
Green	Key Considerations	A key consideration for passage within Gorge Reservoir is non-native species removal.
Green	Key Considerations	A key consideration for passage at Gorge Dam is non-native species removal.
Green	Key Considerations	A key consideration for upstream and downstream passage throughout the project is Bull trout volitional passage.
Green	Key Considerations	A key consideration for upstream and downstream passage is the estimation of habitat availability in tributaries.
Green	Key Considerations	Key considerations for upstream and downstream passage within the reservoir transit strategy are water temperature, residence time/velocity, water surface fluctuations, predation, and stranding potential.
Green	Key Considerations	A key consideration for fish passage is the water surface fluctuation within Gorge Reservoir with rare occasions of drawdown (for maintenance).
Orange	Potential Technologies	Potential downstream passage technologies at the Gorge Dam include Floating Surface Collector, Floating Screen Structure, and a Fixed Collector.
Orange	Potential Technologies	Potential downstream passage technologies at the Gorge Dam include guidance and barrier structures.
Orange	Potential Technologies	Potential downstream passage technologies in the Gorge Reservoir include in-tributary and/or passive head of reservoir collection at Stetattle Creek.
Orange	Potential Technologies	A potential upstream passage technology at the Gorge Dam is a Technical Fish Ladder. Fitting this into the landscape is a consideration for use of this technology.
Orange	Potential Technologies	A potential upstream passage technology at the Gorge Dam is Trap and Transport.
Orange	Potential Technologies	A potential upstream passage technology at the Gorge Powerhouse is Trap and Transport.
Pink	Data Gaps	Data gaps at the Gorge Powerhouse include a characterization of fish use and occurrence.
Pink	Data Gaps	Data gaps within the Gorge Bypass Reach include an estimation of what flows are passable and a determination of the current fish distribution.
Purple	Fish Release Locations	For downstream release, there is interest in retaining the flexibility to release into the Gorge Bypass Reach, downstream of Gorge Dam into dam tailwater.
Purple	Fish Release Locations	For upstream release into Gorge Reservoir, there is interest the capability of sorting, holding, and transporting fish to desired location within Gorge Reservoir.
Purple	Fish Release Locations	For downstream release into Skagit River, there is interest the capability of sorting, holding, and transporting fish to desired location within the Skagit River system.
Yellow	Fish Collection Location	For downstream collection from within the Gorge Reservoir, there is opportunity on left (south) side of the reservoir in front of the intake structure.
Yellow	Fish Collection Location	For upstream collection, there is opportunity at Gorge Dam within the Gorge Bypass Reach.
Yellow	Fish Collection Location	For upstream collection, there is opportunity at the Gorge Powerhouse the Skagit River mainstem.

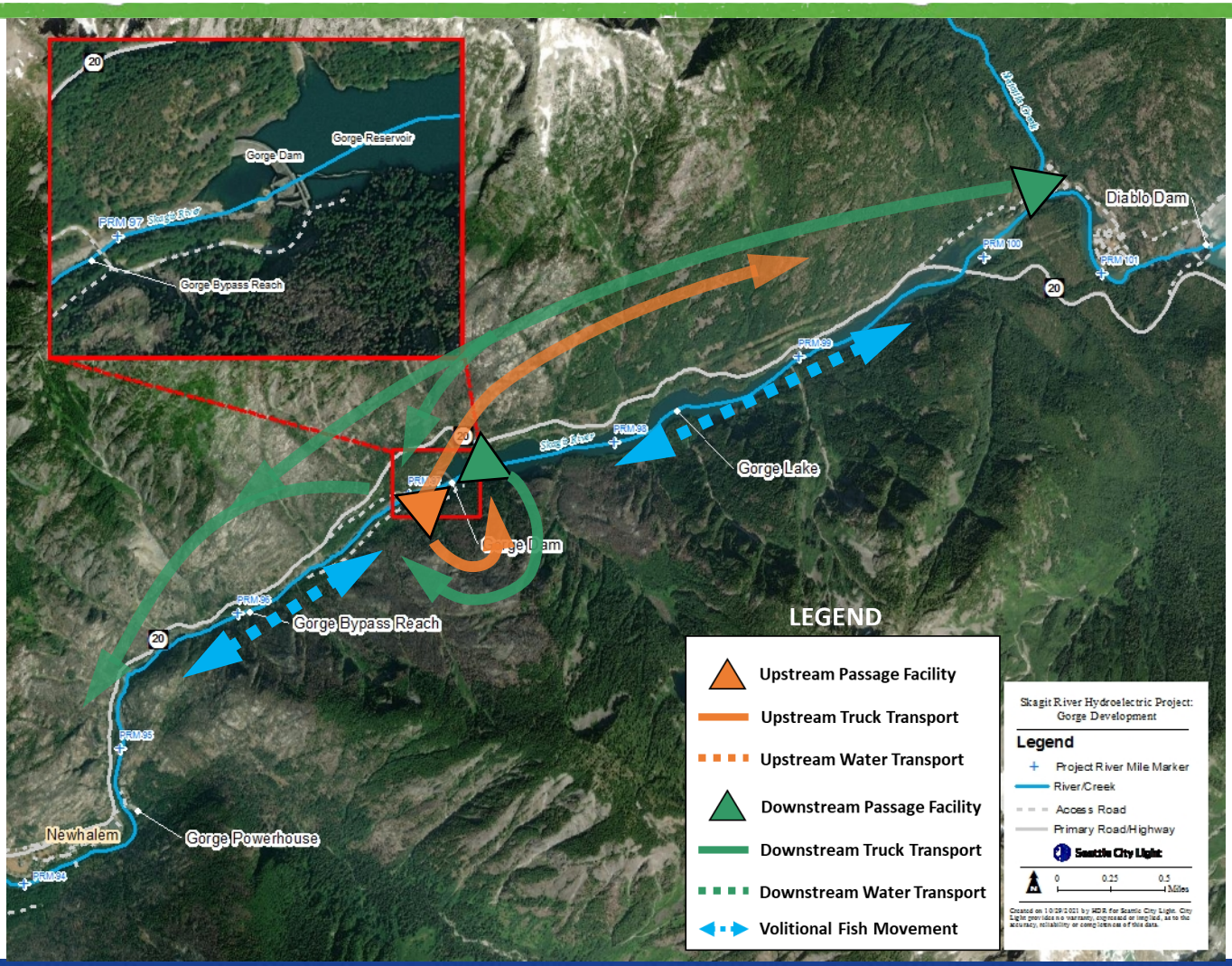
AWS BRAINSTORMING – GORGE DEVELOPMENT
SUMMARY OF OPTIONS

Option Characteristic	Option							
	Option G1	Option G2	Option G3	Option G4	Option G5	Option G6	Option G7	Option G8
Facility Locations								
Gorge Powerhouse	➡	➡			➡		➡	
Gorge Dam			➡	➡		➡		➡
Forebay at Dam Intake	➡	➡	➡				➡	➡
Hwy 20 at Stetattle Creek					➡	➡	➡	➡
Fish Passage Strategy								
Reservoir Bypass	➡							
Tributary Management					➡	➡	➡	➡
Reservoir Transit	➡	➡	➡	➡			➡	➡
Gorge Bypass Reach			➡	➡		➡		➡
Technologies for Upstream Passage								
Fish Ladder (volitional)				➡				
Trap and Transport (non-volitional)	➡	➡	➡		➡	➡	➡	➡
Fish Pass								
Technologies for Downstream Passage								
Forebay Collector	➡	➡	➡	➡			➡	➡
In Tributary Collector								
Head of Reservoir Collector					➡	➡	➡	➡
Downstream Trap and Haul	➡	➡	➡	➡	➡	➡	➡	➡
Bypass Pipe/Channel							➡	➡

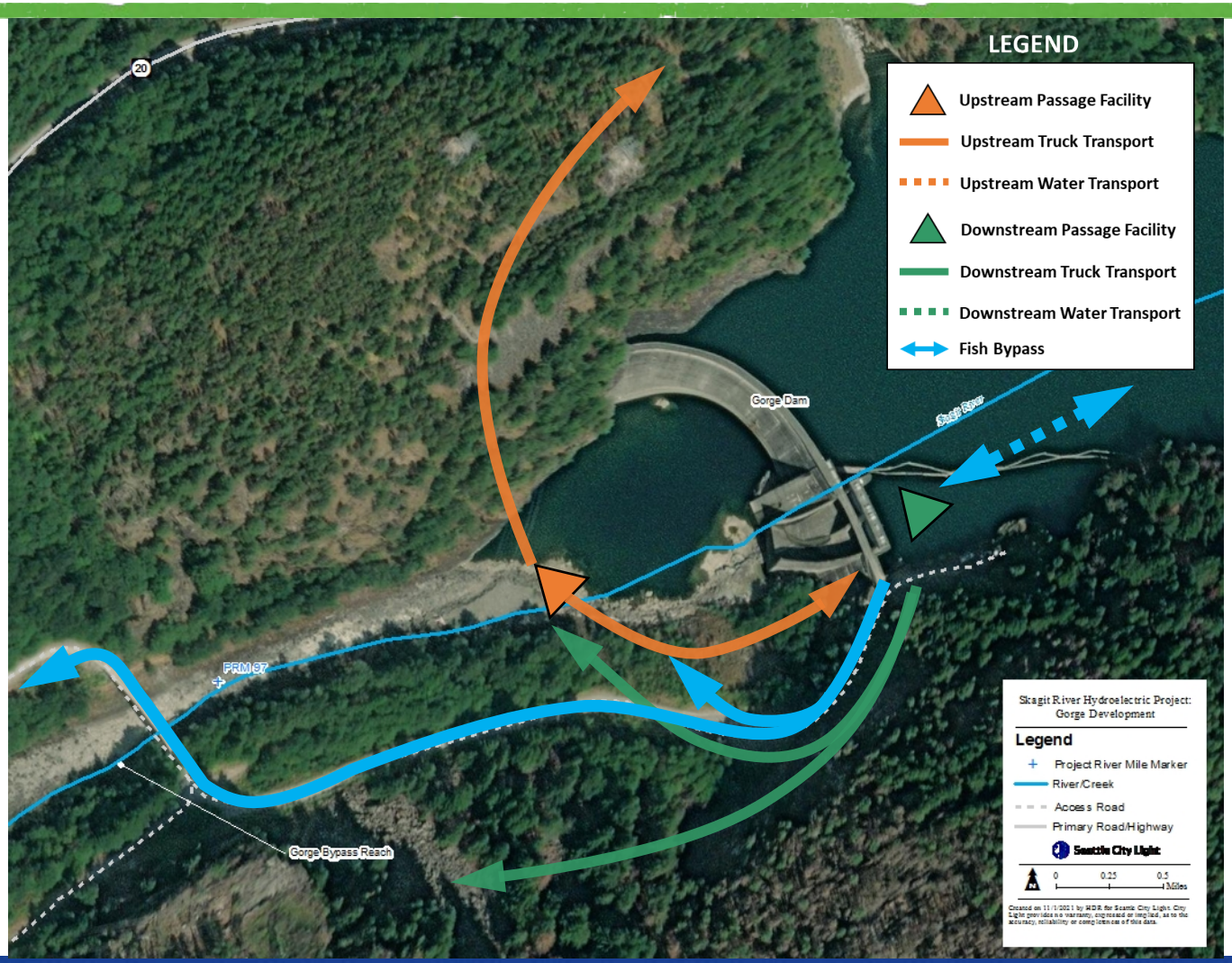
AWS BRAINSTORMING – GORGE DEVELOPMENT *OPTIONS **G1** AND **G2***



AWS BRAINSTORMING – GORGE DEVELOPMENT
*OPTION **G3***



BRAINSTORMING OPTIONS: GORGE DEVELOPMENT



AWS BRAINSTORMING – GORGE DEVELOPMENT
UPSTREAM OPTIONS: GORGE DAM

- Upstream Passage Options at Gorge Dam
  - Fish Ladder
    - Volitional passage
    - Monitoring provisions
  - Trap and Transport
    - Sorting
    - Holding
    - Biometrics / genetics
    - Monitoring and tagging
    - Selective passage / invasive removals
    - Transport to multiple points of release

AWS BRAINSTORMING – GORGE DEVELOPMENT
UPSTREAM OPTIONS: GORGE POWERHOUSE

- Upstream Passage Options at Gorge Powerhouse
  - Fish Ladder to Gorge Dam
    - Volitional (2.5 mile) transit
    - Auxiliary Water Supply distribution
    - Monitoring provisions
  - Trap and Transport
    - Sorting
    - Holding
    - Biometrics / genetics
    - Monitoring and tagging
    - Selective passage / invasive removals
    - Transport to multiple points of release

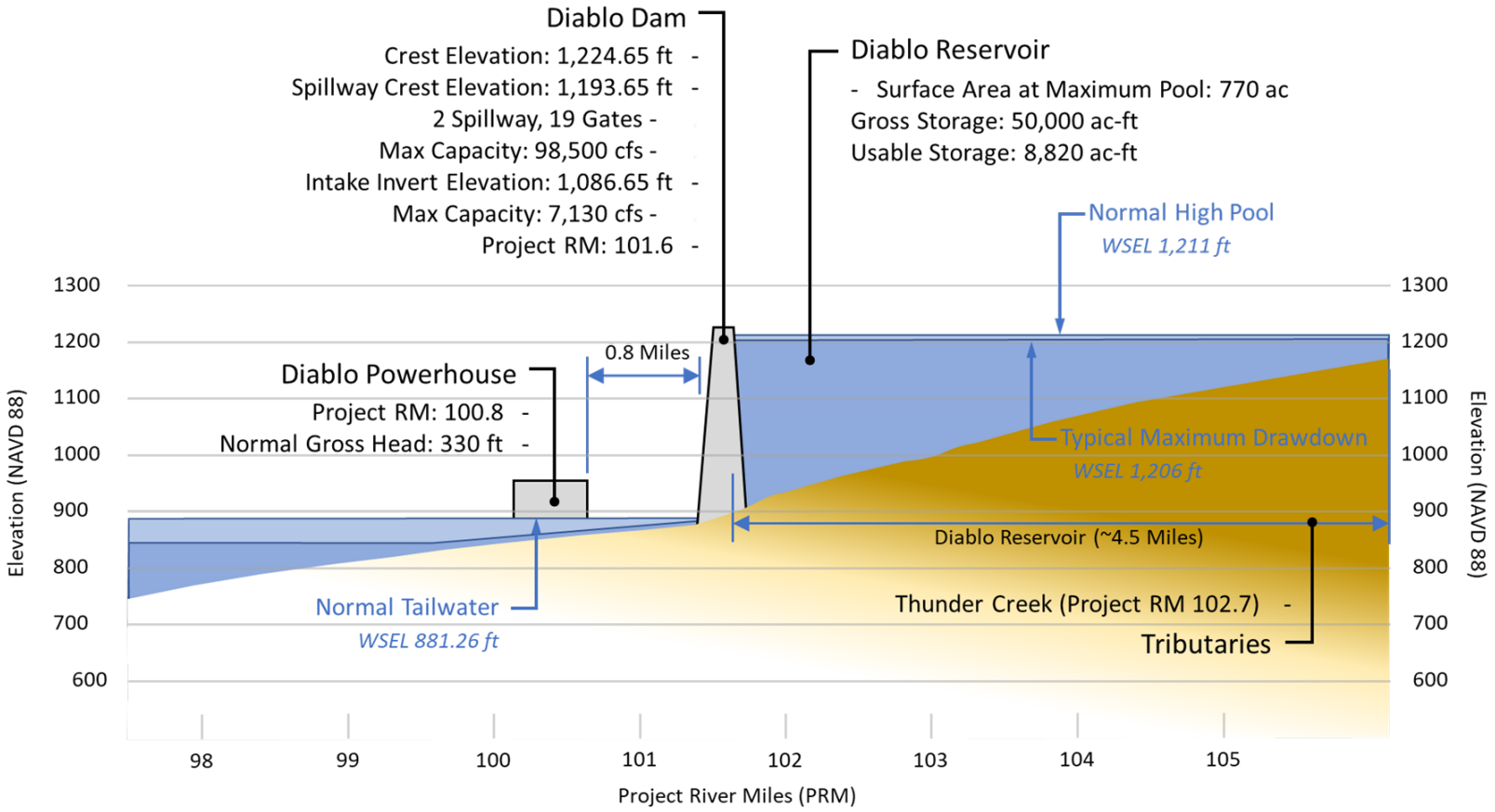
AWS BRAINSTORMING – GORGE DEVELOPMENT
DOWNSTREAM OPTIONS: GORGE DAM

- Downstream Fish Passage Options at Gorge Dam
  - Forebay Collectors
    - Fixed Forebay Collector (likely given low reservoir fluctuation)
    - FSS or FSC (TBD)
    - Trap and transport strategy downstream
  - Gravity Bypass
    - To stilling basin and Gorge Bypass Reach
    - To point downstream of Gorge Bypass Reach

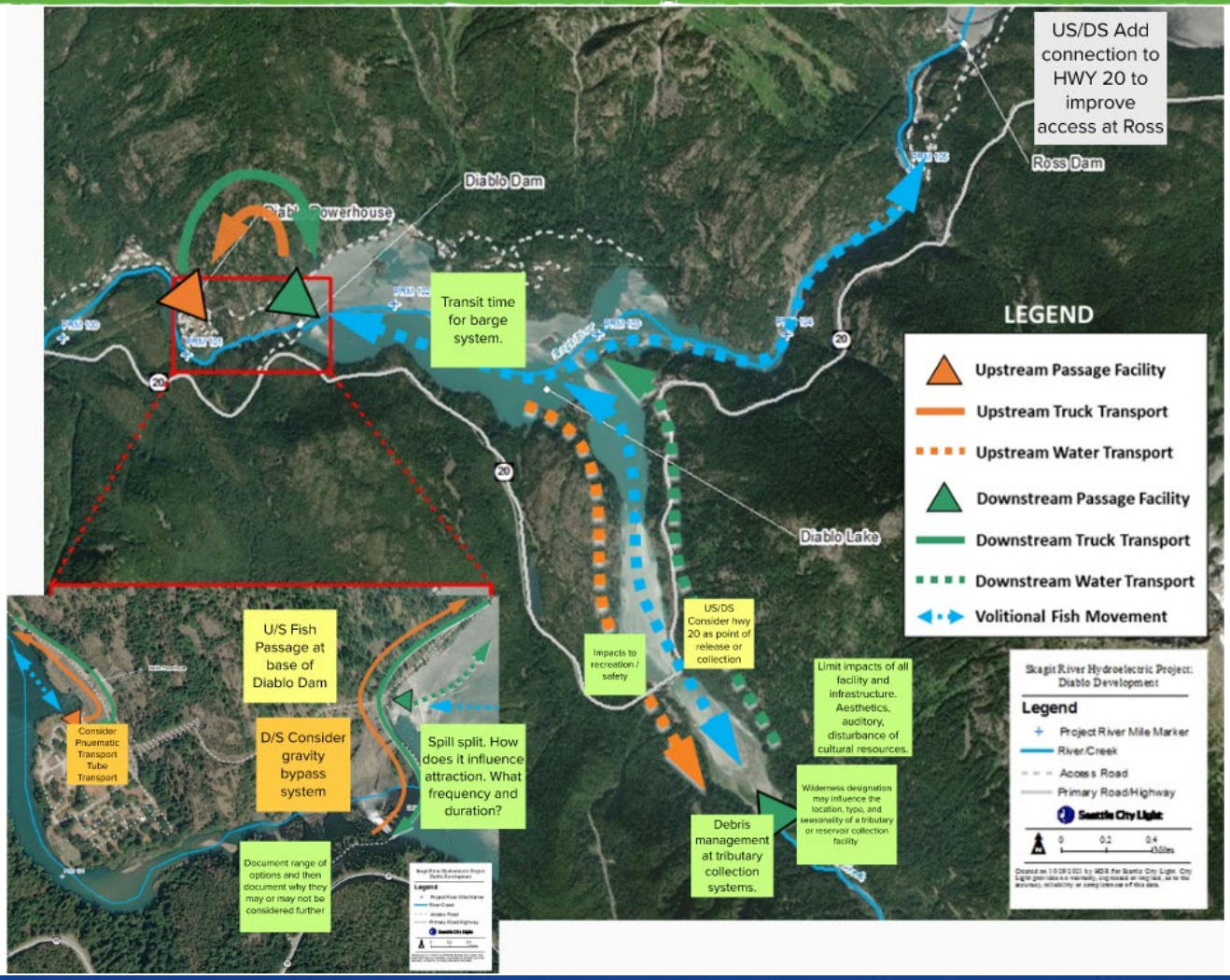
AWS BRAINSTORMING – GORGE DEVELOPMENT
DOWNSTREAM OPTIONS: GORGE DAM

- Downstream Fish Passage Options at Gorge Dam
  - Tributary Collection
    - In-tributary collection weir(s)
    - Head of reservoir passive collection system(s)

AWS BRAINSTORMING – DIABLO DEVELOPMENT



AWS BRAINSTORMING – DIABLO DEVELOPMENT



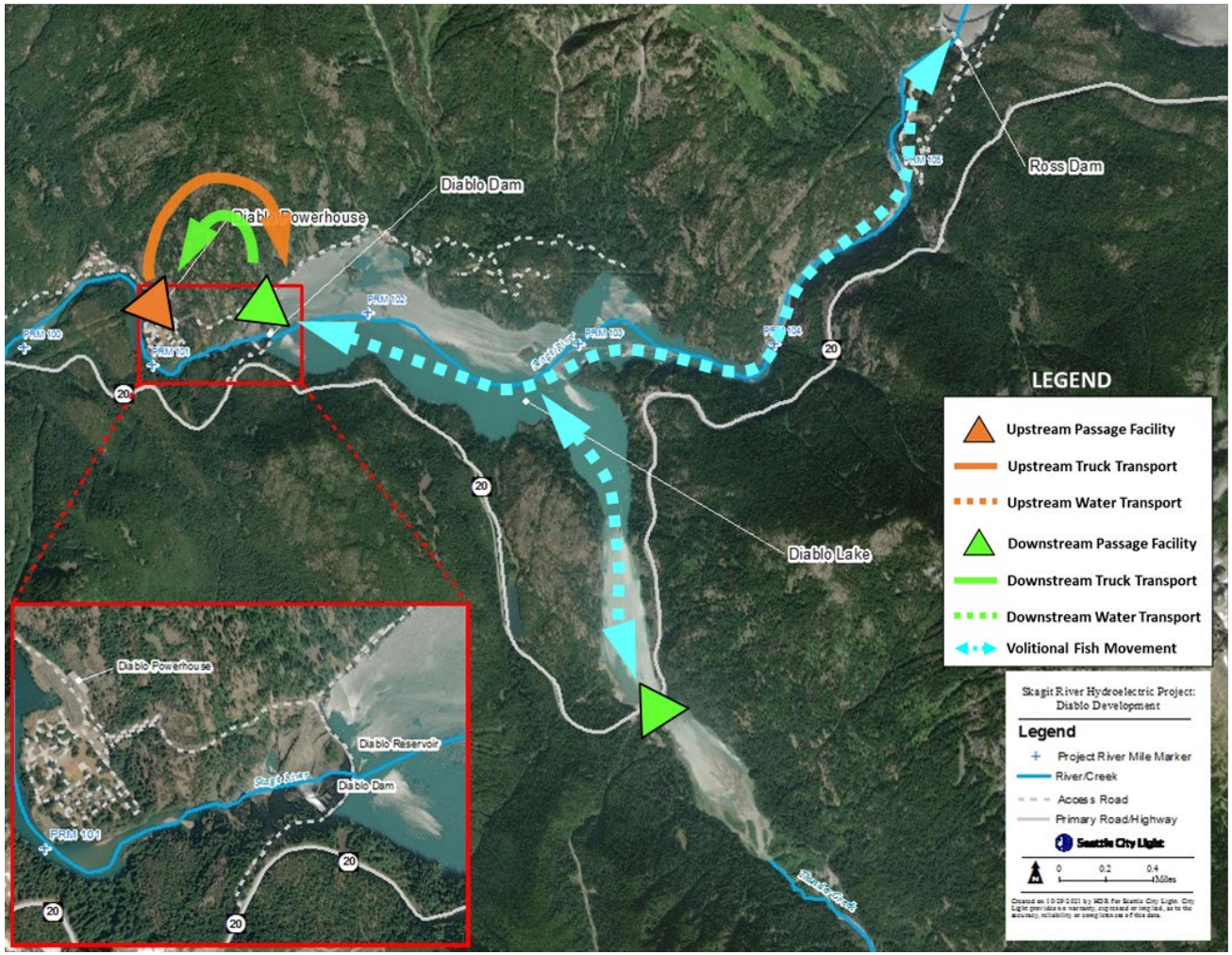
AWS BRAINSTORMING – DIABLO DEVELOPMENT

Sticky Color	Brainstorming Topic	Comment
Green	Key Considerations	A key consideration for all passage options is to document the range of all options and provide justification for removal of options not considered further in the alternative formulation process.
Green	Key Considerations	A key consideration for passage within Diablo Reservoir is transit time for the barge system. Existing road infrastructure does not exist to Ross Dam.
Green	Key Considerations	A key consideration for passage at Diablo Dam is how spill is split between the spill gates, spill frequency and duration, and how attraction would be influenced by these operational patterns.
Green	Key Considerations	A key consideration for a potential tributary or reservoir collection system at Thunder Creek is debris management. There are potentially high magnitude, frequency, and duration of debris events that may negatively influence fish passage facility operation at the tributary level.
Green	Key Considerations	A key consideration for a potential tributary or reservoir collection facility at Thunder Creek is wilderness designation. This may influence the allowable location, type, and seasonality of the facility.
Green	Key Considerations	A key consideration for all potential passage facilities and infrastructure is to limit disturbance to cultural resources (aesthetics, auditory, etc.)
Green	Key Considerations	Key considerations for a potential tributary or reservoir collection facility at Thunder Creek are safety and impacts to recreation (e.g., boat launch and campgrounds located in the Thunder Arm vicinity).
Yellow	Fish Collection Location	For upstream transport collection, there is opportunity at the base of Diablo Dam.
Yellow	Fish Collection Location	For upstream and downstream transport, there is opportunity to site a facility at Hwy 20 crossing of Thunder Arm as a point of release or collection.
Orange	Potential Technologies	For upstream transport in the town of Diablo, consider the use of pneumatic transport tubes (Whooshh).
Orange	Potential Technologies	For downstream transport at Diablo Dam, consider a gravity bypass system.
Grey	Other	For upstream and downstream transport at the Ross Development, consider adding a connection to Hwy 20 to improve access.

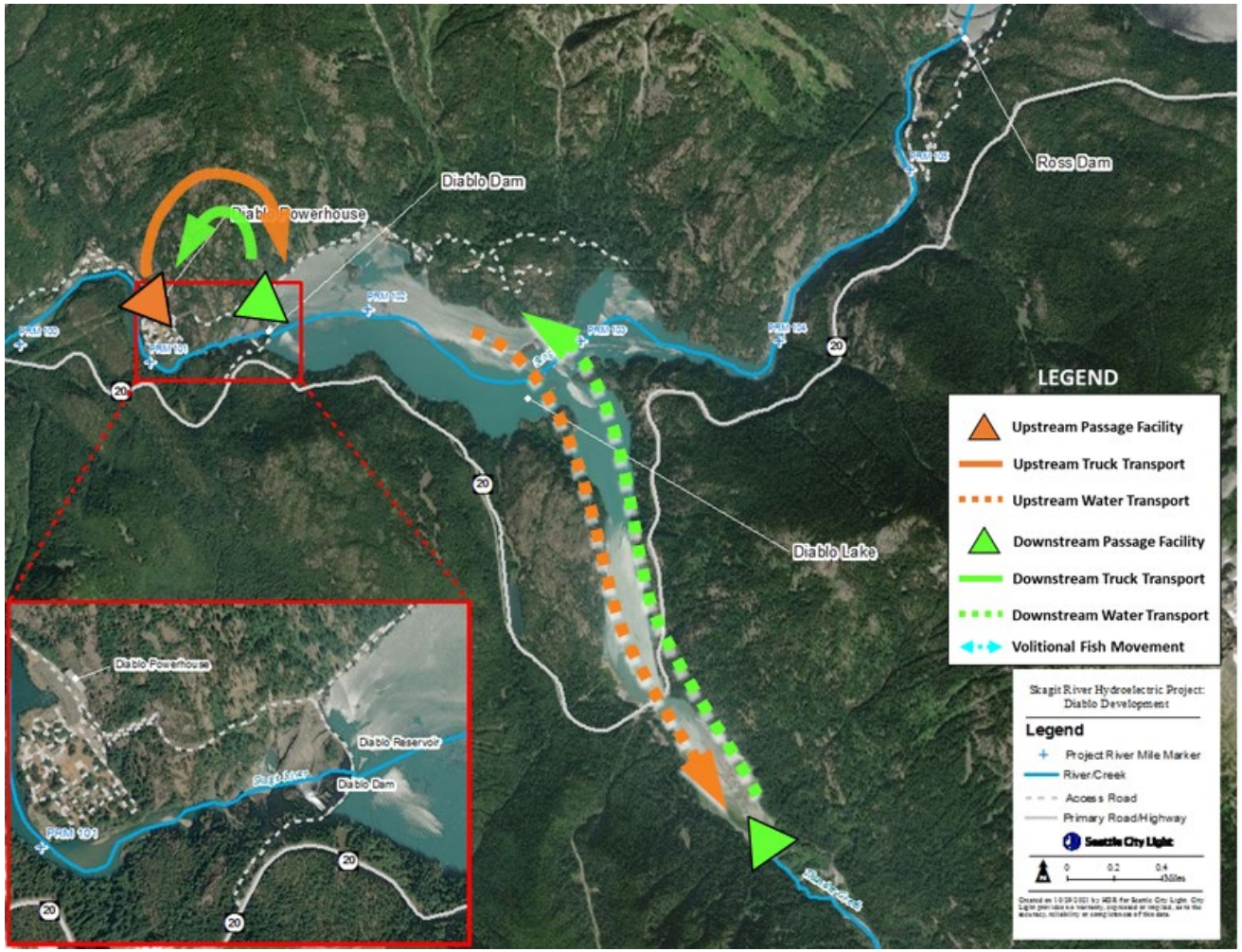
AWS BRAINSTORMING – DIABLO DEVELOPMENT
SUMMARY OF OPTIONS

Option Characteristic	Option								
	Option D1	Option D2	Option D3	Option D4	Option D5	Option D6	Option D7	Option D8	Option D9
Facility Locations									
Diablo Powerhouse	➡		➡		➡		➡		➡
Diablo Dam		➡		➡		➡		➡	
Forebay at Dam Intake	➡	➡					➡	➡	➡
Hwy 20 at Thunder Creek					➡	➡	➡	➡	
Gorge Powerhouse									
Fish Passage Strategy									
Reservoir Bypass									
Tributary Management					➡	➡	➡	➡	
Reservoir Transit	➡	➡	➡	➡			➡	➡	➡
Technologies for Upstream Passage									
Fish Ladder (volitional)			➡	➡					
Trap and Transport (non-volitional)	➡	➡			➡	➡	➡	➡	
Pneumatic Fish Transport Tube									➡
Fish Pass									
Technologies for Downstream Passage									
Forebay Collector	➡	➡	➡	➡			➡	➡	➡
In Tributary Collector									
Head of Reservoir Collector					➡	➡	➡	➡	
Downstream Trap and Haul	➡	➡	➡	➡	➡	➡	➡	➡	➡
Bypass Pipe/Channel							➡	➡	

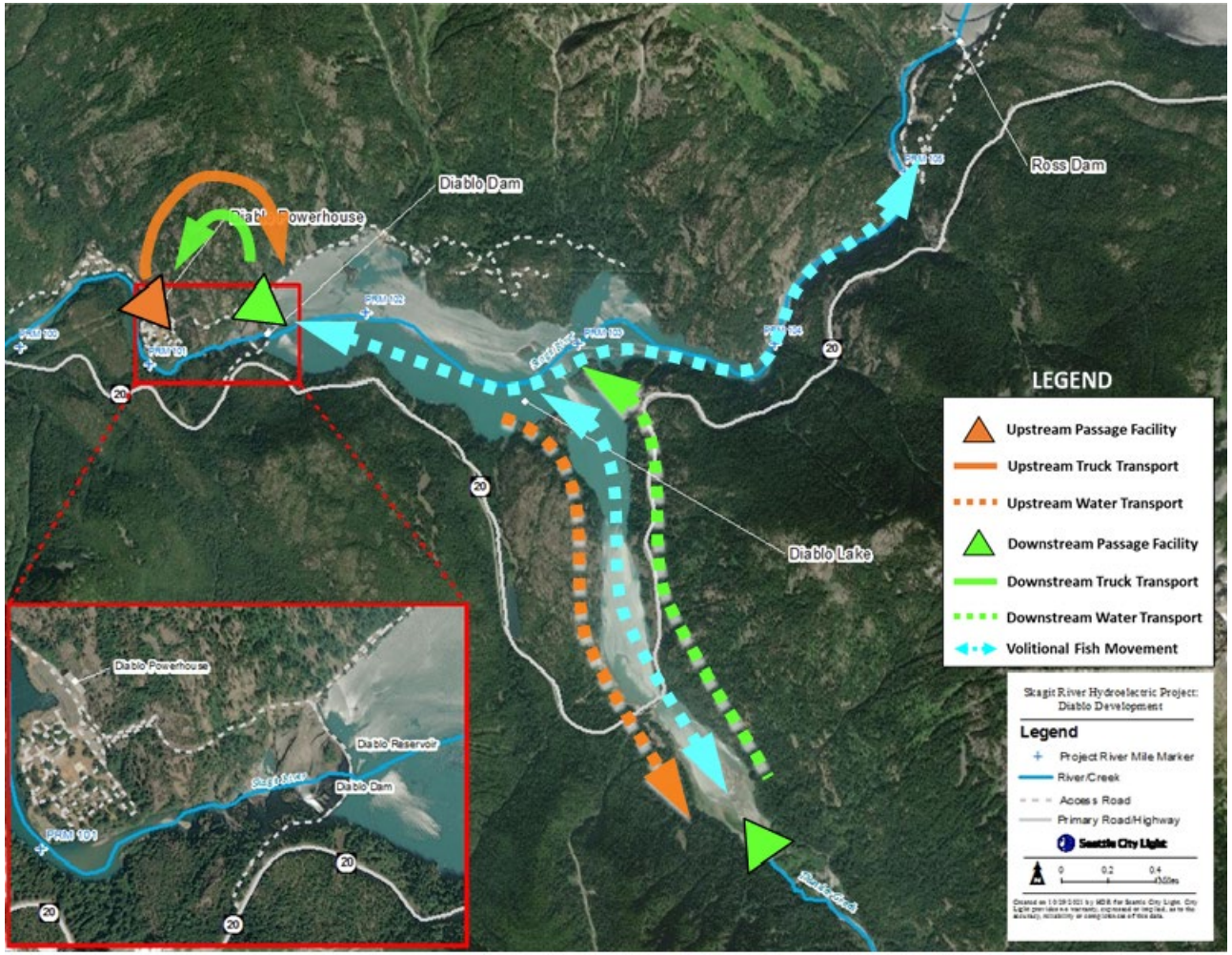
AWS BRAINSTORMING – DIABLO DEVELOPMENT
*OPTIONS **D1** AND **D2***



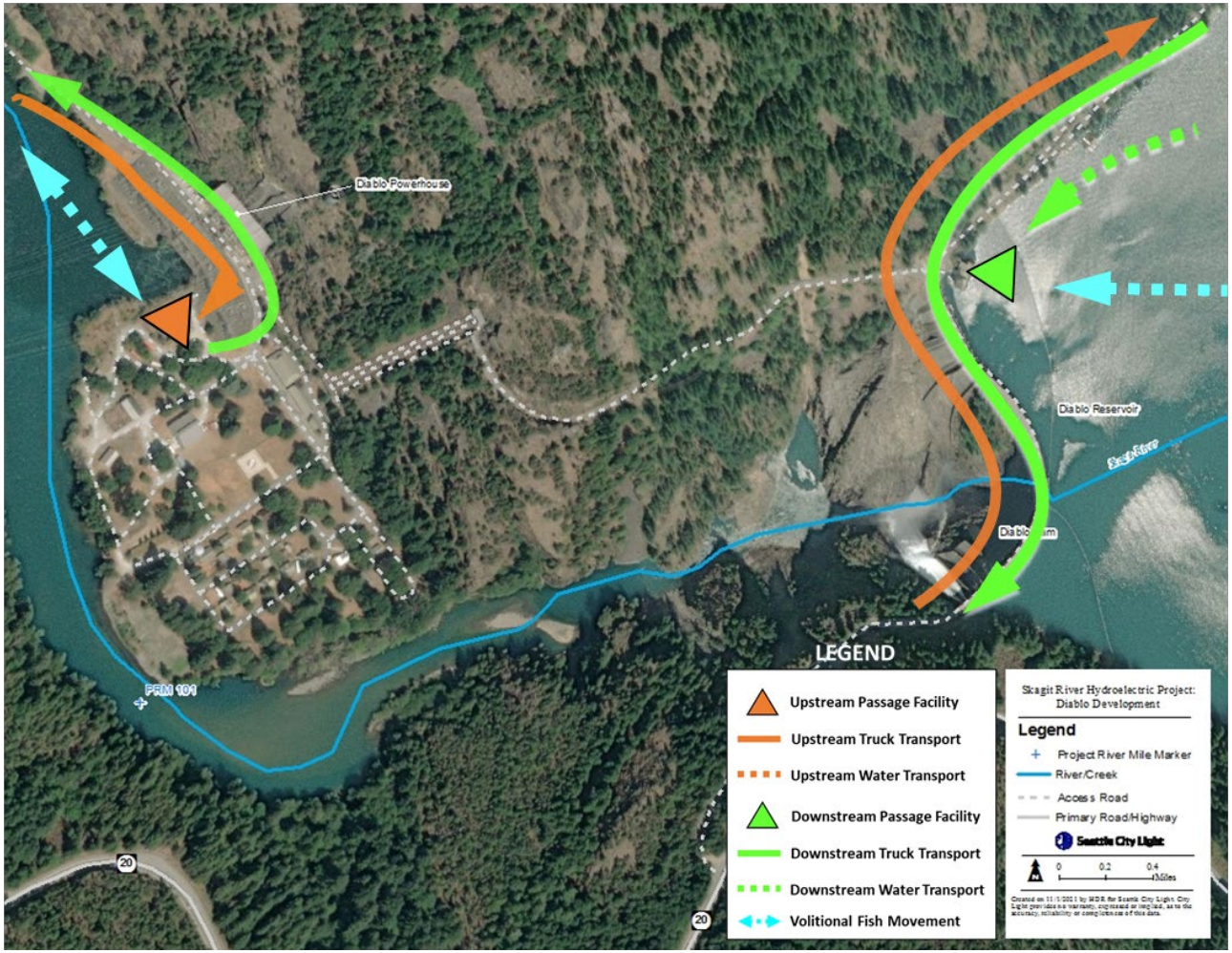
AWS BRAINSTORMING – DIABLO DEVELOPMENT
*OPTIONS **D5** AND **D6***



AWS BRAINSTORMING – DIABLO DEVELOPMENT
*OPTIONS **D7** AND **D8***



AWS BRAINSTORMING – DIABLO DEVELOPMENT
OPTIONS WITH DIABLO POWERHOUSE



AWS BRAINSTORMING – DIABLO DEVELOPMENT *UPSTREAM OPTIONS*

- Upstream Passage Options at town of Diablo
  - Fish Ladder to Diablo Dam
    - Volitional (0.8 mile) transit
    - Monitoring provisions
  - Trap and Transport
    - Sorting
    - Holding
    - Biometrics / genetics
    - Monitoring and tagging
    - Selective passage / invasive removals
    - Transport to multiple points of release

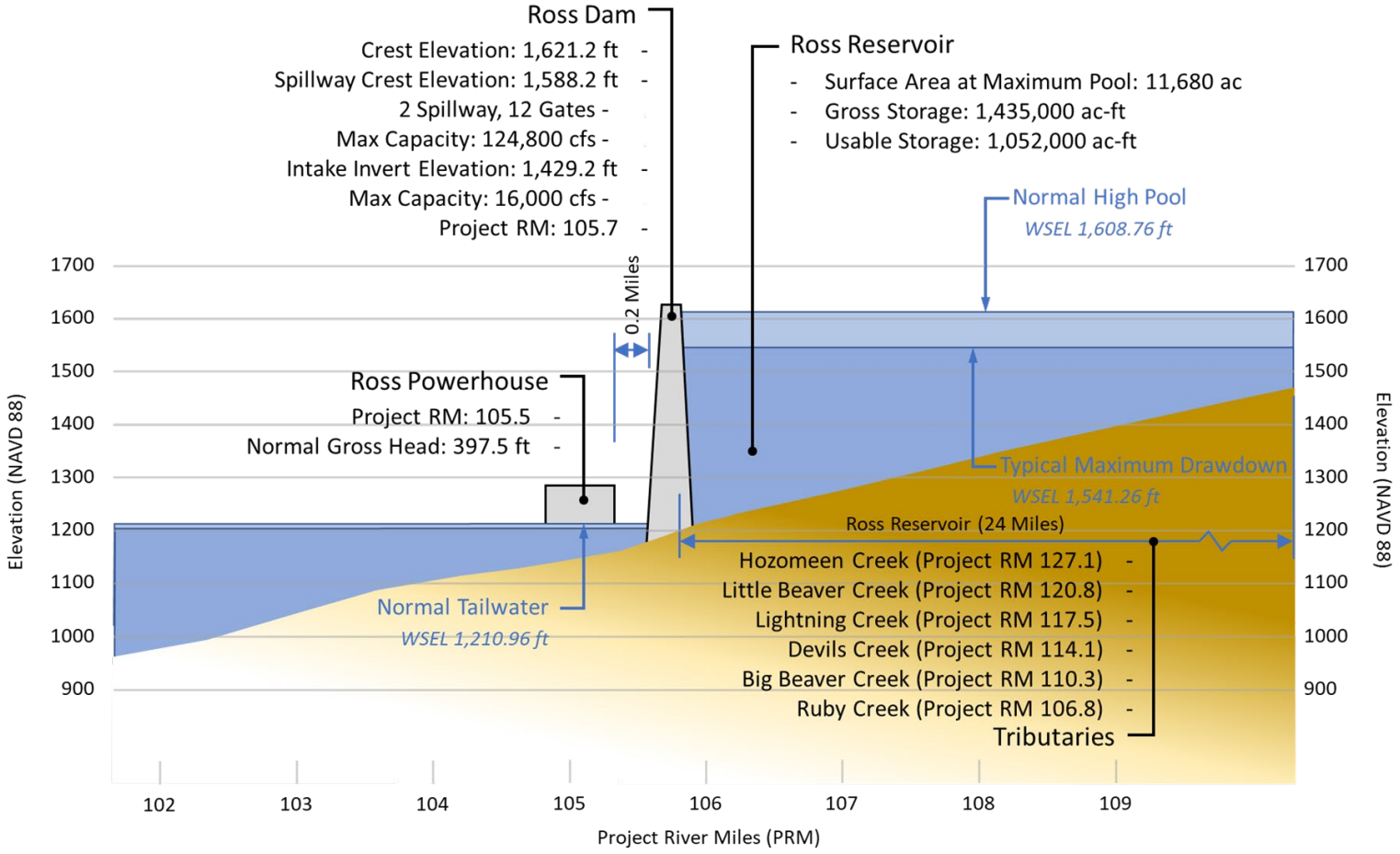
AWS BRAINSTORMING – DIABLO DEVELOPMENT *DOWNSTREAM OPTIONS*

- Downstream Fish Passage Options at Diablo Dam
  - Forebay Collectors
    - Fixed Forebay Collector (likely given low reservoir fluctuation)
    - FSS or FSC (TBD)
    - Partial or complete entrainment barriers
    - Guide nets
    - Trap and transport strategy downstream
  - Gravity Bypass
    - To point of release near Diablo Powerhouse

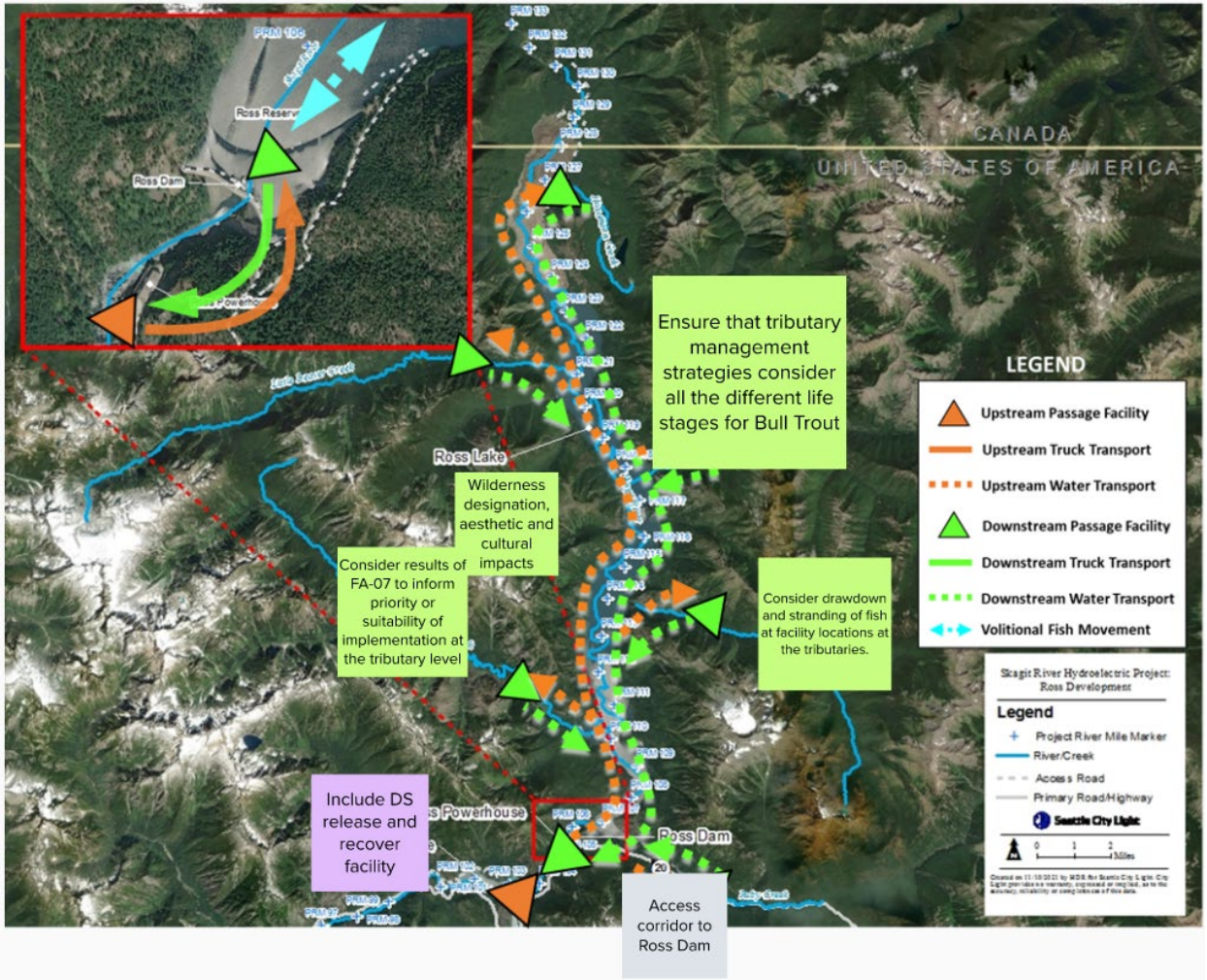
AWS BRAINSTORMING – DIABLO DEVELOPMENT *DOWNSTREAM OPTIONS*

- Downstream Fish Passage Options at Diablo Dam
  - Tributary Collection
    - In-tributary collection weir(s)
    - Head of reservoir passive collection system(s)

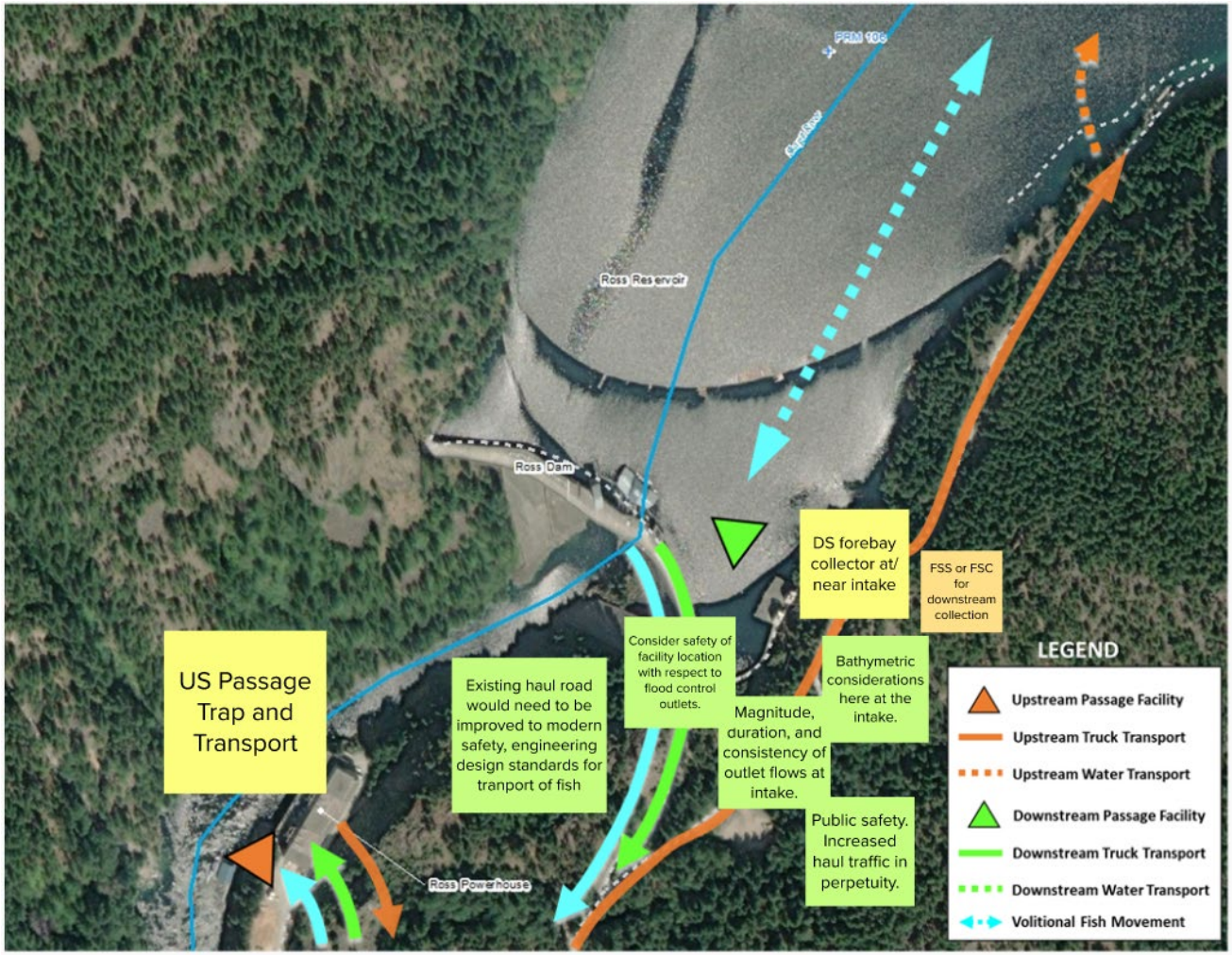
AWS BRAINSTORMING – ROSS DEVELOPMENT



AWS BRAINSTORMING – ROSS DEVELOPMENT



AWS BRAINSTORMING – ROSS DEVELOPMENT



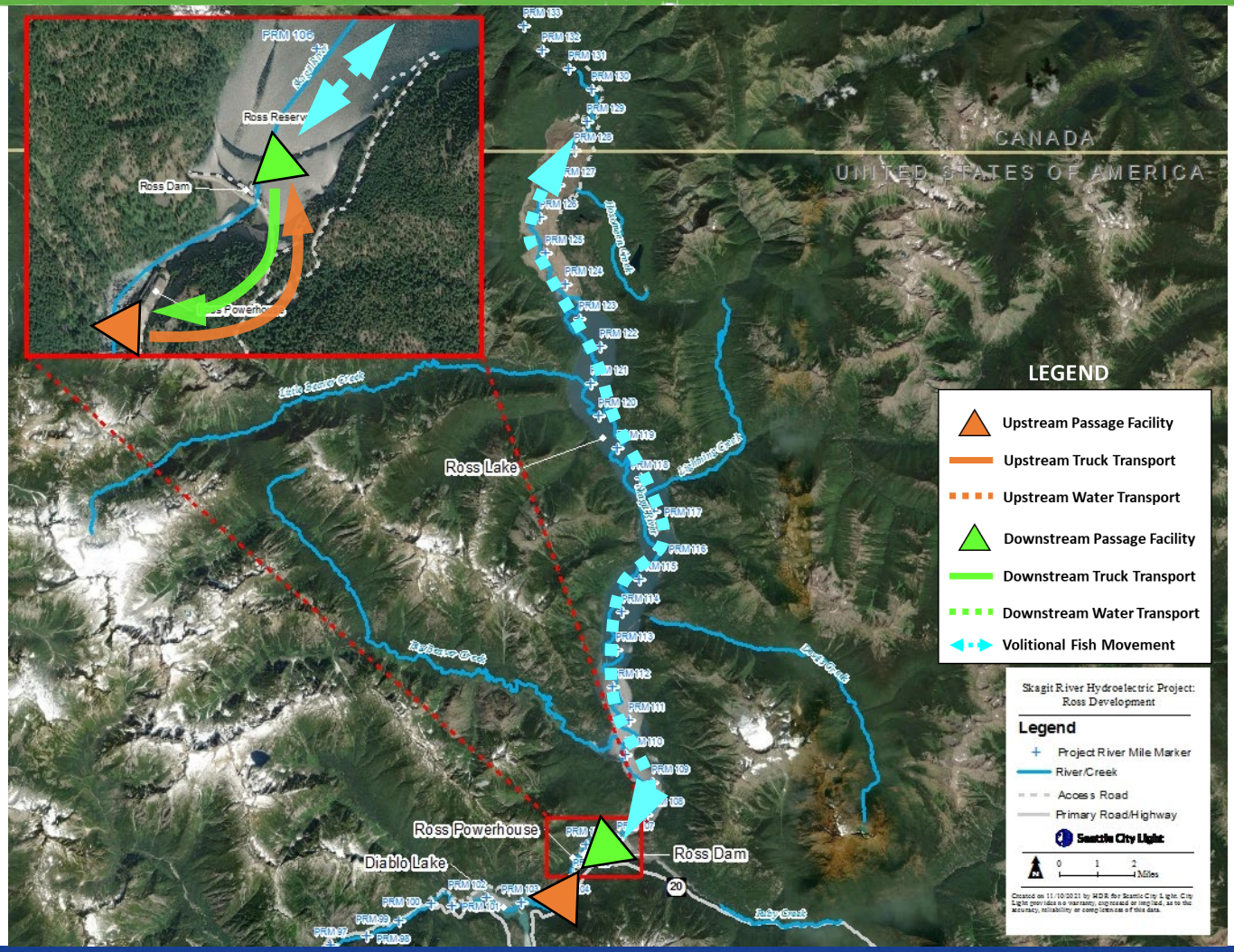
AWS BRAINSTORMING – ROSS DEVELOPMENT

Sticky Color	Brainstorming Topic	Comment
Green	Key Considerations	A key consideration for potential tributary facilities is wilderness designation. This may influence the allowable location, type, and seasonality of the facility.
Green	Key Considerations	A key consideration for all potential passage facilities and infrastructure is to limit disturbance to cultural resources (aesthetics, auditory, etc.)
Green	Key Considerations	Key considerations for potential tributary facilities are the results of FA-07. These results will inform the priority or suitability of implementation at the tributary level.
Green	Key Considerations	A key consideration for potential tributary facilities is the drawdown and stranding of fish at the tributaries.
Green	Key Considerations	A key consideration for tributary management strategies are all the different life stages of bull trout.
Green	Key Considerations	A key consideration for downstream passage at Ross Dam is the magnitude, duration, and consistency of outlet flows at the intake structure.
Green	Key Considerations	A key consideration for downstream passage at Ross Dam is the bathymetry at the intake.
Green	Key Considerations	A key consideration for downstream passage at Ross Dam is the safety of the facility location with respect to the flood control outlets.
Green	Key Considerations	A key consideration for both upstream and downstream passage at the Ross Development is that the existing haul road would need to be improved to modern safety, engineering, and design standards for the transport of fish.
Green	Key Considerations	A key consideration for both upstream and downstream passage at the Ross Development is public safety on the haul road. Haul traffic would be increased in perpetuity.
Yellow	Fish Collection Location	For downstream transport collection, there is opportunity at/near the intake structure in the Ross Reservoir forebay.
Yellow	Fish Collection Location	For upstream transport collection, there is opportunity in the vicinity of Ross Powerhouse.
Purple	Fish Release Location	A downstream release and recover facility should be included downstream of Ross Dam.
Orange	Potential Technologies	For downstream transport at Ross Dam, consider the use of a Floating Screen Structure (FSS) or Floating Surface Collector (FSC)
Grey	Other	For upstream and downstream transport at the Ross Development, consider adding a connection to Hwy 20 to improve access.

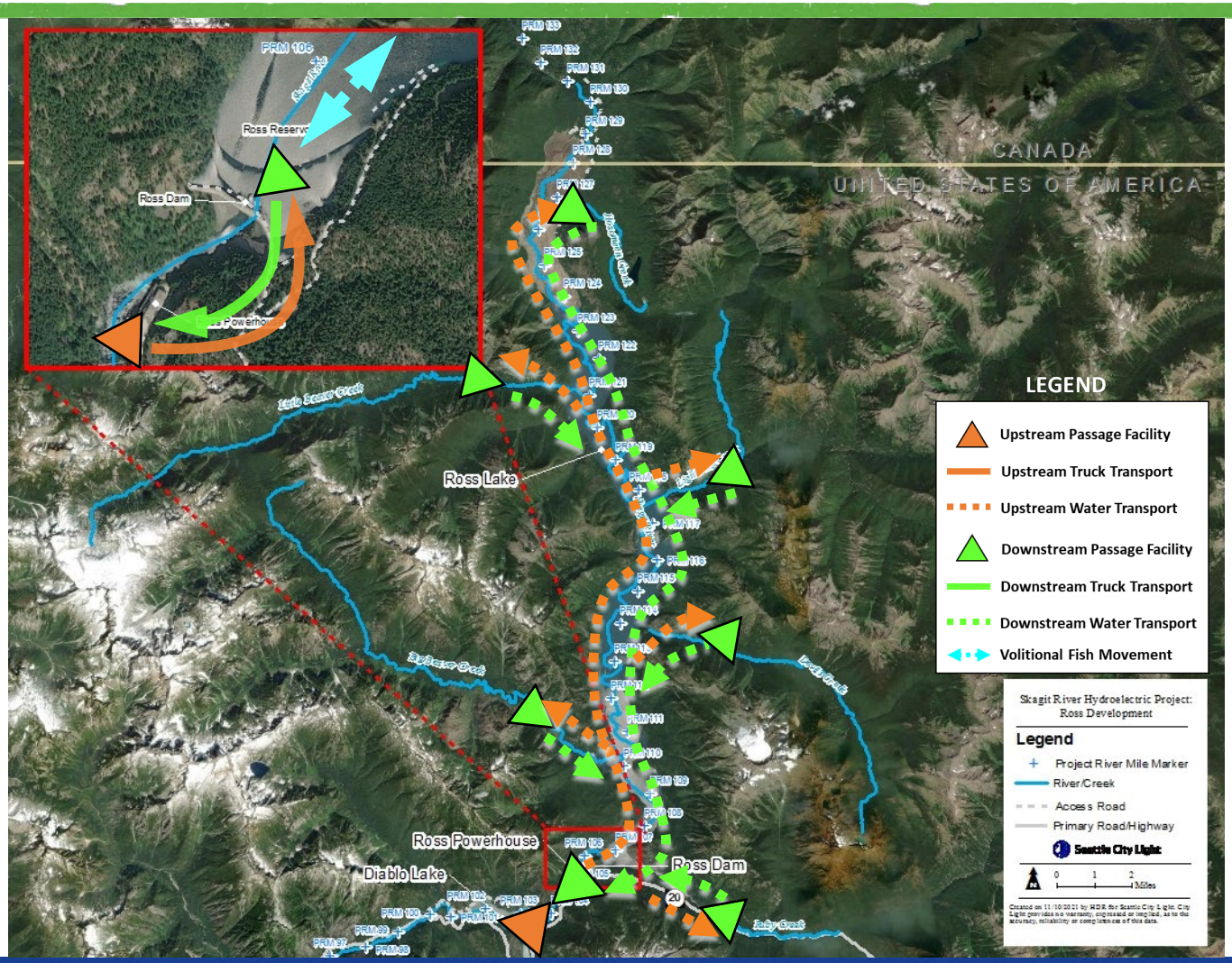
AWS BRAINSTORMING – ROSS DEVELOPMENT
SUMMARY OF OPTIONS

Option Characteristic	Option						
	Option R1	Option R2	Option R3	Option R4	Option R5	Option R6	Option R7
Facility Locations							
Ross Powerhouse	➡	➡	➡	➡	➡	➡	➡
Forebay at Ross Intake	➡	➡			➡	➡	➡
Ross Lake at Tributary			➡				
Tributary(s) to Ross Lake				➡			
Gorge Powerhouse							
Fish Passage Strategy							
Reservoir Bypass							
Tributary Management			➡	➡	➡	➡	
Reservoir Transit	➡	➡			➡	➡	➡
Technologies for Upstream Passage							
Fish Ladder (volitional)		➡					
Trap and Transport (non-volitional)	➡		➡	➡	➡	➡	
Pneumatic Fish Transport Tube							➡
Fish Pass							
Technologies for Downstream Passage							
Forebay Collector	➡	➡			➡	➡	➡
In Tributary Collector				➡			
Head of Reservoir Collector			➡		➡	➡	
Downstream Trap and Haul	➡	➡		➡	➡		➡
Bypass Pipe/Channel						➡	➡

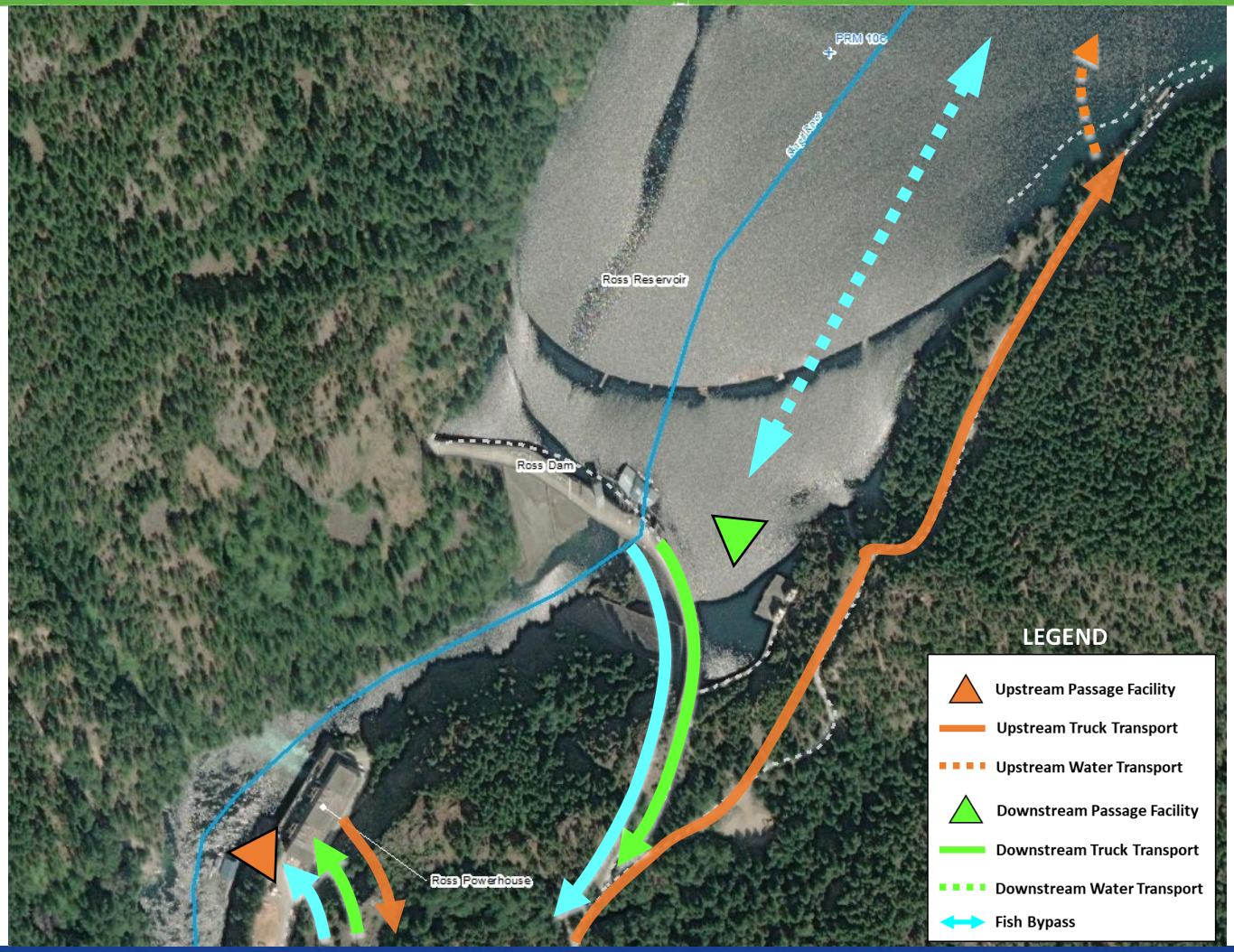
AWS BRAINSTORMING – ROSS DEVELOPMENT
*OPTION **R1***



AWS BRAINSTORMING – ROSS DEVELOPMENT
*OPTIONS **R3** AND **R4***



AWS BRAINSTORMING – ROSS DEVELOPMENT
*OPTIONS **R7** AND **R8***



AWS BRAINSTORMING – ROSS DEVELOPMENT *UPSTREAM OPTIONS*

- Upstream Passage Options at Ross Powerhouse
  - Fish Ladder to Ross Dam
    - Likely not an option that can be implemented without a complex ladder exit system due to high headwater fluctuation
      - Pumped flow exit flume return
      - Multi-ported helical exit structure
  - Trap and Transport
    - Sorting
    - Holding
    - Biometrics / genetics
    - Monitoring and tagging
    - Selective passage / invasive removals
    - Transport to multiple points of release

AWS BRAINSTORMING – ROSS DEVELOPMENT *DOWNSTREAM OPTIONS*

- Downstream Fish Passage Options at Ross Dam
  - Forebay Collectors
    - FSS or FSC (likely given high reservoir fluctuation)
    - Partial or complete entrainment barriers
    - Guide nets
    - Trap and transport strategy downstream
  - Gravity Bypass (option)
    - To point of release near Ross Powerhouse

AWS BRAINSTORMING – ROSS DEVELOPMENT *DOWNSTREAM OPTIONS*

- Downstream Fish Passage Options at Ross Dam
  - Tributary Collection
    - In-tributary collection weir(s)
    - Head of reservoir passive collection system(s) likely not feasible due to reservoir drawdown
      - Requires numerous seasonal repositioning which would require a very high level of operational effort

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BREAK

10 minutes

Will return 2:20 PM

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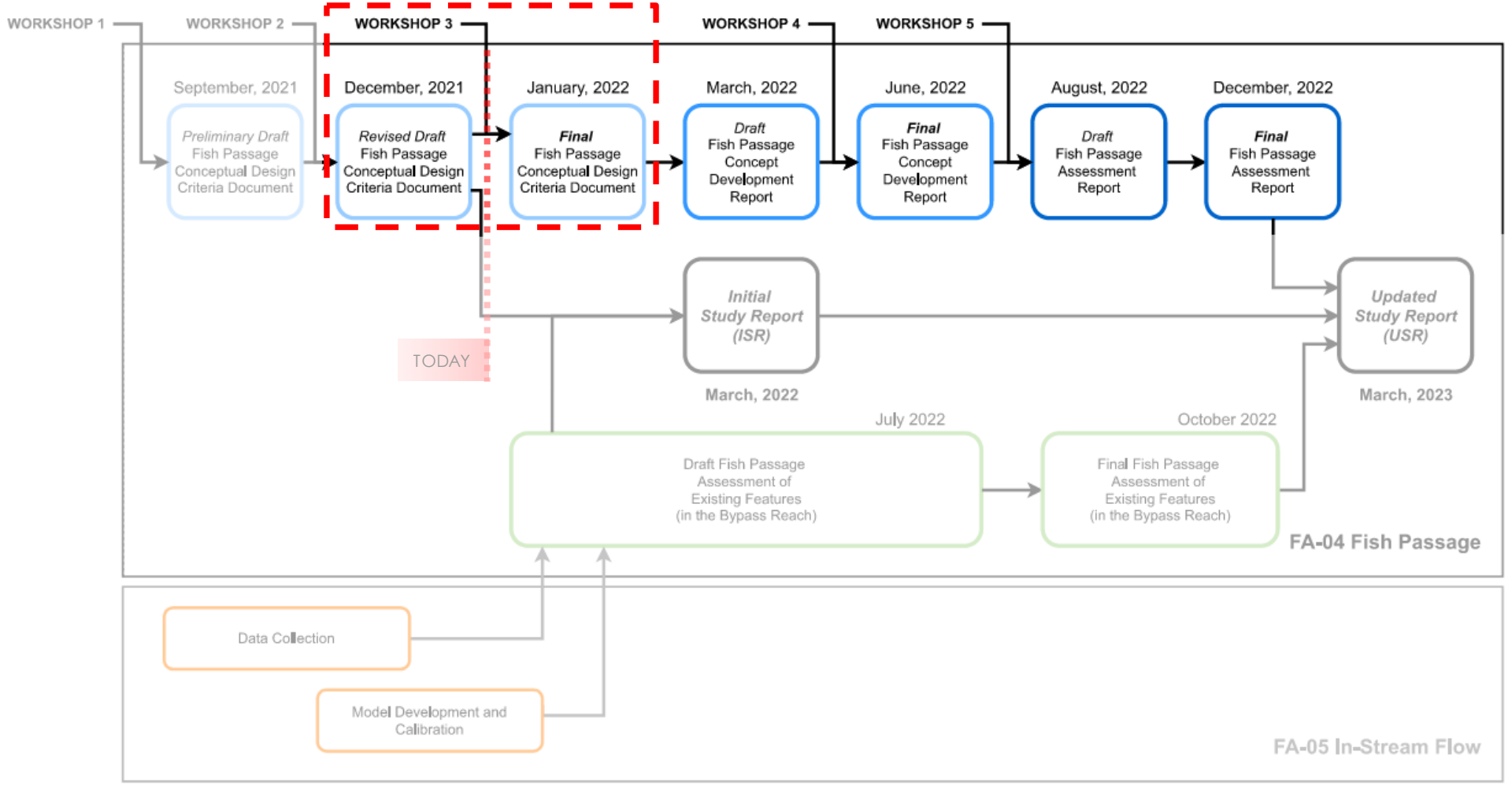
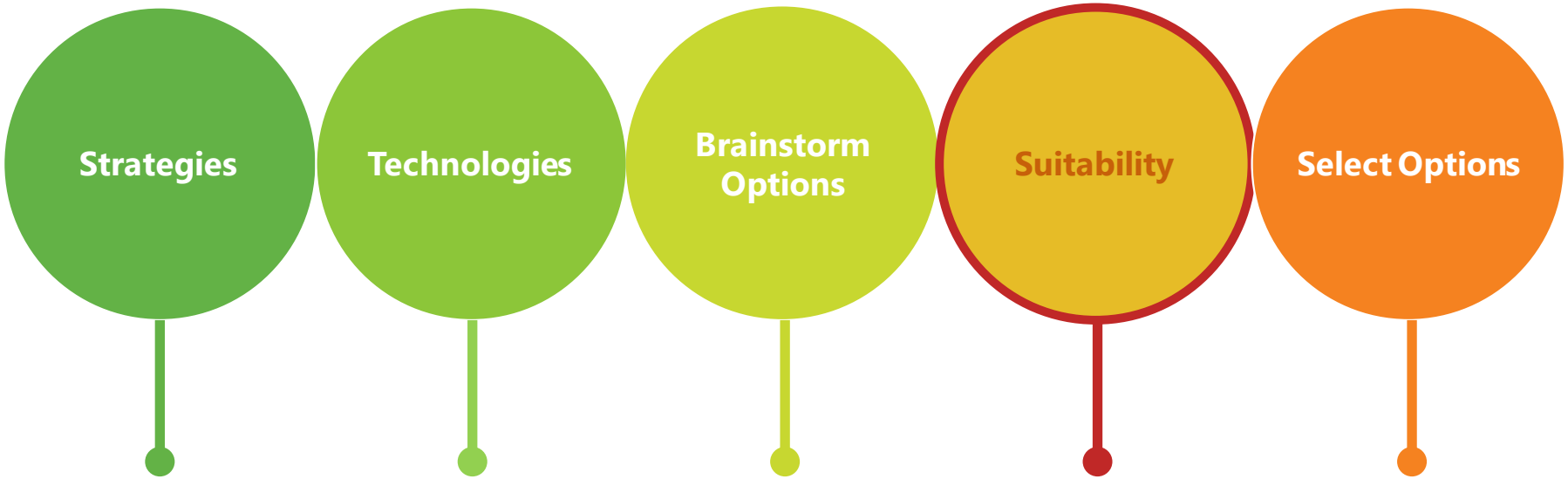
FACTORS INFLUENCING FISH PASSAGE FACILITY TECHNICAL FEASIBILITY

FISH PASSAGE STUDY – PROCESS FLOWCHART



FISH PASSAGE OPTION DEVELOPMENT



PURPOSE OF FISH PASSAGE STUDY

- The Fish Passage Study focuses on **technical feasibility**: the ability to build and operate facilities that meet performance criteria.
- Per the RSP and as reiterated by LPs during review of the Preliminary DCD:
  - Although biological and socioeconomic feasibility are components in the comprehensive evaluation of establishing fish populations above fish passage barriers, this study evaluates only the question of "technical feasibility."

DISCUSSION GOALS

- As stated in RSP, following Workshop 3 City Light will finalize list of passage options to be evaluated in the next stage of the study
  - Goal 1 - narrow list of all passage technologies that have been considered to date, based on factors that influence feasibility
  - Goal 2 – select a range of options that bracket the variety of biological and fish management opportunities

WHAT IS "FEASIBILITY"?

- Feasibility is taken as its common usage: "possible to achieve" (Webster 1992).
- For a project to be determined to be feasible, it must be able to achieve the objectives established by the project developer(s) and the standards of performance established for projects of a similar nature and purpose.
- Ability to achieve or 'level of confidence' to be defined using rating scales at the next stage of the study process

WHAT ARE FACTORS?

- Measures used to evaluate whether physical and operational characteristics of a particular fish passage option will meet specific objectives.
- Factors are based on previous experience developing high dam fish passage at other facilities and can be refined.

FEASIBILITY FACTOR 1

Engineering

- Conforms to modern engineering standards and guidelines
- Conforms to agency design principles and guidelines (NOAA, WDFW, USFWS)
- Can be engineered given physical properties and infrastructure in existing environment

Construct-ability

- Conforms to modern construction practice, means, and methods
- Cost risk and uncertainty can be mitigated

Operable

- Can be operated as intended in the environment within which it is proposed to be placed

FEASIBILITY FACTOR 2

Operational Influence

Influence on viability, purpose, and objectives of existing uses (e.g., Flood Control)

Life and Safety

Must not diminish established life and safety requirements of existing infrastructure and use

FEASIBILITY FACTOR 3

Performance

Potential to meet anticipated Fish Passage Performance Standards established for similar facilities, such as collection efficiency, passage efficiency, survival, and combined passage efficiency through the Project.

FEASIBILITY FACTOR 4

Adaptability

Potential to accommodate foreseeable future changes in operational or environmental conditions.

Potential to accommodate a broad range of biological and fish management goals and objectives

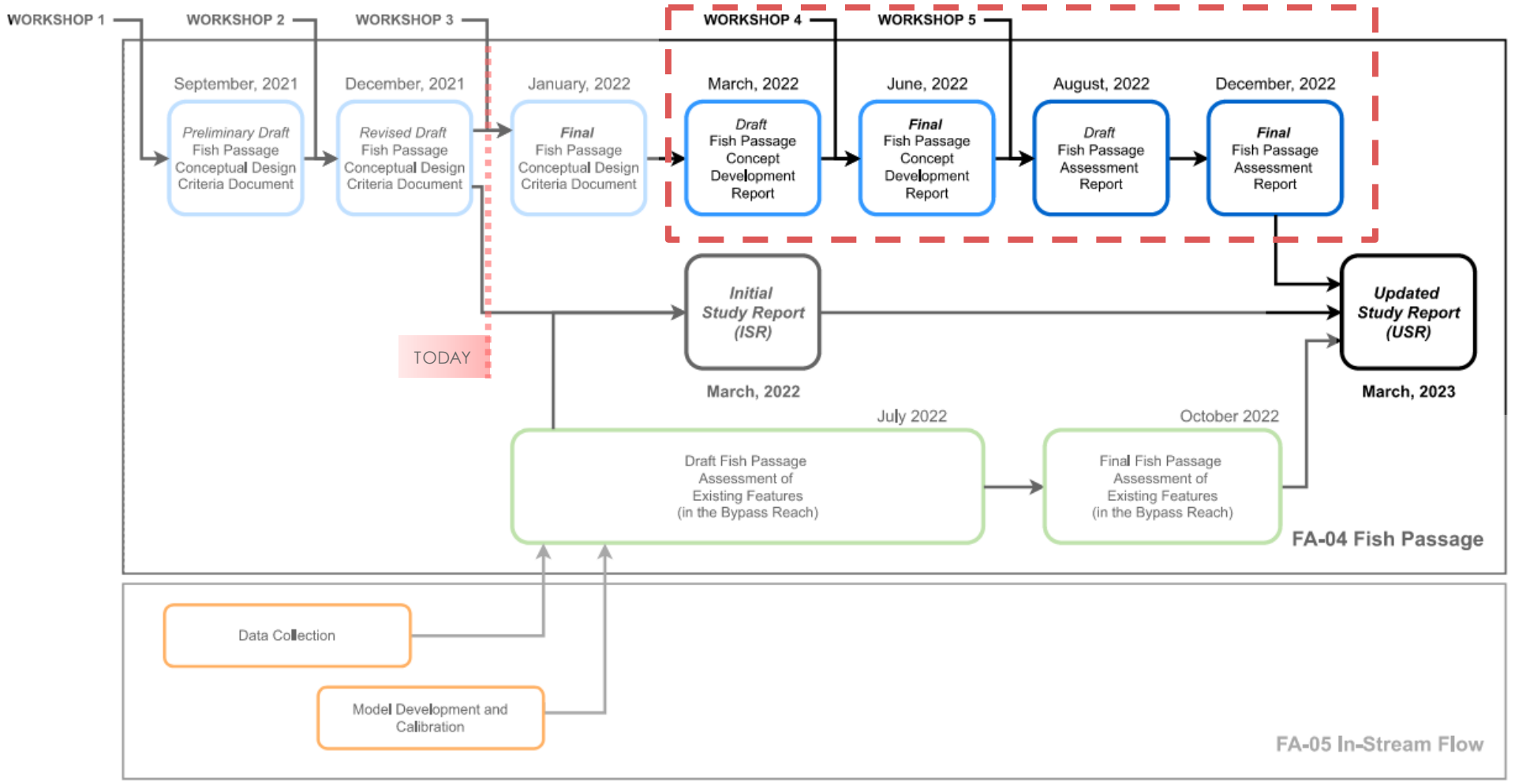
APPLICATION OF SUITABILITY CRITERIA AND FEASIBILITY FACTORS

- Now (Today):
  - Review qualitative level of suitability for all upstream and downstream passage options considered to date
  - Technologies that are suited to known operational environments at each development may advance to the next phase of study

APPLICATION OF SUITABILITY CRITERIA AND FEASIBILITY FACTORS

- Later (2022):
  - Factors are subjective and can be further refined in next stages of study.
  - Concept Development Report (stage 2 of this study) will focus on conceptual design, preliminary engineering, and cost development.
  - Rating scales and quantitative results of feasibility assessment for each feasibility factor will be developed As part of the Fish Passage Facility Assessment (stage 3 of this study).

FISH PASSAGE STUDY – PROCESS FLOWCHART



DISCUSSION

- Discussion and Questions

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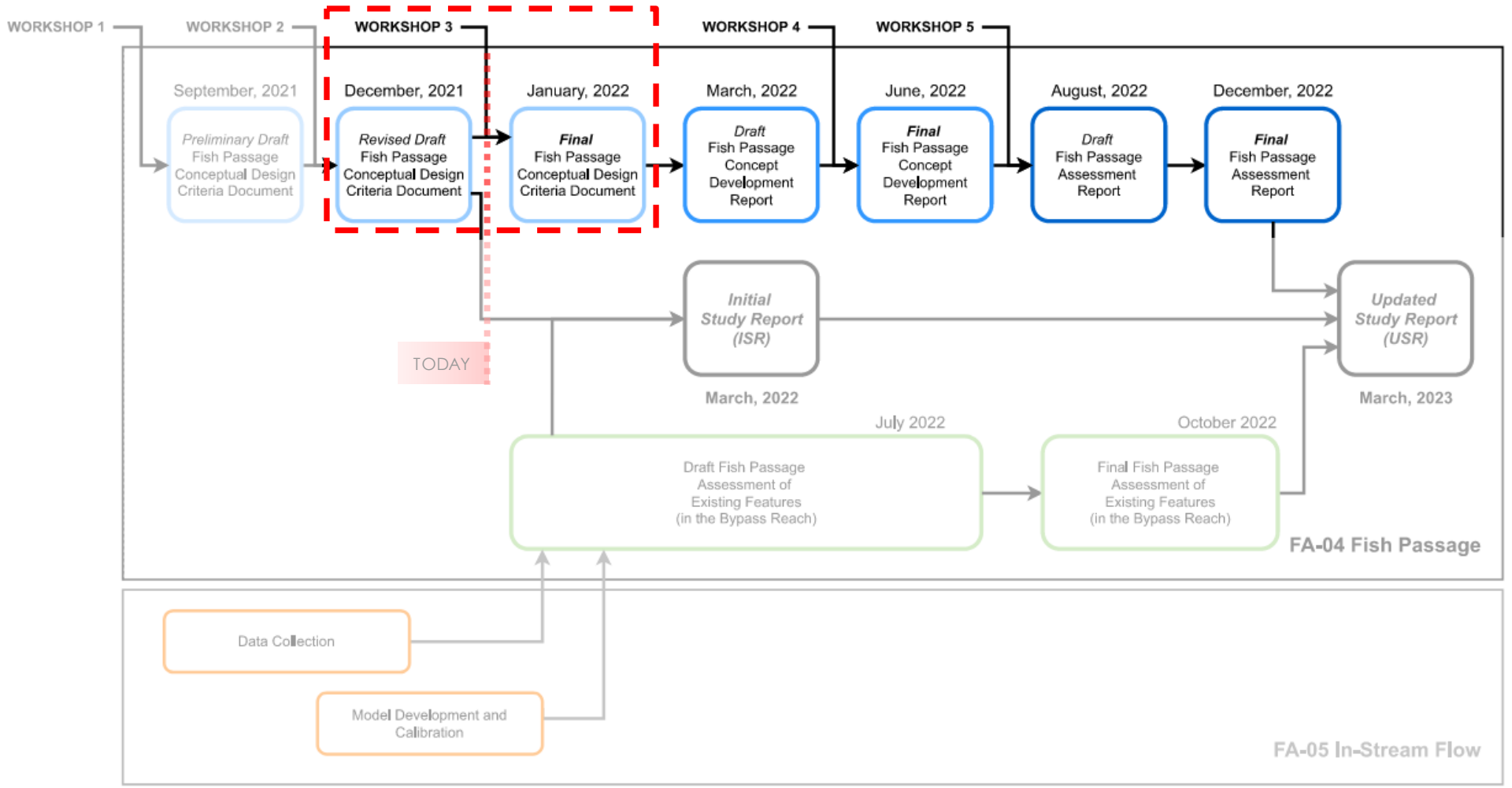
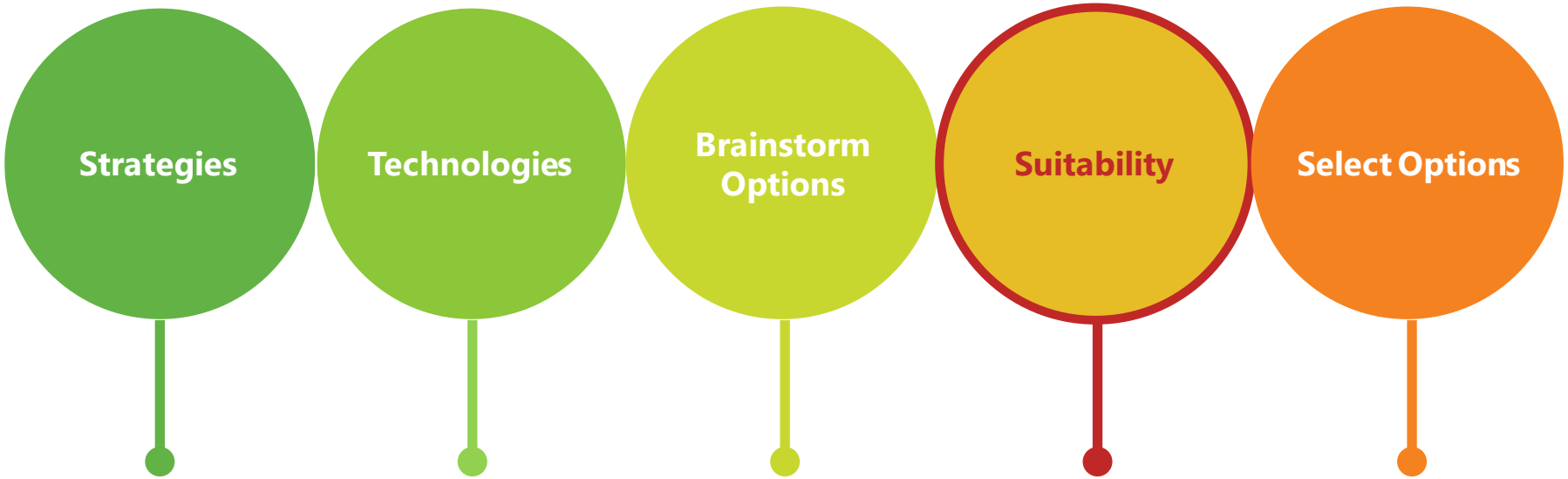
METHODS FOR SELECTION OF FISH PASSAGE OPTIONS TO ADVANCE TO NEXT STUDY STAGE

FISH PASSAGE STUDY – PROCESS FLOWCHART



FISH PASSAGE OPTION DEVELOPMENT



OPTION REVIEW AND SELECTION

- Review suitability for all upstream and downstream technologies considered
  - Location
  - Operating environment
  - Technology capability and application
- Technologies that are suited to known operational environments at each development will advance to the next phase of study
- Select options that best represent a wide range of fish passage facility and fish management strategies

UPSTREAM FISH PASSAGE FACILITY SUITABILITY

	Potential Upstream Fish Passage Technology			
	Trap and Transport	**Fish Ladders and Fishways**	**Pneumatic Fish Transport Tube**	**Fish Passes**
Capability and Characteristic of Operating Environment				
Monitoring capability	●	◐	●	◐
Selective passage (potential for removal of invasive species)	●	○	●	○
Holding, sorting, sampling, biometrics, tagging, etc.	●	○	●	●
Multiple points of release	●	○	○	○
Volitional passage	○	●	●	●
Tailwater fluctuation (0 to 10 ft)	●	●	●	●
Tailwater fluctuation (10 to 20 ft)	◐	◐	◐	◐
Tailwater fluctuation (> 20 ft)	◑	○	◑	○
Forebay fluctuation (0 to 10 ft)	●	●	●	●
Forebay fluctuation (10 to 20 ft)	●	◐	◐	○
Forebay fluctuation (> 20 ft)	●	○	◐	○
Total hydraulic head (0 to 50 ft)	●	●	●	●
Total hydraulic head (50 to 100 ft)	●	◐	●	◐
Total hydraulic head (> 100 ft)	●	○	◑	○
Long history of performance	●	●	○	●
Experimental technology	No	No	Yes	No
Operational Suitability				
Gorge Powerhouse	●	○	○	○
Gorge Dam	●	◐	◐	◐
Diablo Powerhouse	●	◐	○	○
Diablo Dam	●	◐	◐	◐
Ross Dam	●	○	◐	○

Note: ○ = Low Suitability; ◐ = Moderate Suitability; ● = High Suitability

DOWNSTREAM SUITABILITY

	Potential Downstream Fish Passage Technology							
	Fixed Inlet Collectors	Floating Surface Collectors	Floating Screen Structures	Head of Reservoir Collection	In-River or Tributary Collectors	Turbine Passage	Surface Spill	Bypass Systems
Capability and Characteristic of Operating Environment								
Monitoring capability	➡	➡	➡	➡	➡	⇨	⇨	➡
Selective passage (potential for removal of invasive species)	➡	➡	➡	➡	➡	⇨	⇨	➡
Holding, sorting, sampling, biometrics, tagging, etc.	➡	➡	➡	➡	➡	⇨	⇨	➡
Multiple points of release	➡	➡	➡	➡	➡	⇨	⇨	⇨
Volitional downstream passage	➡	⇨	⇨	⇨	⇨	➡	➡	➡
Reservoir stage fluctuation (0 to 10 ft)	➡	➡	➡	➡	N/A	➡	➡	➡
Reservoir stage fluctuation (10 to 20 ft)	➡	➡	➡	➡	N/A	➡	➡	➡
Reservoir stage fluctuation (> 20 ft)	⇨	➡	➡	⇨	N/A	⇨	⇨	⇨
Total hydraulic height (0 to 50 ft)	➡	➡	➡	➡	N/A	➡	➡	➡
Total hydraulic height (50 to 100 ft)	➡	➡	➡	➡	N/A	➡	➡	➡
Total hydraulic height (> 100 ft)	➡	➡	➡	➡	N/A	⇨	⇨	➡
Effective forebay Size (< 100 ac)	➡	➡	➡	N/A	N/A	➡	➡	➡
Effective forebay Size (100-200 ac)	➡	➡	➡	N/A	N/A	➡	➡	➡
Effective forebay Size (> 200 ac)	⇨	⇨	⇨	N/A	N/A	⇨	⇨	⇨
Reservoir thermal stratification (strong)	⇨	⇨	⇨	➡	➡	⇨	⇨	⇨
Multiple target species	➡	➡	➡	➡	➡	➡	⇨	➡
Peak rates of migration (high i.e., >20,000)	➡	➡	➡	⇨	⇨	➡	➡	➡
Peak rates of migration (low i.e., <20,000)	➡	➡	➡	➡	➡	➡	➡	➡
Long history of high performance	➡	➡	➡	⇨	➡	➡	➡	➡
Experimental technology	No	No	No	Yes	Yes	No	No	No
Capable of providing high attraction flow	➡	➡	➡	⇨	⇨	➡	➡	➡
Ability to manage high debris loads	⇨	⇨	⇨	⇨	⇨	➡	➡	➡
Operational Suitability								
Gorge Dam	➡	➡	➡	➡	➡	⇨	⇨	➡
Diablo Dam	➡	➡	➡	➡	➡	⇨	⇨	➡
Ross Dam	⇨	➡	➡	⇨	➡	⇨	⇨	➡

Note: ⇨ = Low Suitability; ➡ = Moderate Suitability; ➡ = High Suitability

PASSAGE OPTIONS SUMMARY: ROSS DEVELOPMENT

Option Characteristic	Option						
	Option R1	Option R2	Option R3	Option R4	Option R5	Option R6	Option R7
Facility Locations							
Ross Powerhouse	➡	➡	➡	➡	➡	➡	➡
Forebay at Ross Intake	➡	➡			➡	➡	➡
Ross Lake at Tributary			➡				
Tributary(s) to Ross Lake				➡			
Gorge Powerhouse							
Fish Passage Strategy							
Reservoir Bypass							
Tributary Management			➡	➡	➡	➡	
Reservoir Transit	➡	➡			➡	➡	➡
Technologies for Upstream Passage							
Fish Ladder (volitional)		➡					
Trap and Transport (non-volitional)	➡		➡	➡	➡	➡	
Pneumatic Fish Transport Tube							➡
Fish Pass							
Technologies for Downstream Passage							
Forebay Collector	➡	➡			➡	➡	➡
In Tributary Collector				➡			
Head of Reservoir Collector			➡		➡	➡	
Downstream Trap and Haul	➡	➡		➡	➡		➡
Bypass Pipe/Channel						➡	➡

SUMMARY OF OPTIONS – DIABLO DEVELOPMENT

Option Characteristic	Option								
	Option D1	Option D2	Option D3	Option D4	Option D5	Option D6	Option D7	Option D8	Option D9
Facility Locations									
Diablo Powerhouse	➡		➡		➡		➡		➡
Diablo Dam		➡		➡		➡		➡	
Forebay at Dam Intake	➡	➡					➡	➡	➡
Hwy 20 at Thunder Creek					➡	➡	➡	➡	
Gorge Powerhouse									
Fish Passage Strategy									
Reservoir Bypass									
Tributary Management					➡	➡	➡	➡	
Reservoir Transit	➡	➡	➡	➡			➡	➡	➡
Technologies for Upstream Passage									
Fish Ladder (volitional)			➡	➡					
Trap and Transport (non-volitional)	➡	➡			➡	➡	➡	➡	
Pneumatic Fish Transport Tube									➡
Fish Pass									
Technologies for Downstream Passage									
Forebay Collector	➡	➡	➡	➡			➡	➡	➡
In Tributary Collector									
Head of Reservoir Collector					➡	➡	➡	➡	
Downstream Trap and Haul	➡	➡	➡	➡	➡	➡	➡	➡	➡
Bypass Pipe/Channel							➡	➡	

SUMMARY OF OPTIONS: GORGE DEVELOPMENT

Option Characteristic	Option							
	Option G1	Option G2	Option G3	Option G4	Option G5	Option G6	Option G7	Option G8
Facility Locations								
Gorge Powerhouse	➡	➡			➡		➡	
Gorge Dam			➡	➡		➡		➡
Forebay at Dam Intake	➡	➡	➡				➡	➡
Hwy 20 at Stetattle Creek					➡	➡	➡	➡
Fish Passage Strategy								
Reservoir Bypass	➡							
Tributary Management					➡	➡	➡	➡
Reservoir Transit	➡	➡	➡	➡			➡	➡
Gorge Bypass Reach			➡	➡		➡		➡
Technologies for Upstream Passage								
Fish Ladder (volitional)				➡				
Trap and Transport (non-volitional)	➡	➡	➡		➡	➡	➡	➡
Fish Pass								
Technologies for Downstream Passage								
Forebay Collector	➡	➡	➡	➡			➡	➡
In Tributary Collector								
Head of Reservoir Collector					➡	➡	➡	➡
Downstream Trap and Haul	➡	➡	➡	➡	➡	➡	➡	➡
Bypass Pipe/Channel							➡	➡

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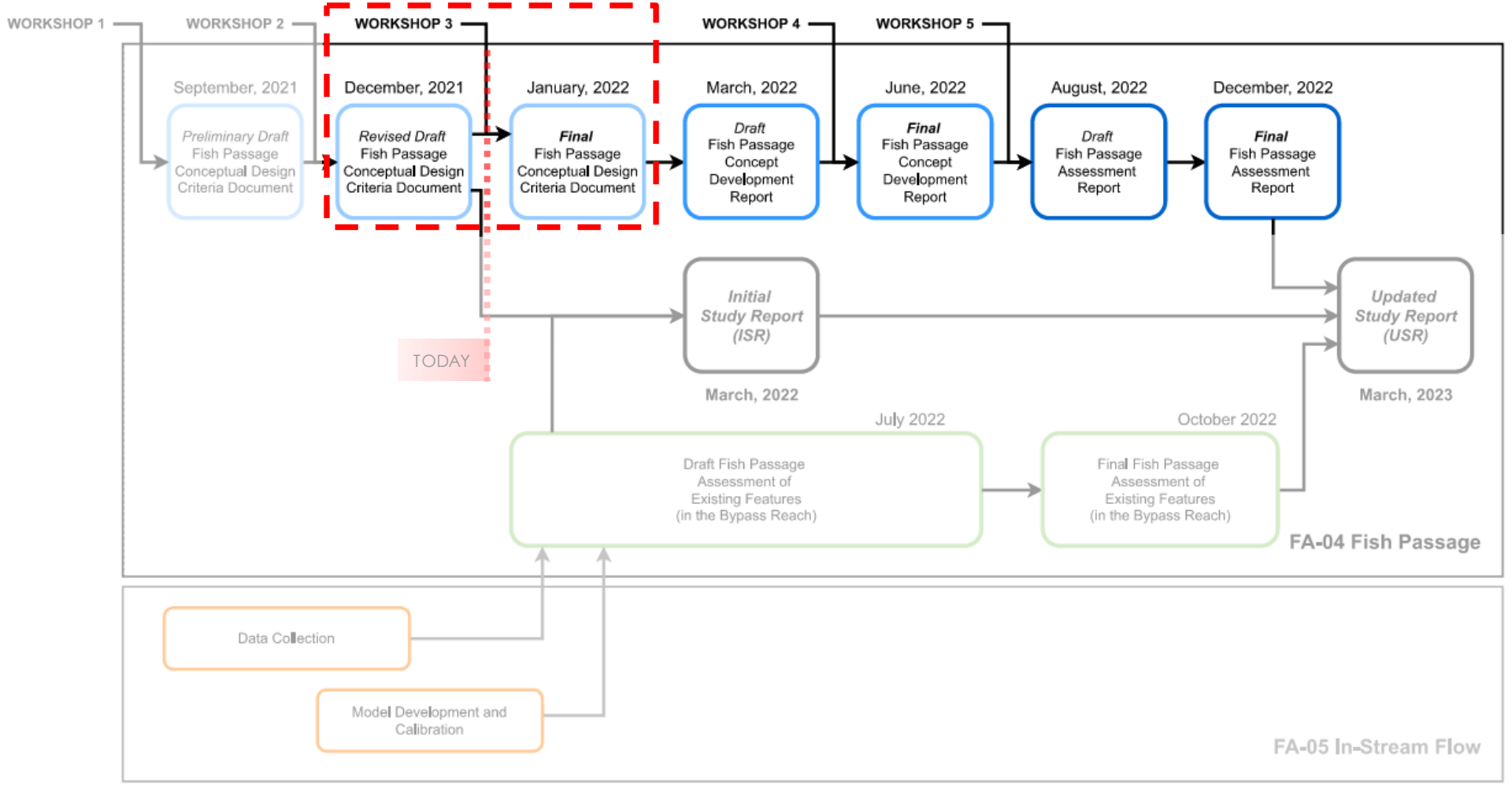
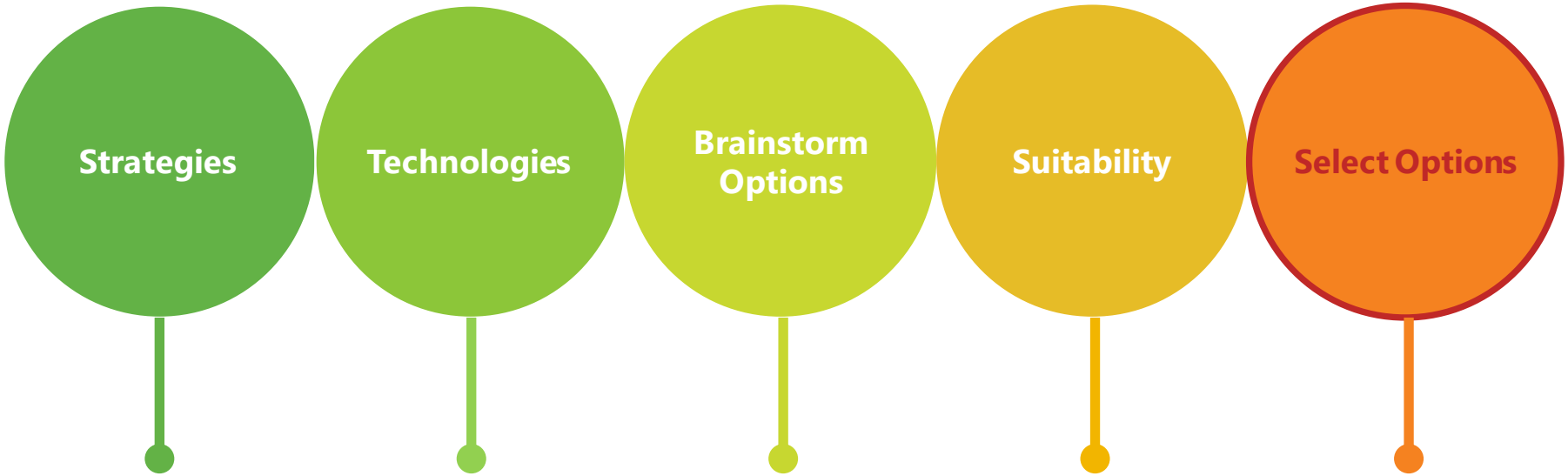
PROPOSED LIST OF OPTIONS FOR FURTHER EVALUATION

FISH PASSAGE STUDY – PROCESS FLOWCHART



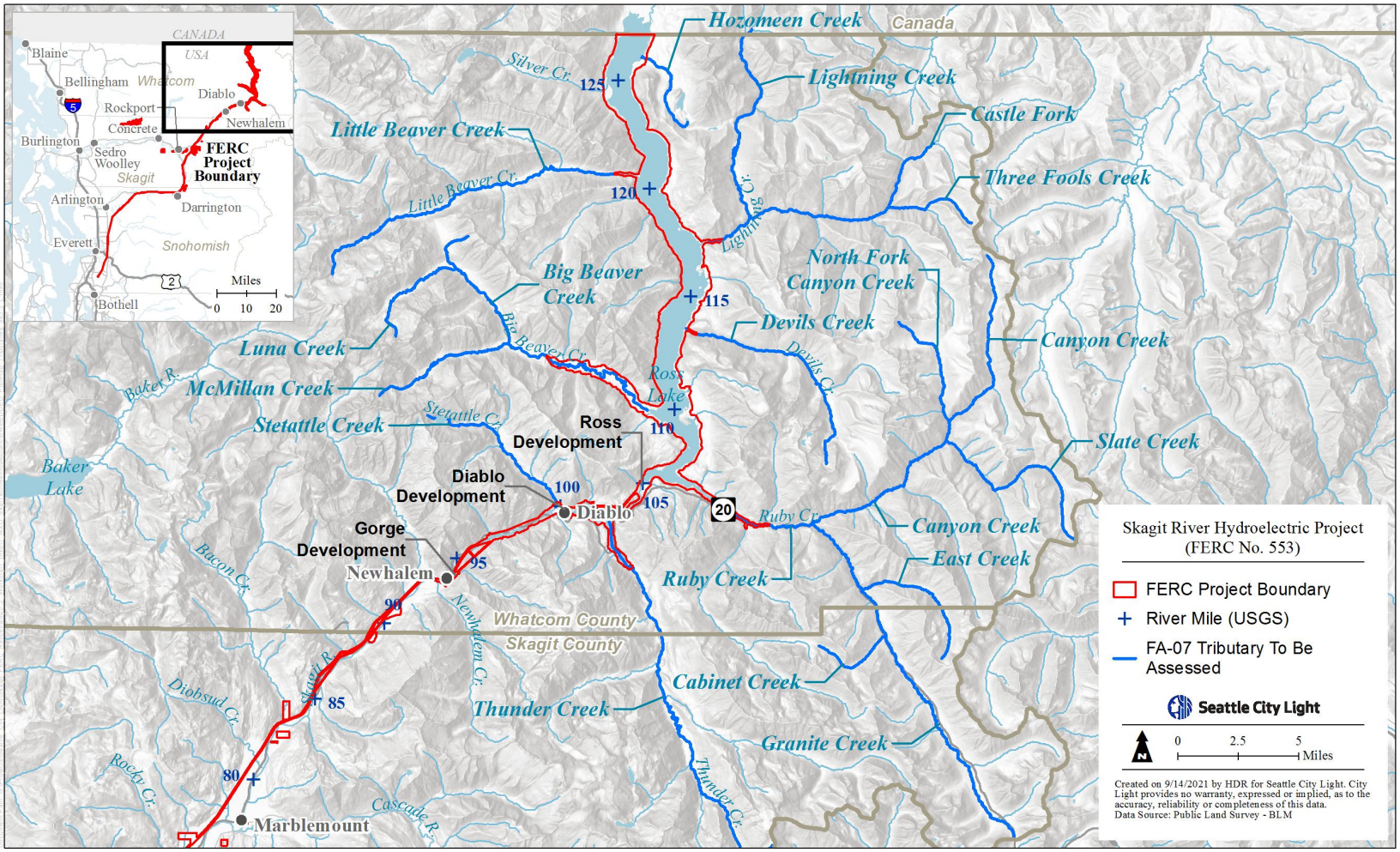
FISH PASSAGE OPTION DEVELOPMENT



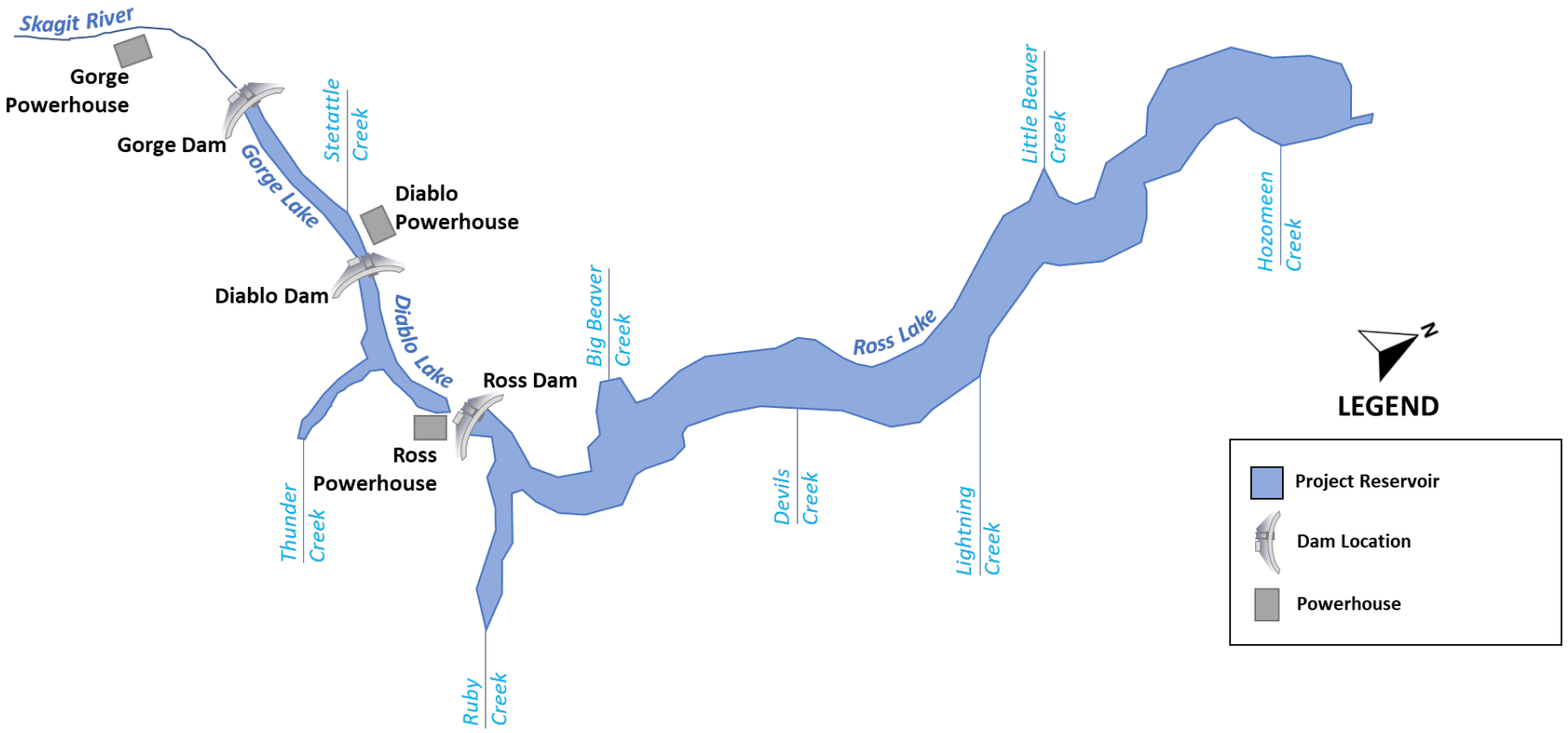
PROPOSED PATHWAY TO SELECT OPTIONS TO ADVANCE TO NEXT STUDY STAGE

- Use list of brainstorming options developed during November AWS meetings to narrow the field to those likely feasible
- Section 8 of DCD summarizes all options
- Review tables for each development and remove those that appear less suitable, unlikely to be developed due to constraints (e.g., Wilderness, Cultural, historic), or redundant
- Any option(s) not carried forward will be documented

OVERVIEW OF UPPER SKAGIT SYSTEM



OVERVIEW OF UPPER SKAGIT SYSTEM



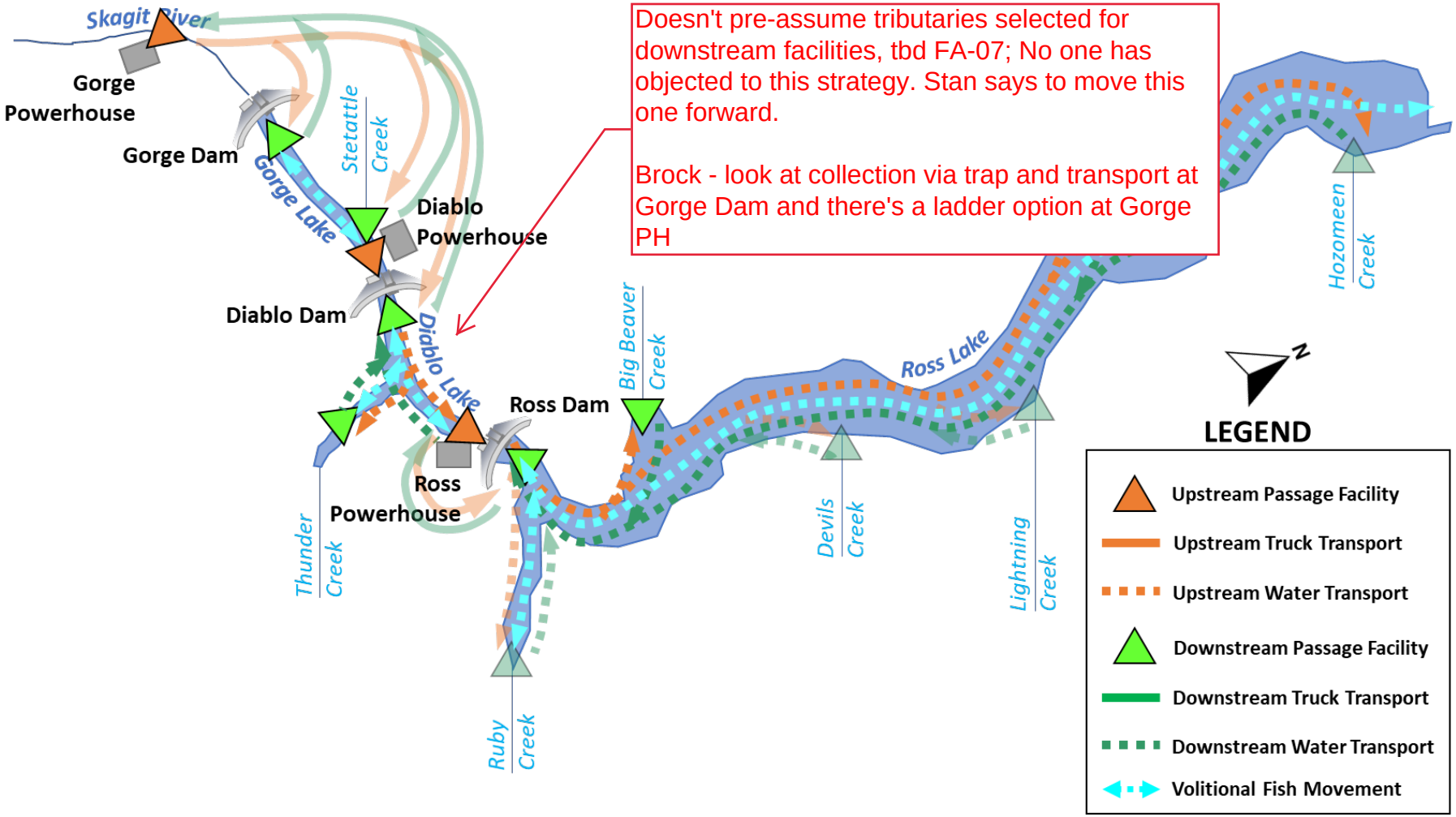
POTENTIAL OPTION 1 – MULTI OBJECTIVE

- Combines Options G7, D7, and R5
- Upstream Passage
  - Trap and Transport at each development
- Downstream Passage
  - Forebay Collector at each development
  - Head of Reservoir Tributary Collector(s) - TBD
  - Trap and Transport fish transit
- Highly adaptable to numerous biological goals and fish management strategies

POTENTIAL OPTION 1 – MULTI OBJECTIVE

Option Characteristic	Project Location										
	George Powerhouse	Gorge Dam	Forebay at Gorge Intake	Stetattle Creek	Diablo Powerhouse	Diablo Dam	Forebay at Diablo Intake	Thunder Creek	Ross Dam	Forebay at Ross Intake	Ross Lake Tributaries
Fish Passage Strategy											
Reservoir Bypass				→				→			→
Selective Passage/Transport				→				→			→
Tributary Management				→				→			→
Reservoir Transit				→				→			→
Volitional Self-Selection				→				→			→
Inter-project Reservoir Transit				→				→			→
Technologies for Upstream Passage											
Fish Ladder (volitional)											
Trap and Transport (non-volitional)	→				→				→		
Pneumatic Fish Transport Tube											
Fish Pass											
Technologies for Downstream Passage											
Forebay Collector			→				→			→	
In Tributary Collector											
Head of Reservoir Collector				→				→			→
Downstream Trap and Haul			→	→			→	→		→	→
Bypass Pipe/Channel											

POTENTIAL OPTION 1 – MULTI OBJECTIVE



POTENTIAL OPTION 2 – RESERVOIR BYPASS

- Option G1
- Upstream Passage
  - Trap and Transport at Gorge Powerhouse only
- Downstream Passage
  - Forebay Collector at Ross Intake Forebay only
  - Trap and Transport fish transit
- Focused strategy using available habitat upstream of Ross Dam

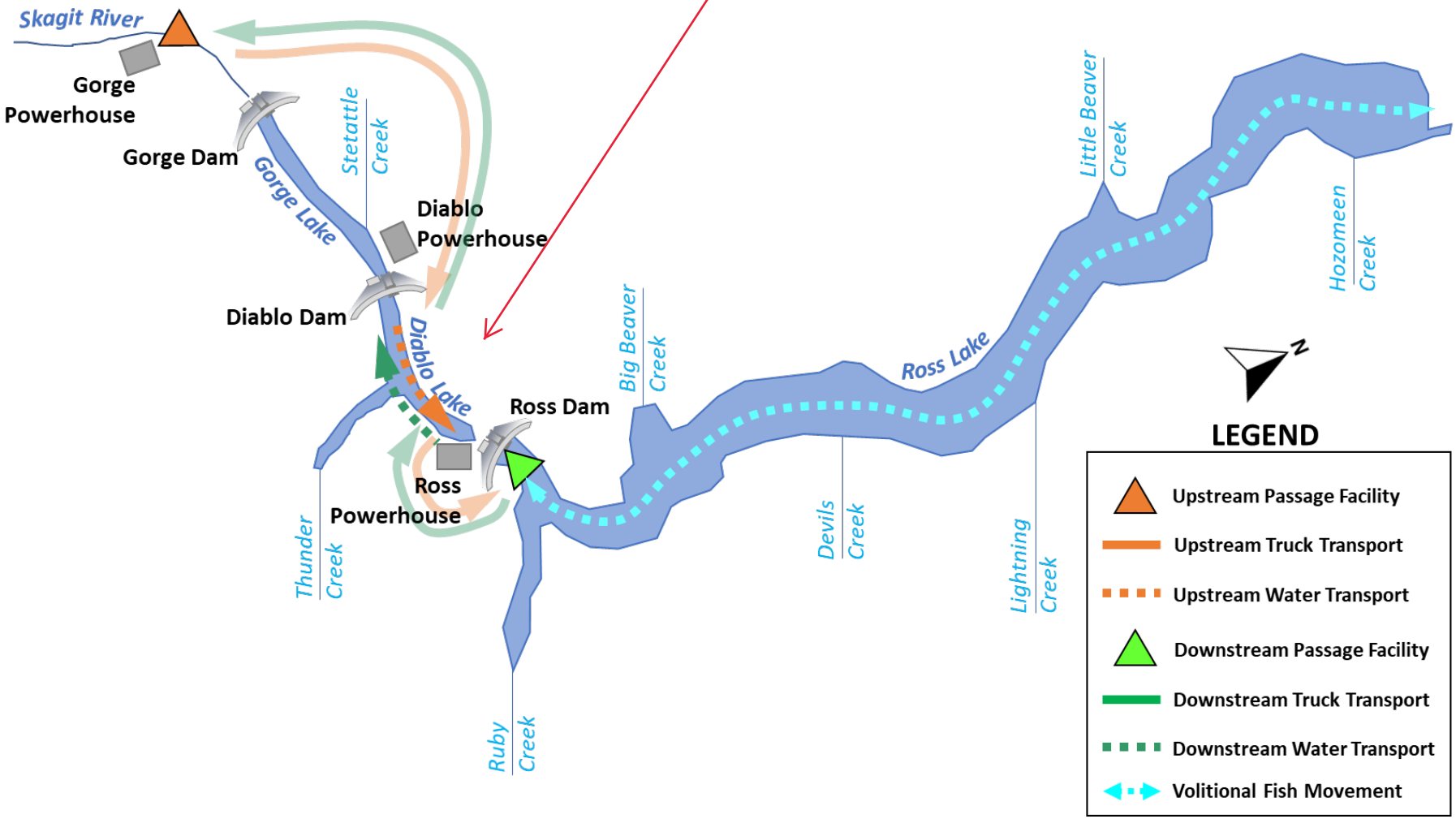
POTENTIAL OPTION 2 – RESERVOIR BYPASS

Option Characteristic	Project Location										
	George Powerhouse	Gorge Dam	Forebay at Gorge Intake	Stetattle Creek	Diablo Powerhouse	Diablo Dam	Forebay at Diablo Intake	Thunder Creek	Ross Dam	Forebay at Ross Intake	Ross Lake Tributaries
Fish Passage Strategy											
Reservoir Bypass				→				→			→
Selective Passage/Transport											→
Tributary Management											
Reservoir Transit											→
Volitional Self-Selection											→
Inter-project Reservoir Transit											
Technologies for Upstream Passage											
Fish Ladder (volitional)											
Trap and Transport (non-volitional)	→										
Pneumatic Fish Transport Tube											
Fish Pass											
Technologies for Downstream Passage											
Forebay Collector										→	
In Tributary Collector											
Head of Reservoir Collector											
Downstream Trap and Haul										→	
Bypass Pipe/Channel											

reminded him that that's a management strategy and this would
Would have to develop goals first. If self-selection and reservoir
Trout is required, we should potentially not look at this option.

Jeff - agree that this might work for BT - BT passage between re
important.

POTENTIAL OPTION 2: RESERVOIR BYPASS



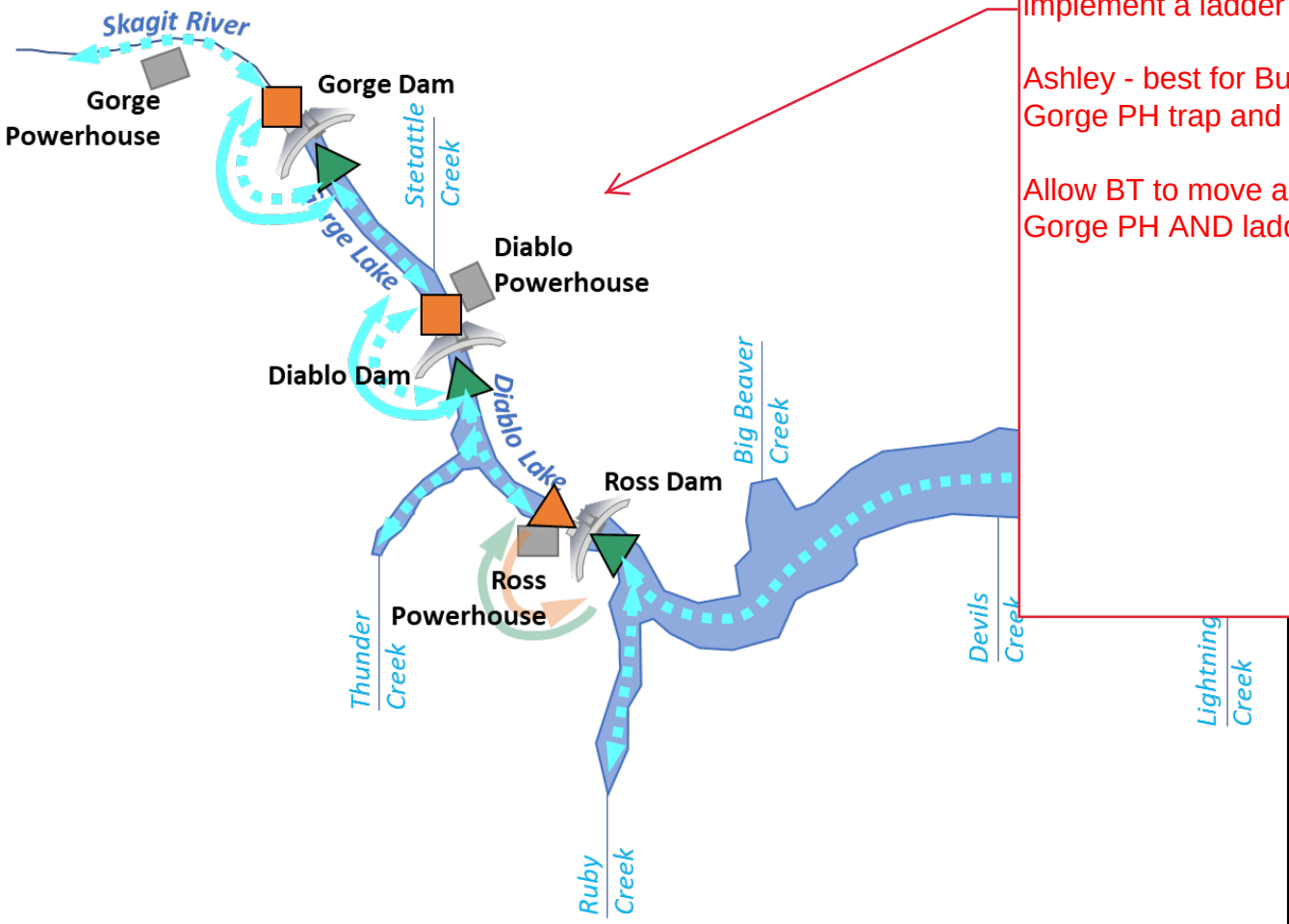
POTENTIAL OPTION 3 – VOLITIONAL

- Combines G4, D4, and R1
- Upstream Passage
  - Fish Ladder at Gorge and Diablo Dams
  - Trap and Transport at Ross Dam
- Downstream Passage
  - Forebay Collector at each development
  - Downstream bypass pipe
- Emphasis on volitional upstream and downstream fish migration, self-selection, with potential for inter-project reservoir transit. Limits trap and haul.

POTENTIAL OPTION 3 – VOLITIONAL

Option Characteristic	Project Location										
	George Powerhouse	Gorge Dam	Forebay at Gorge Intake	Stetattle Creek	Diablo Powerhouse	Diablo Dam	Forebay at Diablo Intake	Thunder Creek	Ross Dam	Forebay at Ross Intake	Ross Lake Tributaries
Fish Passage Strategy											
Reservoir Bypass											
Selective Passage/Transport											
Tributary Management											
Reservoir Transit				→				→			→
Volitional Self-Selection				→				→			→
Inter-project Reservoir Transit				→				→			→
Technologies for Upstream Passage											
Fish Ladder (volitional)		→				→					
Trap and Transport (non-volitional)									→		
Pneumatic Fish Transport Tube											
Fish Pass											
Technologies for Downstream Passage											
Forebay Collector			→				→			→	
In Tributary Collector											
Head of Reservoir Collector											
Downstream Trap and Haul											
Bypass Pipe/Channel		→				→			→		

POTENTIAL OPTION 3 – VOLITIONAL



implement a ladder at gorge PH possible?

Ashley - best for Bull Trout, but for anadromous might want Gorge PH trap and haul up to Ross.

Allow BT to move around better - trap and transport at Gorge PH AND ladder at Gorge Dam

- US Trap and Haul Facility
- Upstream Truck Transport
- Downstream Passage Facility
- Downstream Truck Transport
- Fish Bypass
- Volitional Fish Movement

SUMMARY OF OPTIONS 1 THROUGH 3

Option Characteristic	Project Location										
	George Powerhouse	Gorge Dam	Forebay at Gorge Intake	Stetattle Creek	Diablo Powerhouse	Diablo Dam	Forebay at Diablo Intake	Thunder Creek	Ross Dam	Forebay at Ross Intake	Ross Lake Tributaries
Fish Passage Strategy											
Reservoir Bypass				➡				➡			➡
Selective Passage/Transport				➡				➡			➡
Tributary Management				➡				➡			➡
Reservoir Transit				➡				➡			➡
Volitional Self-Selection				➡				➡			➡
Inter-project Reservoir Transit				➡				➡			➡
Technologies for Upstream Passage											
Fish Ladder (volitional)		➡				➡					
Trap and Transport (non-volitional)	➡				➡				➡		
Pneumatic Fish Transport Tube											
Fish Pass											
Technologies for Downstream Passage											
Forebay Collector			➡				➡			➡	
In Tributary Collector											
Head of Reservoir Collector				➡				➡			➡
Downstream Trap and Haul			➡	➡			➡	➡		➡	➡
Bypass Pipe/Channel		➡				➡					

DISCUSSION

- Questions and Discu

Brock - look at ladder only at Diablo, doesn't think ladder at Gorge is viable

Stan - reservoir bypass downstream bypass strategy: juveniles could be flushed downstream during spills and have no way out. Solution - add forebay collectors at Diablo and Gorge to collect juveniles and move to Skagit

Andrew asked Stan if still concerned about flushing over dam if focused on tributary collectors. Stan says yes because production wouldn't be limited to tribs as some rearing would occur in reservoirs. Gave Baker River as example where sockeye lost.

Dudley - Suggests phasing and testing - pilot study and incremental testing; he said doing a good job teasing out alternatives: Mike, yes, array of data gaps and study needs to address engineering and biological data gaps if an alternative moved forward. As part of Stage 2 - where start talking about costs, what if - did a pilot study. As go into Concept Development Report - will discuss implementation and costs, can consider phasing as an option for passage implementation in addition to the full-blown passage concepts presented in the Workshop 3 ppt. In spirit of providing wide range of options, can keep broad range now - inform later decisions when information is better known.

Andrew - discuss bypass reach - should we collect at Gorge PH to avoid it? not much response and Matt Love recommended we don't talk about it. Rick said the bypass is culturally sensitive for many reasons. Brian - flows are also important. Rick - what options are tribes comfortable with? Rick says - tribe may not want Gorge PH collection the bypass is sensitive and and can't say if it should be avoided now, but maybe later....

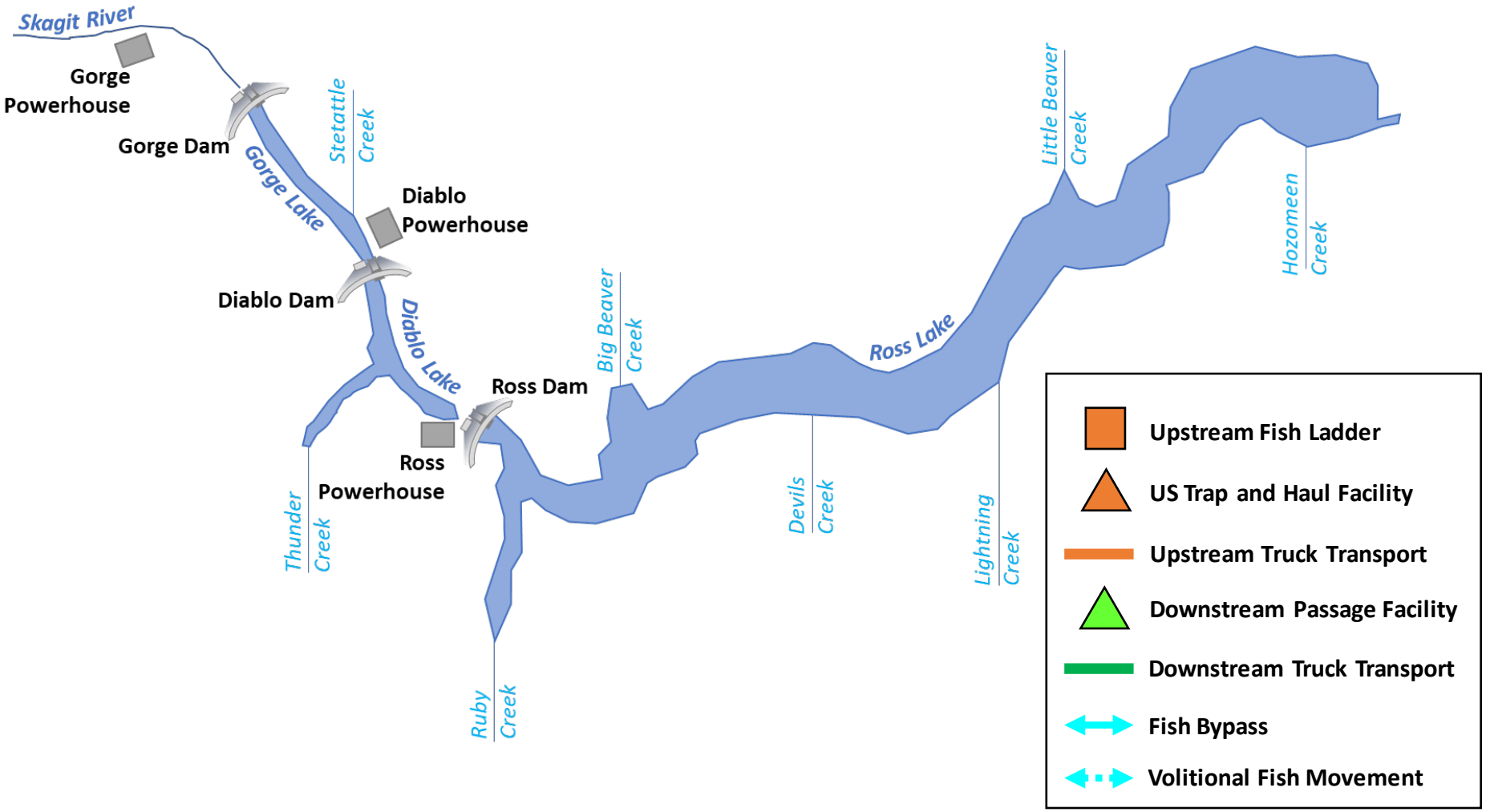
POTENTIAL OPTION(S) – TBD

- TBD
- Upstream Passage
  - TBD
- Downstream Passage
  - TBD
- Emphasis TBD

POTENTIAL OPTION(S)– TBD

Option Characteristic	Project Location										
	George Powerhouse	Gorge Dam	Forebay at Gorge Intake	Stetattle Creek	Diablo Powerhouse	Diablo Dam	Forebay at Diablo Intake	Thunder Creek	Ross Dam	Forebay at Ross Intake	Ross Lake Tributaries
Fish Passage Strategy											
Reservoir Bypass											
Selective Passage/Transport											
Tributary Management											
Reservoir Transit											
Volitional Self-Selection											
Inter-project Reservoir Transit											
Technologies for Upstream Passage											
Fish Ladder (volitional)											
Trap and Transport (non-volitional)											
Pneumatic Fish Transport Tube											
Fish Pass											
Technologies for Downstream Passage											
Forebay Collector											
In Tributary Collector											
Head of Reservoir Collector											
Downstream Trap and Haul											
Bypass Pipe/Channel											

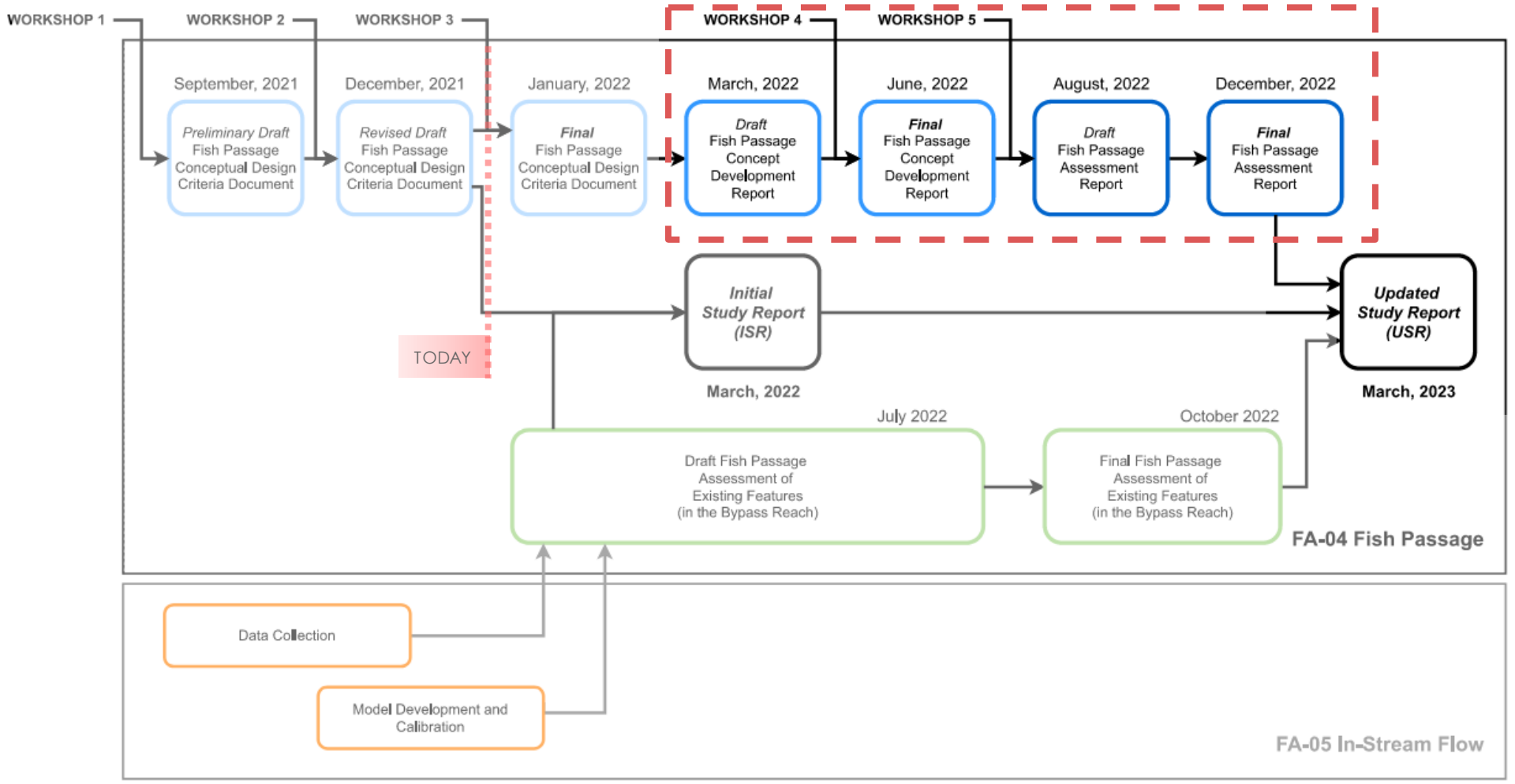
POTENTIAL OPTION(S)– TBD



NEXT STEPS

- Refine options in collaboration with AWS participants
- Complete Final DCD
- Concept Development Report (stage 2 of this study) will focus on conceptual design, preliminary engineering, and cost development.
- Feasibility assessment will be performed As part of the Fish Passage Facility Assessment (stage 3 of this study).

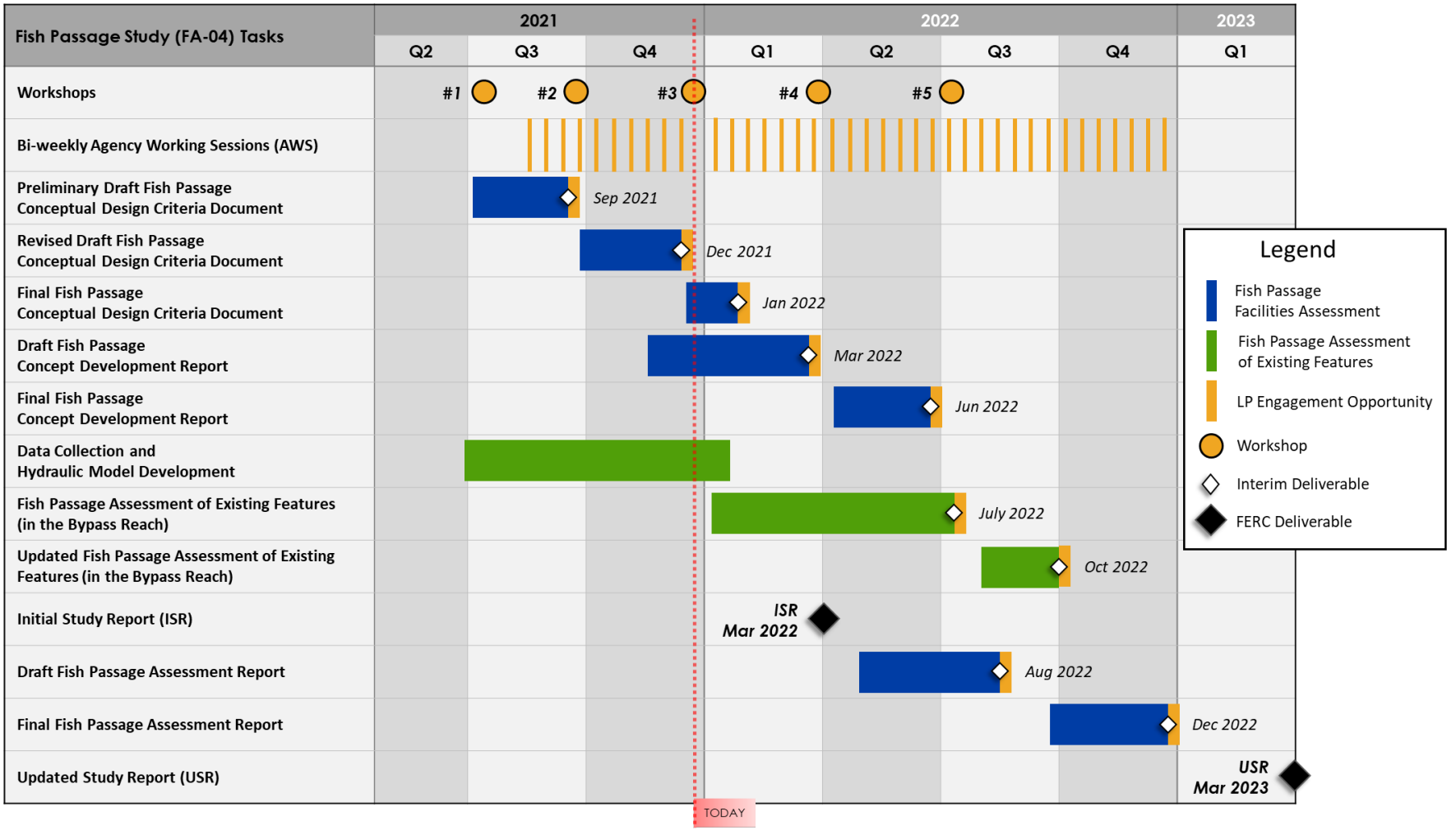
FISH PASSAGE STUDY – PROCESS FLOWCHART



Seattle City Light

ACTION ITEMS AND NEXT STEPS

SCHEDULE OVERVIEW



FISH PASSAGE FACILITIES ASSESSMENT – KEY MILESTONES

Milestone	Anticipated Schedule
Fish Passage Conceptual Design Criteria Report	
Revised Draft DCD and Workshop No. 3	**December 2021**
Final DCD	January 2022
Initial Study Report	March 2022
Fish Passage Concept Development Report	
Draft Report	March 2022
Final Report	June 2022
Fish Passage Assessment of Existing Features in the Bypass Reach	
Draft Report	July 2022
Final Report	October 2022
Fish Passage Assessment Report	
Draft Report	August 2022
Final Report	December 2022
Updated Study Report (USF, Fish Passage Study Sections)	March 2023

ACTION ITEMS AND NEXT STEPS

- Review action items
- Next steps
  - Finalize list of potential fish passage options
  - Develop Final Fish Passage Facilities Design Criteria Document
  - Begin developing Draft Fish Passage Concept Development Report
  - Develop concept designs and cost estimates for each option
  - Spring 2022 – Initiate Fish Passage Assessment of Existing Features in the Bypass Reach

OUR MISSION

Seattle City Light is dedicated to delivering customers affordable, reliable and environmentally responsible electricity services.

OUR VISION

We resolve to provide a positive, fulfilling and engaging experience for our employees. We will expect and reinforce leadership behaviors that contribute to that culture. Our workforce is the foundation upon which we achieve our public service goals and will reflect the diversity of the community we serve.

We strive to improve quality of life by understanding and answering the needs of our customers. We aim to provide more opportunities to those with fewer resources and will protect the well-being and safety of the public.

We aspire to be the nation's greenest utility by fulfilling our mission in an environmentally and socially responsible manner.

OUR VALUES

Safety, Environmental Stewardship, Innovation, Excellence, Customer Care

THE NATION'S GREENEST UTILITY
SINCE 1905
SEATTLE CITY LIGHT

Seattle City Light

Skagit Hydroelectric Project Relicensing:
FA-04 Fish Passage Work Group
December 16, 2021

Meeting Summary

Attendance

Licensing Participants (LPs):
Brock Applegate, WA Department of Fish & Wildlife (WDFW)
Stuart Beck, Kleinschmidt Associates (for Swinomish Indian Tribal Community)
Curtis Clement, Upper Skagit Indian Tribe (USIT)
Matt Cutlip, Federal Energy Regulatory ~~Committee~~Commission (FERC)
Jeff Garnett, US Fish and Wildlife Service (USFWS)
Rick Hartson, USIT
Brian Lanouette, USIT
Kevin Lautz, WDFW
Bridget Moran, American Rivers
Logan Negherbon, National Marine Fisheries Service~~s~~ (NMFS)
Duncan Pfeifer, WDFW
Ashley Rawhouser, National Park Service (NPS)
Dudley Reiser, Kleinschmidt Group (for Swinomish Indian Tribal Community~~Tribe~~)
Valentino Villaluz, Swinomish Indian Tribal Community
Stan Walsh, Skagit River System Cooperative (SRSC)
Erik Young, Skagit Fisheries Enhancement Group

Seattle City Light (City Light):
Andrew Bearlin, City Light
Erin Lowery, City Light

Cascadia Law (for City Light)
Matt Love, Cascadia Law

Consultant Team:
Jenna Borovansky, HDR
Mike Garello, HDR
Becky Holloway, HDR
Bao Le, ~~HDR~~HEC
Nicole Loo, HDR
Theo Malone, HDR
Jacob Venard, HDR

Facilitation Team:
Greer Maier, Triangle Associates
Lauren Schultz, Triangle Associates

Meeting Materials

Meeting materials sent in advance:

- Revised Draft Design Criteria Document (DCD) & Attachment E Comment Response Matrix
- NOA Commitments
- Agency Work Session Meeting Notes
- Fish Passage Work Group Discussion Tracker
- Meeting Presentation

Action Items

Action Item	Responsibility	Deadline
Licensing Participants		

LPs will submit comments, questions and feedback on the Revised Draft Design Criteria Document (DCD) to the Consultant Team by January 6th; **Mike Garello** (mike.garello@hdrinc.com) and **Becky Holloway** (becky.holloway@hdrinc.com)	LPs	**January 6, 2022**
City Light		
The Agency Work Session (AWS) group will further discuss fish passage ~~alternative~~ options at their January 10th meeting.	AWS Group/Consultant Team	**January 10, 2022**

Summary of Issues Discussed, Action Items, and Decisions

Welcome and Agenda Overview

The facilitator, Greer Maier, Triangle Associates, welcomed the group and led a roll call. She gave a brief overview of the meeting purpose. Objectives for the meeting included:

- Inform LPs regarding the status of the Fish Passage Assessment of Existing Features in the Bypass Reach study and report.
- Inform LPs about how comments on the Preliminary Draft Design Criteria Document (DCD) were responded to and incorporated into the Revised Draft.
- Inform LPs regarding the development of passage options for each alternative as discussed during Agency Work Sessions (AWS).
- Discuss factors influencing fish passage facility technical feasibility.
- Request concurrence on which fish passage alternatives will be carried forward into the Concept Development Report (Stage 2 of the Fish Passage Facilities Alternatives Assessment).

Becky Holloway, HDR- Consultant Team, provided an overview of the agenda and fish passage study schedule (see slide 6). She described the current process and two deliverables of the study: the Fish Passage Facilities Alternatives Assessment and the Fish Passage Assessment of Existing Features in the Gorge Bypass Reach. The next stage of the Fish Passage Facilities Alternatives Assessment~~assessment~~ includes the development of concept designs and cost estimates for each alternative. She mentioned the ISR report will provide a summary of work to date and will be part of the overall study report provided to FERC in 2022. Becky noted that the Fish Passage Agency Work Session (AWS) group has been meeting bi-weekly. AWS meeting notes can be found here.

Fish Passage Assessment of Existing Features in the Bypass Reach

Mike Garello, HDR- Consultant Team, outlined the process for developing the Fish Passage Assessment of Existing Features in the Bypass Reach. He explained the elements of the Bypass Reach assessment, noting that most of the field work and data collection has been completed (see slide 13). Currently, the study team is using site characterization and field data to inform and calibrate the Hydrodynamic model. This information will be compiled to understand how flow ranges may limit or promote fish passage.

Mike explained that field work was done in collaboration with the FA-05 Instream Flow study team. He described the various tools used for field work and provided examples of the application of each tool, including timelapse photos from a range of flows in the Bypass Reach (see slides 15-29).

In the next phase of the study, fish passage potential for target species will be evaluated over a range of flows, using swim and endurance data for species and surrogates. The draft bypass reach assessment report will be available for LP review on July 1, 2022.

Questions and Discussion

- In response to a question regarding estimated unregulated hydrology, Mike clarified that hydrology falls under the FA-05 Instream Flow study.

Overview of Revised Draft DCD

Becky Holloway provided an overview of the Revised Draft DCD and Comment Matrix (Attachment E). She described the elements completed thus far and emphasized the need to narrow the list of feasible fish passage alternatives. She then walked through comments on the Preliminary DCD, noting common themes (see slides 35-38). One of the common themes of comments was illustrated by a NMFS comment. Becky asked Logan Negherbon, NMFS, to read his comment and explain the rationale. Logan noted that the study should include all fish passage solutions deemed technically feasible, rather than a recommended passage solution. City Light and the AWS concurred with this approach and decided that agencies and co-managers will develop biological and fish management goals in the future, and that the development of such goals is not part of this study.

Next, Becky explained how all comments were coded based on their status (resolved, unresolved, resolution pending, and rolled over to next submittal). The majority of comments were resolved, and all comments received a response in the comment response matrix. Becky described the type of comments that were deferred and the substantive changes in the DCD that were developed from the comments. The largest changes were made in Section 5 in part due to the AWS's decision to pivot away from developing biological goals and objectives within the study context (see slides 39-41). In addition, a new Section (8) was developed to summarize all upstream and downstream passage options discussed to date during AWS meetings, for each development.

Questions and Discussion

- When asked about next steps, Becky clarified that the study team would appreciate comments on the Revised Draft DCD by January 6, 2022.

Action Items:

- LPs will submit comments, questions and feedback on the Revised Draft Design Criteria Document (DCD) to the Consultant Team by January 6th; **Mike Garello** (mike.garello@hdrinc.com) and **Becky Holloway** (becky.holloway@hdrinc.com).

Development of Fish Passage Options

Mike Garello described how the proposed fish passage strategies were developed through brainstorming at the AWS meetings. These AWS brainstorming sessions generated a wide range of potential fish passage options. Stan Walsh, a member of the AWS group, explained that the AWS decided to shift focus from biological goals & objectives to the technical feasibility of fish passage options. Theo Malone, HDR- Consultant Team, further described the AWS brainstorming process, highlighting the collaborative process used to gather feedback on potential fish passage options. Theo described the process the AWS used to develop fish passage options at each development (slides 45-50).

Mike then walked through options for Gorge, Diablo, and Ross dams that resulted from the brainstorming. He showed tables that described each of the options for each development based on

facility locations, fish passage strategies, technologies for upstream passage, and technologies for downstream passages. Mike also showed maps and described potential upstream and downstream fish passage facilities, transport, and bypass options (see slides 50-82 and *Section 8 – Potential Fish Passage Facility Options* in the Revised Draft DCD). Options that are not selected for advancement to the next stage of the study~~as part of the final criteria design document~~ will be documented in the final DCD, with rationale for exclusion from further consideration.

Discussions and Questions:

- In response to a question from NPS, Theo clarified that the symbols presented on the maps are not precise locations, but rather representative locations for discussion purposes.

Discuss Factors Influencing Fish Passage Facility Technical Feasibility

Mike Garello showed how the feasibility analysis fits into the steps and timeline for fish passage study development. He defined technical feasibility and described feasibility factors that will be used (slides 87-92). Mike described how the application of suitability criteria and feasibility factors fits in the study timeline. He identified two specific goals of the Work Group discussion: (1) develop a narrow list of all passage technologies that have been considered to date, based on factors that influence feasibility; and (2) select a range of options that bracket the variety of biological and fish management opportunities. Mike then explained that after the DCD is finalized and fish passage feasibility options are narrowed down, the feasibility factors can be further refined in 2022.

Methods for Selection of Fish Passage

Mike walked through the option review and selection process based on suitability (see slide 100-102). Mike detailed the range of options for strategies and technologies for both upstream and downstream passage at each facility (see slides 102-104 – note: fish graphics in tables represent the level of suitability in qualitative terms). Mike noted that a narrative is in development for fish passage suitability.

Questions and Discussion:

- In response to a question from NPS about the feasibility of using the haul road between Diablo and Ross dams, Mike explained the transport from Diablo to Ross would be long but still possible by using trucks and barges. A key consideration identified during the AWS brainstorming discussions was the potential need for significant infrastructure improvements or other mitigating methods to overcome transport issues.
- In response to a question from the Skagit River System Cooperative regarding the size of tank trunks, Mike mentioned that this question will be addressed in concept development.
- There was general discussion around the types of fish passage transport options being considered as well as why they are not ranked. Mike explained that many of the technologies have similar elements, but it's a matter of where and how an option is implemented that makes the difference in feasibility.
- Jeff Garnett, USFWS, suggested differentiating and narrowing down options to reflect the considerable differences between use cases and feasibility.
- There was a question about the "fish pass" category for upstream passage.
- Mike clarified a question related to the feasibility of floating verses fixed juvenile collectors, explaining that if a fixed collector is feasible, it is likely more efficient in regard~~s~~ to the level of engineering, construction, and cost needed to implement. Logan Negherbon added that fixed and floating collectors are of equal suitability, but floating is less preferred.
-

Proposed List of Alternatives for Further Evaluation

Mike Garello summarized the proposed options for further evaluation that the AWS developed. He explained that the study's goal is to create a range of options that brackets the range of feasibility. The options represent a wide range of management strategies and inform concept development and cost estimates. Mike noted that this is an essential discussion to gather additional feedback to inform the Final DCD. Mike then provided an overview of the potential three options for the Work Group to consider:

Potential Option 1 – Multi Objective (see slides 114-116)
This strategy combines several fish passage options and has the greatest level of flexibility, feasibility, and adaptability to accomplish ~~the~~future biological goals and fish management strategies. This multi-objective potential strategy combines G7, D7, and R5 and would use an upstream fish passage approach using trap and transport at various points of release. Downstream passage would include an array of forebay collectors at the intake as well as head reservoir tributary collectors (informed by productivity levels determined in FA-07). The strategy offers a broad array of options for fish passage and future fish passage strategies to be determined be resource agencies and co-managers.

Potential Option 2 – Reservoir Bypass (see slides 117-119)
This strategy is the simplest and most straightforward and is similar to that used in the Lewis River, with a collection facility at Gorge Powerhouse for trap and transport and a forebay collector at Ross Intake for trap and transport downstream. This strategy does not provide the opportunity for managing fish throughout multiple reservoirs but could be modified.

Potential Option 3: Volitional (see slides 120-122)
This strategy focuses on fish ladders in Gorge and Diablo dams, and trap and transport options at Ross (combining multiple facilities and strategies). This option emphasizes volitional upstream and downstream fish migration, self-selection, and the potential for inter-project reservoir transit. It limits trap and haul. There would be fish ladders at Gorge and Diablo dams with trap and transport at Ross Dam. For downstream passage, fish are collected via forebay collectors and could be moved via bypass pipe(s).

Questions and Discussion:

- In response to a question from WDFW regarding the implementation of fish ladders, Mike explained that it would be difficult to implement a fish ladder. He also mentioned that there are challenges with fish ladders. Mike noted the study team would incorporate forebay collectors to assist with downstream fish passage.
- A representative from the Skagit River System Cooperative noted that not having engineered downstream passage in *Option 2 – Reservoir Bypass* at all dams may be problematic because spill cannot be controlled, and fish may get trapped.
- There was a brief discussion on trap and transport, and the opportunity to establish more certainty through phasing of the fish passage strategies. Mike clarified that there will be data gaps that will need to be addressed down the road through concept development. Andrew Bearlin, City Light, suggested greater thought and conversation around phasing in future Work Group meetings.
- In response to a question from City Light regarding tributary trapping strategies, a representative from the Skagit River System Cooperative expressed that tributary trapping would not be all-encompassing, and fish production is not limited to those tributary areas where trapping would occur.
- A representative from the Skagit River System Cooperative raised two questions for future consideration: (1) how often would spill occur? and (2) what are the ways in which fish could move around collection facilities and how frequently could this occur?
- The group discussed fish passage options being implemented at dams versus the powerhouse. A representative from WDFW noted the fish passage potential at dams versus the powerhouse and

the potential productivity in the bypass reach. Mike Garello mentioned that those locations can be modified based on input.

- A representative from City light suggested further conversation around the challenges and opportunities in the bypass reach. The group briefly discussed the cultural importance of the bypass reach. Andrew also described City Light's commitment to implementing instream flows in the bypass reach.
- In response to a question from USIT regarding the mapped locations of tributary collection, Mike clarified that the study team is not singling out any tributaries, but instead providing typical examples that can be used to develop costs and concepts associated with developing~~implanting~~ fish passage options at specific sites.
- In response to a question from NPS regarding the type of fish productivity information needing to be gathered from FA-07, Andrew Bearlin explained that FA-07 could inform fish passage options and locations. This was noted as a topic for study integration.
- The group discussed advancing *Option 1 – Multi Objective* for further consideration, noting the need for greater refinement on the locations of upstream passage facilities and downstream facility sites in the tributaries. Mike clarified that the discussion is a first step at refining strategies, and further iterations will be developed at AWS meetings. No opposition was indicated for the advancement of *Option 1 – Multi Objective*.
- The group discussed the advancement of *Option 2 – Reservoir Bypass*. Mike described modifications and future discussion points for this option. Logan suggested adding trap and transport at Gorge Dam. Mike noted the limitations of fish passage with this strategy (e.g., bull trout). Use cases could inform future fish passage policy decisions and biological goals. The group indicated that *Option 2 – Reservoir Bypass* needed further discussion in the AWS group.
- In response to a question from American Rivers regarding the number of miles of spawning habitat in Stetattle Creek, Erin Lowery estimated 1/4 or 1/2 mile.
- Mike Garello described modifications to *Option 3 – Volitional,* such as implementing ladders at Diablo and moving trap and transport to Ross, making this option similar to *Option 1 – Multi Objective*. The feasibility of fish ladders needs to be discussed. Andrew Bearlin clarified that no one strategy is meant to be the ultimate fish passage solution, but rather representative of the types of facilities and operations that could be employed. Mike added that these strategies outlining feasibility could inform future decisions and are not meant as recommendations. Mike noted that further discussion is needed within the AWS group to refine *Option 3 – Volitional*.
- Dudley Reiser, KA/Swinomish, asked that given the uncertainty in how successful individual or combined specific options will be, whether "phasing" of fish passage components would be a part of the evaluation process. Mike acknowledged that phasing would be considered.

Next Steps

Mike explained next steps, which include further refinement of fish passage options with the AWS; finalizing the DCD in January; and starting the Draft Fish Passage Concept Development Report. Greer noted that the next AWS meeting will be on January 10th, where the group will refine fish passage options. The AWS meetings occur every two weeks. The next FA-04 Fish Passage Work Group meeting is scheduled for ~~will take place on~~ January 27th.

Action Item:

- The Agency Work Session (AWS) group will further discuss fish passage alternative options at their January 10th AWS meeting.

Meeting adjourned at 4:40 pm.

FISH PASSAGE TECHNICAL STUDIES INTERIM REPORT

ATTACHMENT D

AGENCY WORK SESSION DISCUSSION SUMMARIES

Skagit River Hydroelectric Project
Seattle City Light (City Light)
FA-04 Fish Passage Agency Work Session[1]
Meeting Date – August 9, 2021

Summary of Discussion Topics, Agreements, Ongoing Discussions, and Action Items

Attendance

Licensing Participants (LPs):
Brock Applegate, Washington Department of Fish and Wildlife (WDFW)
Duncan Pfeifer, WDFW
Kevin Lautz, WDFW
Brian Lanouette, Upper Skagit Indian Tribe (USIT)
Jon-Paul Shannahan, USIT
Stephen Lewis, U.S. Fish and Wildlife Service (FWS)
Jared McKee, FWS
Jeff Garnett, FWS
Logan Negherbon, National Marine Fisheries Service (NMFS)
Stan Walsh, Skagit River System Cooperative (SRSC)

Seattle City Light (City Light):
Erin Lowery, City Light
Andrew Bearlin, City Light

Consultant Team:
Michael Garello, Consultant Team
Becky Holloway, Consultant Team
Bao Le, Consultant Team
Jacob Venard, Consultant Team
Theo Malone, Consultant Team
Nicole Loo, Consultant Team

Summary of Discussion Topics

1. Introductions: Affiliation, Project Role, Relevant Experience
2. Agency Work Session (AWS) Goals and Objectives
    a. Goal of work session is to provide a collaborative forum to review activities, discuss next steps, and solicit feedback regarding the technical details involved in FA-04 efforts
    b. Discussed additional items that participants would like discussed in these meetings
3. Study Plan Progress and Schedule Update
    a. Reviewed Look-Ahead Schedule and Milestones for Workshop No. 2
    b. Reviewed current tasks already in progress
    c. Discussed concerns relating to the study plan timeline, data availability and usage, and forum for greater LP participation

Agreements

1. Consultant Team will prepare next meeting's agenda to include:
    a. Review of what the fish passage study development process entails from the ground up (general info/data required, evaluation process, etc.)
    b. Present outline of the Preliminary Draft Fish Passage Conceptual Design Criteria Document

[1] Note that Agency Work Sessions are not facilitated by Triangle and Associates. In general, these meetings are technically focused discussions comprised of a small group of City Light/Consultant Team and LP technical staff. The intent of these meetings is to address high priority technical action items to ensure the larger Triangle-facilitated meetings can occur on schedule. Summaries are informal and only capture any agreements, remaining issues, and action items resulting from discussions. These notes are not intended to be formal records of the meeting.

c. Discussion of data needs (gaps, availability, assembly, etc.) and how/where data requested will be incorporated into FA-04 reports and efforts

2. Agency Work Sessions (AWS) are not one-off check-in meetings and are meant to serve as recurring, collaborative work sessions used to discuss the technical details that will aid in the development of FA-04 tasks/deliverables
3. Summary meeting notes will be made available after each AWS. Notes will be posted to SharePoint maintained by Triangle.
4. An agenda will be sent out to the group prior to each AWS

Ongoing Discussion Topics

1. Next AWS call will discuss the Preliminary Draft Fish Passage Conceptual Design Criteria Document
2. City Light and Triangle are preparing a comprehensive Gantt chart that displays milestones of other on-going studies that are connected to FA-04. This chart will be provided to the LPs when complete, and discussions are planned to occur in Q4.
3. Ongoing discussion of data needs (gaps, availability, assembly, etc.) and how/where data requested will be incorporated into FA-04 efforts

Action Items

1. Consultant Team will extend all future AWS meetings from 1 hour to 1.5 hours
2. Consultant Team will reschedule the September 6th AWS meeting from Labor Day to another day that week
3. Consultant Team will provide draft agenda for next AWS meetings and solicit feedback

FA-04 Look-Ahead Schedule

Milestone / Activity	Date
Continue developing Preliminary Draft Fish Passage Conceptual Design Criteria Document	Draft delivered to LPs 9/17/2021
AWS Meeting No. 2	8/23/2021

Skagit River Hydroelectric Project
Seattle City Light (City Light)
FA-04 Fish Passage Agency Work Session[1]
Meeting Date – August 23, 2021

Summary of Discussion Topics, Agreements, Ongoing Discussions, and Action Items

Attendance

Licensing Participants (LPs):
Brock Applegate, Washington Department of Fish and Wildlife (WDFW)
Kevin Lautz, WDFW
Brian Lanouette, Upper Skagit Indian Tribe (USIT)
Logan Negherbon, National Marine Fisheries Service (NMFS)
Ashley Rawhouser, National Park Service (NPS)

Seattle City Light (City Light):
Andrew Bearlin, City Light

Consultant Team:
Michael Garello, Consultant Team
Becky Holloway, Consultant Team
Bao Le, Consultant Team
Jacob Venard, Consultant Team
Theo Malone, Consultant Team
Nicole Loo, Consultant Team

Summary of Discussion Topics

1. Greeting, Attendance, and Agenda Review
    a. Mike began the meeting with roll call and a brief overview of the anticipated agenda
    b. No new topics were added or requested
2. Fish Passage Assessment Approach
    a. Provided overview of fish passage study approach based upon Final FA-04 RSP
    b. Discussed data linkages and how available data can influence the development of fish passage strategies and facility concepts
        i. Biological data has significant influence on facility type, size, location, configuration, and operational requirements
        ii. As applicable, rationale will be provided for why specific data was used/not used
    c. Discussed approach to filling data gaps when needed
        i. Placeholders will be created for data gaps/uncertainties in the current narrative; data that later becomes available can be folded in and concepts/strategies can be reevaluated in an iterative process
        ii. Assumptions can be discussed/evaluated in the AWS group; additional feedback will be solicited from the LPs when they review the interim reports
    d. Discussed general approach to developing strategies and concepts
        i. Potential alternatives can be scaled to consider a range of biological and physical conditions as well as management strategies
3. Study Plan Progress and Schedule Update
    a. Reviewed Look-Ahead Schedule and Milestones for Workshop No. 2
    b. Reviewed current tasks already in progress and next steps
        i. Continue developing Preliminary Draft Design Criteria Document (DCD)

[1] Note that Agency Work Sessions are not facilitated by Triangle and Associates. In general, these meetings are technically focused discussions comprised of a small group of City Light/Consultant Team and LP technical staff. The intent of these meetings is to address high priority technical action items to ensure the larger Triangle-facilitated meetings can occur on schedule. Summaries are informal and only capture any agreements, remaining issues, and action items resulting from discussions. These notes are not intended to be formal records of the meeting.

ii. Continue gathering and synthesizing data to address remaining data gaps
iii. Establish preliminary technical, operational, and biological goals, criteria, and constraints

4. Future Discussion Topics/Agenda Items for Next Meeting
    a. Discuss lists of inputs/data sources for the DCD and assumptions used when we don't have data
        i. Review full data needs list and biological data needs list
        ii. Present the data we have and discuss data gaps and how we can work together to fill those gaps
    b. Updates on on-going work on the Gorge Bypass Reach
        i. Attendees requested that we include updates on the Gorge Bypass Fish Passage Evaluation
        ii. Opportunity for updates: FA-05 Workshop #3 on Thursday, 8/26/21. This workshop will provide detailed updates on data collection activities performed to date for the Gorge Bypass Fish Passage Evaluation

Agreements

1. Consultant Team will prepare next meeting's agenda to include:
    a. Discussion of the list of inputs/data sources for the DCD and assumptions to use when we don't have data
        i. Review full data needs list and biological data needs list (e.g., run-timing, outmigration timing, reservoir curves)
        ii. Present the data we have and discuss data gaps and how we can work together to fill those gaps
        iii. Discuss what data means to a specific passage concept/strategy
2. AWS will serve as a forum to discuss assumptions and the rationale for using/not using data
3. AWS participants serve as liaisons to the greater LP group/data co-managers and will relay information, feedback, questions, and concerns to the AWS group to be addressed at subsequent workshops

Ongoing Discussion Topics

1. Use of assumptions and data
    a. Data needs (gaps, availability, assembly, etc.) and how/where data requested will be incorporated into FA-04 efforts
    b. Rationale for using/not using data and assumptions
2. Linkages to other on-going studies to FA-04; study will be iterative and incorporate relevant information from other studies as it becomes available (e.g., reservoir temperature studies)

Action Items

1. Consultant Team to share copy of today's presentation
2. Consultant Team to share lists of info/data needs
    a. Detailed list of greater information needs
    b. List of biological information needs
3. Consultant Team to include study name/number on emails

FA-04 Look-Ahead Schedule

Milestone/Activity	Anticipated Schedule
Preliminary DCD development	7/16/ 2021 - 9/17/2021
Workshop #2 PPT Presentation Development	8/27/2021 – 9/17/2021
Workshop # 2 LP Agenda Review	9/7/2021
AWS Meeting #3	9/8/2021
Submit Agenda, Workshop PPT Presentation, and Preliminary Draft DCD to LPs	9/17/2021
AWS Meeting #4	9/20/2021
Workshop #2	9/23/2021

Skagit River Hydroelectric Project
Seattle City Light (City Light)
FA-04 Fish Passage Agency Work Session[1]
Meeting Date – September 8, 2021

Summary of Discussion Topics, Agreements, Ongoing Discussions, and Action Items

Attendance

Licensing Participants (LPs):
Jared McKee, U.S. Fish and Wildlife Service (FWS)
Jeff Garnett, FWS
Logan Negherbon, National Marine Fisheries Service (NMFS)
Ashley Rawhouser, National Park Service (NPS)
Stan Walsh, Skagit River System Cooperative (SRSC)
Brian Lanouette, Upper Skagit Indian Tribe (USIT)
Brock Applegate, Washington Department of Fish and Wildlife (WDFW)
Kevin Lautz, WDFW
Duncan Pfeifer, WDFW

Seattle City Light (City Light):
Andrew Bearlin, City Light
Erin Lowery, City Light

Consultant Team:
Michael Garello, Consultant Team
Becky Holloway, Consultant Team
Bao Le, Consultant Team
Jacob Venard, Consultant Team
Theo Malone, Consultant Team
Nicole Loo, Consultant Team

Summary of Discussion Topics

1. Greetings, Attendance, Agenda, and Action Items Review
    a. Mike began the meeting with roll call and a brief overview of the anticipated agenda
    b. No new topics were added or requested
    c. Action items from previous meeting were reviewed and all were noted as completed
2. Data Collection and Information Needs
    a. Provided a high-level overview of the Request for Information (RFI) Tracking Table
        i. Discussed development of the tracking table and how it is an evolving list that will continually be refined as the study progresses and more information becomes available
        ii. Discussed how tracking list could be improved with fields and placeholders for linkages to other concurrent studies
        iii. Co-managers are working on a response to the biological data RFI
    b. Provided a summary of data collected and data gaps identified thus far
        i. Discussed the need for more specific data on fish abundance, fish size, peak migration timing, reservoir transit behavior, and survival of juvenile outmigrants
        ii. Habitat Suitability Curves (HSC) group for FA-02 is beginning to discuss species periodicity this month and their findings would be useful for FA-04 efforts
    c. Presented examples of how data is used to inform concept development

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i. Demonstrated how abundance data along with peak migration data and periodicity influences facility size and complexity
ii. Demonstrated how reservoir fluctuation data influences facility size, location, and complexity

d. Discussed how information from other concurrent studies will be tracked and evaluated at a future check-in point
    i. Information from other studies with be evaluated and incorporated at a later date as it becomes available and necessary updates to the FA-04 study will be incorporated accordingly
    ii. Upcoming deliverables will utilize the information currently available and placeholders and ranges for values will be incorporated for results of other ongoing studies
e. Discuss real estate issues/limitations within NPS boundary
    i. Cultural and recreational uses

3. Study Plan Progress and Schedule Update
    a. Reviewed Look-Ahead Schedule and Milestones for Workshop No. 2
    b. Reviewed current tasks already in progress and next steps
        i. Continue gathering and synthesizing data to address remaining data gaps
        ii. Establish preliminary technical, operational, and biological goals, criteria, and constraints
        iii. Prepare Preliminary Draft Design Criteria Document (DCD)
        iv. Prepare Workshop No. 2 PPT
4. Future Discussion Topics/Agenda Items for Next Meeting
    a. Continue discussion of RFI Tracking Table with focus on biological data needs and data gaps to fill
    b. Discuss target/focal species for passage and the different strategies/technologies that may be employed to accommodate selected species

Agreements

1. Consultant Team will prepare next meeting's agenda to include:
    a. Continuing discussion of RFI Tracking Table with focus on biological data needs and data gaps to fill
    b. Discussion of target species for passage and the different strategies/technologies that may be employed to accommodate selected species
        i.
2. RFI Tracking Table is an evolving list that will continually be refined as the study progresses and more information becomes available
3. Consultant Team will add the following to RFI list:
    a. Coordination with NPS cultural and recreational staff required to refine development constraints
    b. Column for linkages to on-going studies, and how they may inform biological data

Ongoing Discussion Topics

1. Use of assumptions and data
    a. Data needs (gaps, availability, assembly, etc.) and how/where data requested will be incorporated into FA-04 efforts
    b. Rationale for using/not using data and assumptions
2. Linkages to other on-going studies to FA-04; study will be iterative and incorporate relevant information from other studies as it becomes available

Action Items

1. Consultant Team to share copy of today's presentation
2. Consultant Team to update RFI Tracking Table with suggested feedback and reshare and solicit questions:
    a. Line-item placeholders for data from other ongoing studies
    b. Column showing linkage to other studies for each line item, as applicable
3. Consultant Team to include Pacific Lamprey on periodicity chart and share chart with AWS group to request feedback

FA-04 Look-Ahead Schedule

Milestone/Activity	Anticipated Schedule
Preliminary DCD development	7/16/ 2021 - 9/17/2021
Workshop #2 PPT Presentation Development	8/27/2021 – 9/17/2021
Submit Agenda, Workshop PPT Presentation, and Preliminary Draft DCD to LPs	9/17/2021
AWS Meeting #4	9/20/2021
Workshop #2	9/23/2021

Skagit River Hydroelectric Project
Seattle City Light (City Light)
FA-04 Fish Passage Agency Work Session[1]
Meeting Date – September 20, 2021

Summary of Discussion Topics, Agreements, Ongoing Discussions, and Action Items

Attendance

Licensing Participants (LPs):
Jared McKee, U.S. Fish and Wildlife Service (FWS)
Jeff Garnett, FWS
Stephen Lewis, FWS
Logan Negherbon, National Marine Fisheries Service (NMFS)
Stan Walsh, Skagit River System Cooperative (SRSC)
Brian Lanouette, Upper Skagit Indian Tribe (USIT)
Brock Applegate, Washington Department of Fish and Wildlife (WDFW)
Kevin Lautz, WDFW
Duncan Pfeifer, WDFW

Seattle City Light (City Light):
Andrew Bearlin, City Light
Erin Lowery, City Light

Consultant Team:
Becky Holloway, Consultant Team
Bao Le, Consultant Team
Jacob Venard, Consultant Team
Theo Malone, Consultant Team
Nicole Loo, Consultant Team

Summary of Discussion Topics

1. Greetings and Agenda Review
    a. Becky began the meeting with a brief overview of the anticipated agenda
    b. No new topics were added or requested
2. Data Collection and Information Needs
    a. Continued discussing the RFI Tracking Table
        i. Discussed how FA-04 will incorporate results from FA-08 Fish Entrainment Study
            1. Discussed potential data gap of entrainment potential for smaller classes of fish. City Light to reach out NPS and USGS for available gill net data.
            2. Desktop portion of entrainment study (FA-08) to be completed with the ISR. These results should be available to incorporate in the next FA-04 deliverable (Conceptual Design Report) in spring/summer 2022.
3. Target/Focal Species for Passage
    a. Discussed development of species list—list was approved by LPs at Workshop 1
    b. Clarification needed on the differentiation, if any, between "focal" vs. "target" species.
        i. AWS group suggested to choose one term and use that term moving forward—"target" would be preferred terminology to use.
    c. Discussed that upstream and downstream passage considerations will vary by species
        i. Vertical distribution of species varies greatly and will need to be considered

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d. Discussed available information for target species
    i. Lamprey—Consultant Team has guidelines and best management documents for passage, but welcomes any data specific to the upper Skagit River basin and occurrence/run sizes
    ii. Salish Sucker—Discussed need for more information specific to the upper Skagit River
e. Periodicity chart will be continually refined and updated accordingly per HSC developments e.g., peak timing for each species, inclusion of post-spawning kelts

4. Study Plan Progress and Schedule Update
    a. Preliminary Draft DCD sent out to LPs on 9/17/21 for review
        i. Comments/feedback requested by 10/7/21. More specifics will be discussed at Workshop 2 on 9/23/21 along with any preliminary comments on the DCD
5. Future Discussion Topics/Agenda Items for Next Meeting
    a. Progress check on Preliminary Draft DCD comments
    b. Initiate discussions on biological goals and objectives for each target species

Agreements

1. Consultant Team will prepare next meeting's agenda to include:
    a. Progress check on Preliminary Draft DCD comments
    b. Discussion of biological goals and objectives for each target/focal species
2. Species periodicity chart will be continually refined and updated per HSC developments

Ongoing Discussion Topics

1. Data collection and information needs
2. Linkages to other on-going studies to FA-04; study will be iterative and incorporate relevant information from other studies as it becomes available
3. Species periodicity chart

Action Items

1. Erin Lowery (City Light) to reach out to USGS and NPS regarding availability of gill net data on smaller fish size classes for entrainment study
2. Consultant Team to follow up with definitions for "target" and "focal" species and which term will be used moving forward
3. Consultant Team to continually update species periodicity chart per HSC developments
    a. Peak timing for each species
    b. Remove duplicate Skagit Sockeye
    c. Inclusion of information for post-spawning kelts (tasked to FA-02 team)

FA-04 Look-Ahead Schedule

Milestone/Activity	Anticipated Schedule
Preliminary Draft DCD Review by LPs	9/17/2021 – 10/7/2021
Workshop #2	9/23/2021
AWS Meeting #5	10/4/2021
Preliminary Draft DCD LP Comments Due	10/7/2021

Skagit River Hydroelectric Project
Seattle City Light (City Light)
FA-04 Fish Passage Agency Work Session[1]
Meeting Date – October 4, 2021

Summary of Discussion Topics, Agreements, Ongoing Discussions, and Action Items

Attendance

Licensing Participants (LPs):
Jeff Garnett, U.S. Fish and Wildlife Service (FWS)
Logan Negherbon, National Marine Fisheries Service (NMFS)
Stan Walsh, Skagit River System Cooperative (SRSC)
Brian Lanouette, Upper Skagit Indian Tribe (USIT)
Rick Hartson, USIT
Brock Applegate, Washington Department of Fish and Wildlife (WDFW)
Kevin Lautz, WDFW
Duncan Pfeifer, WDFW

Seattle City Light (City Light):
Andrew Bearlin, City Light
Erin Lowery, City Light

Consultant Team:
Michael Garello, Consultant Team
Becky Holloway, Consultant Team
Bao Le, Consultant Team
Jacob Venard, Consultant Team
Theo Malone, Consultant Team
Nicole Loo, Consultant Team

Summary of Discussion Topics

1. Greetings, Agenda Review, and Previous Action Items
    a. Mike began the meeting with a brief overview of the anticipated agenda
        i. No new topics were added or requested
    b. Action Item Review (from 9/20/21 meeting)
        i. Species selected for fish passage design will be termed "target species" in documents
        ii. Periodicity table has been updated in DCD and will continually be updated as table is refined by HSC group. Additional periodicity meetings will occur in October.
        iii. Erin L. to reach out to USGS and NPS regarding gill net data – Eric clarified that fish collection data using gill nets in Ross reservoir won't provide info on abundance but may provide insight on presence/absence and fish size. Recognize that the nets exhibit larger mesh sizes and won't capture smaller fish size classes and may not be useful for the entrainment study (FA-08).
2. Progress Check on Preliminary Draft DCD Comments
    a. High-level discussion on review progress
    b. Comments requested by 10/7/21 as preferably one consolidated set of comments per affiliation.

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i. Not a hard deadline, but comments received after may not be incorporated in time for the next iteration of the DCD (Revised DCD).

3. Setting Biological Goals and Objectives for Target Species
    a. Reviewed the Fish Passage Facilities Assessment Process. Current stage of study: Defining Goals and Objectives
        i. This stage of the study process will develop a range of fish passage alternatives that meet an initial range of established biological goals and objectives determined through AWS meetings and feedback from the LPs
        ii. Per NMFS, USFWS, WDFW, USIT, and NPS Study Requests for Feasibility Analysis of Fish Passage, objectives include:
            1. *Development of criteria for determining feasibility of passage concepts based on biological needs and engineering feasibility*
            2. *If passage concepts are determined feasible, additional studies will be necessary to support validation and design of the concept, including but not limited to, biologic studies, hydrodynamic modeling, and associated engineering studies*
    b. Discussed the proposed process for setting goals and objectives
        i. Next AWS meetings will be dedicated to the individual discussion of:
            1. Goals—establish goals for fish passage
            2. Objectives—develop measurable objectives to meet each goal
            3. Benefits—identifying benefits will help determine if the project is consistent with its goals and objectives and provides a "check-in" point to see if a project is appropriate to pursue and whether changes might be required to meet goals
            4. Risks (e.g., genetic implications introduction of invasive species/disease)
            5. Constraints (e.g., reservoir conditions for passage, identification of source population)
        ii. Theo presented the web-based 'Mural' platform to be used in the Goal Setting Brainstorm Exercise to be conducted at the next AWS meeting on 10/18/21
            1. Results from this brainstorm session will be summarized, shared, and discussed at subsequent AWS meetings
            2. Similar brainstorm sessions will be conducted for Objectives, Benefits, Risks, and Constraints at subsequent AWS meetings
    c. Discussed fish passage goals, objectives, benefits, risks, and constraints
        i. Presented case studies to demonstrate that goal/objective setting is an important, long-term, iterative process that is unique to each project
        ii. Range of alternatives are formulated based upon initial goals and objectives.
        iii. As shown in other case studies, the process can take multiple iterations over decades. This study will be an initial step, but further study and collaboration will be required if a fish passage program were to move forward.
4. Study Plan Progress and Schedule Update
    a. Reviewed Look-Ahead Schedule and Milestones for Workshop No. 3
        i. FA-04 Workshop No. 3 tentatively set for 12/16/21
    b. Reviewed current tasks already in progress and next steps
        i. Define goals, objectives, benefits, risks, and constraints
        ii. Prepare Revised Draft DCD
        iii. Prepare ISR report
5. Future Discussion Topics/Agenda Items for Next Meeting
    a. Subsequent AWS meetings will be focused individually on goals, objectives, benefits, risks, and constraints, with the next meeting on 10/18/21 focused on goal setting.
    b. Participants noted that more than one meeting per topic may be desired.

Agreements

1. Consultant Team will prepare next meeting's agenda to include:
    a. Goal Setting
        i. Brainstorm Session using Mural
        ii. Discussion

Ongoing Discussion Topics

1. Goals, objectives, benefits, risks, and constraints
2. Data collection and information needs
3. Linkages to other on-going studies to FA-04; study will be iterative and incorporate relevant information from other studies as it becomes available

Action Items

1. Consultant Team to share copy of today's presentation
2. AWS participants to come ready to share ideas during goal setting brainstorm exercise that will occur during the next AWS meeting on 10/18/21

FA-04 Look-Ahead Schedule

Milestone/Activity	Anticipated Schedule
Preliminary Draft DCD LP Comments Due	10/7/2021
Consultant Team incorporates LP comments on DCD	10/8/2021 – 11/18/2021
AWS Meeting #6	10/18/2021

Skagit River Hydroelectric Project
Seattle City Light (City Light)
FA-04 Fish Passage Study Agency Work Session[1]
Meeting Date – October 18, 2021

Summary of Discussion Topics, Agreements, Ongoing Discussions, and Action Items

Attendance

Licensing Participants (LPs):
Jeff Garnett, U.S. Fish and Wildlife Service (FWS)
Logan Negherbon, National Marine Fisheries Service (NMFS)
Stan Walsh, Skagit River System Cooperative (SRSC)
Brian Lanouette, Upper Skagit Indian Tribe (USIT)
Rick Hartson, USIT
Brock Applegate, Washington Department of Fish and Wildlife (WDFW)
Kevin Lautz, WDFW

Consultant Team:
Michael Garello, Consultant Team
Becky Holloway, Consultant Team
Bao Le, Consultant Team
Jacob Venard, Consultant Team
Theo Malone, Consultant Team
Nicole Loo, Consultant Team

Summary of Discussion Topics

1. Greetings, Agenda Review, and Previous Action Items
    a. Becky began the meeting with a brief overview of the anticipated agenda
        i. No new topics were added or requested
    b. Action Item Review (from 10/4/21 meeting)
        i. Erin L. to reach out to USGS and NPS regarding gill net data—Erin on PTO this week. Note to follow up with him next meeting.
2. Progress Check on Preliminary Draft DCD Comments Received to Date
    a. NMFS Comments
        i. Discussed comment on Bell 1991 estimates of fish size and fishery sources for average weights (p. 3-19)
            1. Becky asked the group for guidance on available data sources on average weights. AWS participants to explore their sources for this data—Stan (SRSC), Logan (NMFS), Rick and Brian (USIT), Brock (WDFW)
        ii. Discussed and clarified comment on characterization of dams (p. 6-1)
            1. Logan clarified that the intent of this comment was to point out that characterizing high head dams by the hydraulic differential exceeding 100 feet excludes relevant technologies applied at lower head systems. Criteria should be a bit more generalized/flexible to ensure the inclusion of analogous dams in the study

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2. Mike agreed and noted that criteria language will be softened to be more flexible to include a wider range of facilities that are analogous to ones that may be considered on the Skagit Project

b. USIT and FWS to provide comments on DCD this week

3. Individual/Group Goal Setting Exercise and Discussion
   a. Mike reviewed general definitions of goals and objectives and the goal/objective setting process
   b. Theo led sample mind mapping/word cloud exercise to demonstrate the Poll Everywhere tool using "Goals when buying a new car" as the sample prompt
   c. Theo initiated the individual mind mapping/word cloud exercise for setting goals for the Fish Passage Study
      i. Stan expressed concerns with participating in the biological goal setting exercise—stated that comanagers of the fisheries resources in the basin need to have policy-level discussions before developing goals. Thus, goal setting should not occur as part of FA-04, but rather will be informed by concurrent studies and agency/tribal discussions in the future.
      ii. Many AWS participants concurred (Logan, Brian, Jeff) and echoed sentiments that discussions about biological goals and objectives were premature.
      iii. The consensus of participants was that AWS group discussions should focus on the technical feasibility of fish passage and that the study outcome is not "is passage feasible and how should it be conducted" but "is it feasible and by what methods" (per NMFS comments on the preliminary draft DCD)
      iv. AWS participants indicated they wanted to shift focus to technical fish passage goals (e.g., range of passage operating conditions, attracting fish at a range of flows, attracting fish at range of full pool elevations) and wanted to explore the whole suite of passage options that are physically possible at each dam
   d. Mike pivoted the discussion to what technical fish passage goals may look like and reviewed alternative formulation and strategies from Workshop No. 2
      i. Fish Passage Strategies—3 main ideas with numerous permutations possible in between
         1. Reservoir Bypass Strategy
         2. Reservoir Tributary Strategy
         3. Reservoir Transit Strategy
      ii. Mike proposed to rearrange the study development process in which passage alternatives (strategies and technologies) are formulated first, then discussions on what biological parameters for each target species are/are not met are brainstormed for each alternative
         1. AWS participants expressed preference for this approach

4. Study Plan Progress and Schedule Update
   a. Reviewed Look-Ahead Schedule and Milestones for Workshop No. 3
      i. FA-04 Workshop No. 3 set for 12/16/21
         1. Revised Draft DCD to be sent to LP's the week prior (12/9/21)
   b. Reviewed current tasks already in progress and next steps
      i. Fish passage alternatives formulation
      ii. Prepare Revised Draft DCD
      iii. Prepare ISR report

5. Future Discussion Topics/Agenda Items for Next Meeting
   a. Fish passage alternatives formulation—brainstorm strategies and technologies

Agreements

1. Establishing biological, ecological, and fisheries resource management goals for fish passage is a co-manager, policy-level discussion that should not occur as part of FA-04, but rather will be informed by concurrent studies and agency/tribal discussions in the future with consideration of recovery planning targets and current and future harvest objectives. Therefore, FA-04 will not establish biological goals and objectives for fisheries resource management but will rather consider biological requirements of target species within the anticipated operating environments of the Gorge, Diablo, and Ross developments. These factors will inform a range of upstream and downstream passage facility alternatives that may be evaluated as part of the study.
2. Consultant Team will prepare next meeting's agenda to include:
    a. Fish passage facilities alternatives formulation—brainstorm strategies and technologies

Ongoing Discussion Topics

1. Formulation of fish passage facility alternatives for each passage strategy
2. Data collection and information needs
3. Linkages to other on-going studies to FA-04; study will be iterative and incorporate relevant information from other studies as it becomes available

Action Items

1. LPs to review Preliminary Draft DCD and upload comments to the LP Comments to DCD folder on the Triangle SharePoint
2. AWS participants to look for available data on average fish weights—Stan (SRSC), Logan (NMFS), Rick and Brian (USIT), Brock (WDFW)
3. Erin L. to reach out to USGS and NPS regarding gill net data

FA-04 Look-Ahead Schedule

Milestone/Activity	Anticipated Schedule
Consultant Team incorporates LP comments on DCD	10/8/2021 – 11/18/2021
AWS Meeting #7	11/1/2021

Skagit River Hydroelectric Project
Seattle City Light (City Light)
FA-04 Fish Passage Study Agency Work Session[1]
Meeting Date – November 1, 2021

Summary of Discussion Topics, Agreements, Ongoing Discussions, and Action Items

Attendance

Licensing Participants (LPs):
Jeff Garnett, U.S. Fish and Wildlife Service (FWS)
Stephen Lewis, FWS
Ashley Rawhouser, National Park Service (NPS)
Keith Kirkendall, National Marine Fisheries Service (NMFS)
Logan Negherbon, NMFS
Stan Walsh, Skagit River System Cooperative (SRSC)
Amy Trainer, Swinomish Indian Tribe
Brian Lanouette, Upper Skagit Indian Tribe (USIT)
Rick Hartson, USIT
Brock Applegate, Washington Department of Fish and Wildlife (WDFW)

Seattle City Light (City Light):
Andrew Bearlin, City Light

Consultant Team:
Michael Garello, Consultant Team
Becky Holloway, Consultant Team
Bao Le, Consultant Team
Jacob Venard, Consultant Team
Theo Malone, Consultant Team
Nicole Loo, Consultant Team

Summary of Discussion Topics

1. Greetings, Agenda Review, and Previous Action Items
    a. Becky began the meeting with a brief overview of the anticipated agenda
    b. Action Item Review (from 10/18/21 meeting)
        i. Data on average fish weights—USIT looking into available data, will keep action item open for other LPs to continue research as well
2. Preliminary Draft DCD Comments
    a. Becky provided a brief overview of comments received to date: NMFS, USFWS, USIT
        i. Comment responses are being tracked in a comment-response matrix and applicable responses are being incorporated into the Revised Draft DCD
    b. Comments received after 11/5/2021 may be deferred to the next iteration of the DCD
3. Fish Passage Alternatives Formulation—Gorge Development
    a. Alternative Brainstorming and Formulation—Mike presented the goals and objectives for the alternative brainstorming and formulation process:
        i. Reboot of the brainstorming process for fish passage alternatives development
        ii. Focus on range of technical options, criteria, and design considerations that influence alternative formulation
        iii. Provide an open forum for brainstorming, discussion, and feedback with AWS participants
    b. Overview of FERC Skagit Project Area and Gorge Development

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i. Mike presented maps, illustrations, aerial figures, and profile figures to provide an overview of the FERC Skagit Project Area and Gorge Development

c. Joint Brainstorming Session of the Gorge Development
   i. Theo introduced and demonstrated the use of the MURAL platform to kick off the brainstorming exercise. AWS participants were encouraged to participate using the shared web link.
   ii. Mike guided and facilitated the Mural brainstorm session for the Gorge Development, posing questions and generating discussion amongst AWS participants
      1. Brainstorming topics included (where: US - Upstream Fish Passage; DS – Downstream Fish Passage)
         a. Fish Collection Locations (US/DS)
         b. Fish Release Locations (US/DS)
         c. Key Considerations (US/DS)
         d. Risks or Concerns (US/DS)
         e. Potential Technologies (US/DS)
         f. Data Gaps
         g. Other
   iii. AWS participants shared their thoughts, ideas, and concerns for the range of brainstorming topics
   iv. The consensus amongst AWS participants was that because we are in the early stages of the alternative formulation and development process, a more comprehensive range of alternatives and strategies should be considered and documented.
   v. AWS participants stressed the importance of including consistent notation for upstream (US) and downstream (DS) when placing sticky notes during the exercise.
   vi. See **Attachment A** for brainstorm results and discussion

4. Study Plan Progress and Schedule Update
   a. Reviewed Look-Ahead Schedule and Milestones for Workshop No. 3
      i. Revised Draft DCD submitted to LPs on 12/9/2021
      ii. FA-04 Workshop No. 3 on 12/16/2021
   b. Reviewed current tasks already in progress and next steps
      i. Continue formulating fish passage alternatives
      ii. Prepare Revised Draft DCD
      iii. Prepare ISR report
5. Future Discussion Topics/Agenda Items for Next Meeting
   a. AWS 8 (11/15/2021):
      i. Review results of alternatives setting exercise and discussion for the Gorge Development
      ii. Alternatives formulation for the Diablo Development
   b. AWS 9 (11/29/2021):
      i. Review results of alternatives setting exercise and discussion for the Diablo Development
      ii. Alternatives formulation for the Ross Development

Agreements

1. Establishing biological, ecological, and fisheries resource management goals for fish passage is a co-manager, policy-level discussion that should not occur as part of FA-04, but rather will be informed by concurrent studies and agency/tribal discussions in the future with consideration of

recovery planning targets and current and future harvest objectives. Therefore, FA-04 will not establish biological goals and objectives for fisheries resource management but will rather consider biological requirements of target species within the anticipated operating environments of the Gorge, Diablo, and Ross developments. These factors will inform a range of upstream and downstream passage facility alternatives that may be evaluated as part of the study.

2. A comprehensive range of fish passage alternatives and strategies should be considered and documented at this stage; all options should be considered up-front and eliminated in subsequent stages as feasibility is assessed.
3. Consultant Team will prepare next meeting's agenda to include:
    a. Review results of alternatives setting exercise and discussion for the Gorge Development
    b. Fish passage alternatives formulation for the Diablo Development

Ongoing Discussion Topics

1. Formulation of fish passage facility alternatives for each passage strategy
2. Data collection and information needs
3. Linkages to other on-going studies to FA-04; study will be iterative and incorporate relevant information from other studies as it becomes available

Action Items

1. AWS participants to look for available data on average fish weights—Stan (SRSC), Logan (NMFS), Rick and Brian (USIT), Brock (WDFW)

FA-04 Look-Ahead Schedule

Milestone/Activity	Anticipated Schedule
Requested comments on Preliminary Draft DCD	10/7/2021
Consultant Team incorporates LP comments on DCD	10/8/2021 – 11/15/2021
AWS Meeting #8	11/15/2021

Attachment A: Gorge Development Brainstorm Results and Discussion

The brainstorm session results and discussion for the Gorge Development are depicted in **Figure 1** and summarized in **Table 1**.

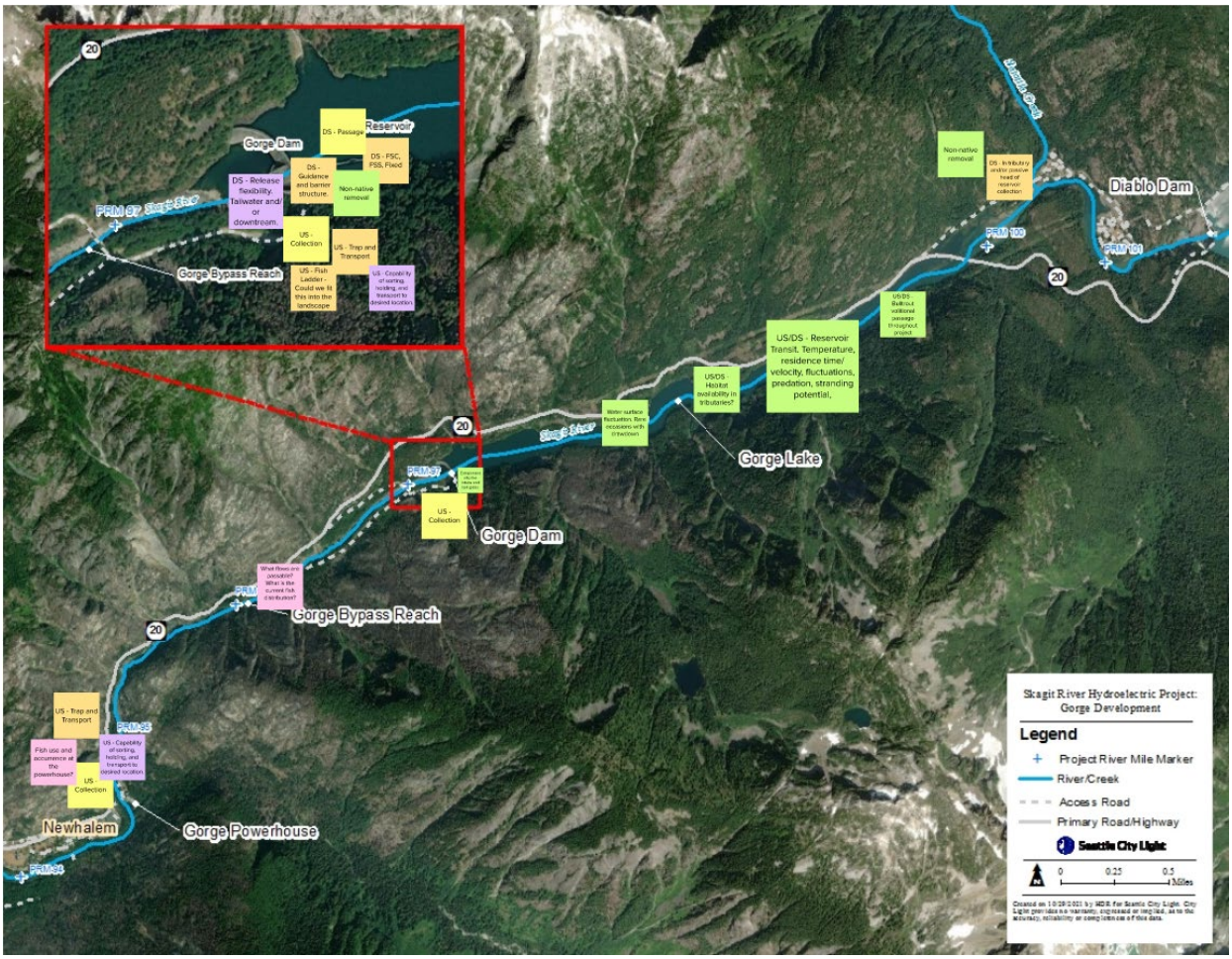

Figure 1. Mural Brainstorming Results for the Gorge Development

Table 1. Mural Brainstorming Results for the Gorge Development

Sticky Color	Brainstorming Topic	Comment
Green	Key Considerations	A key consideration for Downstream Fish Passage at Gorge Dam is the risk of entrainment into the intake and spill gates.
Green	Key Considerations	A key consideration for all fish passage facilities would be to consider the need for non-native species removal.
Green	Key Considerations	A key consideration for upstream and downstream passage throughout the project is allowing Bull trout volitional passage through the reservoir systems to promote foraging and natural migration into available tributary habitat.
Green	Key Considerations	A key consideration for upstream and downstream passage is the estimation of habitat availability in tributaries. The availability and quality of habitat available in key tributaries may influence the need and desire to

		use a reservoir transit strategy and/or emphasize methods to promote access to and production in specific tributaries.
Green	Key Considerations	Key considerations for upstream and downstream passage within the reservoir transit strategy are water temperature, residence time/velocity, water surface fluctuations, predation, and stranding potential. Reservoir transit should be evaluated to the extent possible as part of the fish passage feasibility assessment process.
Green	Key Considerations	A key consideration for fish passage is the water surface fluctuation within Gorge Reservoir with rare occasions of drawdown (for maintenance). The influence on reservoir fluctuation of technology selection should be evaluated as part of the fish passage feasibility assessment process.
Orange	Potential Technologies	Potential downstream passage technologies at the Gorge Dam include Floating Surface Collector, Floating Screen Structure, and a Fixed Collector.
Orange	Potential Technologies	Potential downstream passage technologies at the Gorge Dam should consider the need for guidance and barrier structures to reduce the potential for entrainment.
Orange	Potential Technologies	Potential downstream passage technologies in the Gorge Reservoir include in-tributary and/or passive head of reservoir collection at Stetattle Creek.
Orange	Potential Technologies	A potential upstream passage technology at the Gorge Dam is a Technical Fish Ladder. Fitting this into the landscape is a consideration for use of this technology.
Orange	Potential Technologies	A potential upstream passage technology at the Gorge Dam is Trap and Transport.
Orange	Potential Technologies	A potential upstream passage technology at the Gorge Powerhouse is Trap and Transport.
Pink	Data Gaps	Data gaps at the Gorge Powerhouse include a characterization of fish use and occurrence.
Pink	Data Gaps	Data gaps within the Gorge Bypass Reach include an estimation of what flows are passable and a determination of the current fish distribution.
Purple	Fish Release Locations	For downstream release, there is interest in retaining the flexibility to release into the Gorge Bypass Reach, downstream of Gorge Dam into dam tailwater.
Purple	Fish Release Locations	For upstream fish passage at Gorge Dam using trap and transport technologies, there is interest in the capability of sorting, holding, and transporting fish to desired locations within Gorge Reservoir or elsewhere in the Project as required based upon future management goals not yet determined.
Purple	Fish Release Locations	For downstream fish passage at Gorge Dam using a trap and transport technology, there is interest in the capability of sorting, holding, and transporting fish to desired locations within the Skagit River system based upon future management goals not yet determined.
Yellow	Fish Collection Location	For downstream collection from within the Gorge Reservoir, there is opportunity to site potential downstream fish passage facilities on left (south) side of the reservoir in front of the intake structure.
Yellow	Fish Collection Location	For upstream collection, there is opportunity at Gorge Dam within the Gorge Bypass Reach.
Yellow	Fish Collection Location	For upstream collection, there is opportunity at the Gorge Powerhouse the Skagit River mainstem.

Skagit River Hydroelectric Project
Seattle City Light (City Light)
FA-04 Fish Passage Study Agency Work Session[1]
Meeting Date – November 15, 2021

Summary of Discussion Topics, Agreements, Ongoing Discussions, and Action Items

Attendance

Licensing Participants (LPs):
Jeff Garnett, U.S. Fish and Wildlife Service (FWS)
Ashley Rawhouser, National Park Service (NPS)
Logan Negherbon, National Marine Fisheries Service (NMFS)
Stan Walsh, Skagit River System Cooperative (SRSC)
Amy Trainer, Swinomish Indian Tribe
Brian Lanouette, Upper Skagit Indian Tribe (USIT)
Rick Hartson, USIT
Brock Applegate, Washington Department of Fish and Wildlife (WDFW)
Kevin Lautz, WDFW
Duncan Pfeifer, WDFW

Consultant Team:
Michael Garello, Consultant Team
Becky Holloway, Consultant Team
Bao Le, Consultant Team
Jacob Venard, Consultant Team
Theo Malone, Consultant Team
Nicole Loo, Consultant Team

Summary of Discussion Topics

1. Greetings, Agenda Review, and Previous Action Items
    a. Becky began the meeting with a brief overview of the anticipated agenda
        i. No new topics were added or requested
    b. Action Item Review (from 11/1/21 meeting)
        i. Data on average fish weights—No new updates from LPs. Will keep action item open for LPs to continue looking into.
2. Preliminary Draft DCD Comments
    a. Comments received from NMFS, USFWS, USIT, and Swinomish
        i. Comment responses are being incorporated into the Revised Draft DCD
        ii. USIT comments on temperature data—Info/data from FA-01 will be incorporated into the Final DCD or future deliverables, as the information from FA-01 becomes available
3. Review of Results of Alternatives Setting Exercise and Discussion for the Gorge Development
    a. Mike reviewed the process and results of the brainstorming exercise and discussion for the Gorge Development
        i. Results were summarized in a figure and table in 11/1/21 meeting notes
    b. Mike presented figures demonstrating potential fish passage facility locations and options for the Gorge Development resulting from brainstorm session during previous AWS.
        i. Upstream Fish Passage Options at Gorge Dam
            1. Fish ladder
            2. Trap and transport

[1] Note that Agency Work Sessions are not facilitated by Triangle and Associates. In general, these meetings are technically focused discussions comprised of a small group of City Light/Consultant Team and LP technical staff. The intent of these meetings is to address high priority technical action items to ensure the larger Triangle-facilitated meetings can occur on schedule. Summaries are informal and only capture any agreements, remaining issues, and action items resulting from discussions. These notes are not intended to be formal records of the meeting.

ii. Upstream Fish Passage Options at Gorge Powerhouse
    1. Fish ladder to Gorge Dam
    2. Trap and transport
iii. Downstream Fish Passage Options at Gorge Dam
    1. Forebay collectors
    2. Gravity bypass
        a. To stilling basin and Gorge Bypass Reach
        b. To point downstream of Gorge Bypass Reach
    3. Tributary collection
        a. In-tributary collection weir(s)
        b. Head of reservoir passive collection system(s)

4. Fish Passage Options Formulation—Diablo Development
    a. Fish Passage Options Brainstorming and Formulation—Mike presented the goals and objectives for the options brainstorming and formulation process:
        i. Continuation of the brainstorming process for fish passage alternatives development
        ii. Focus on range of technical options, criteria, and design considerations that influence alternative formulation
        iii. Provide an open forum for brainstorming, discussion, and feedback with AWS participants
    b. Review of Existing Conditions
        i. Mike presented maps, illustrations, aerial figures, and profile figures to provide an overview of the Upper Skagit System and the Diablo Development
            1. Elevations for development profile figures are in NAVD 88
    c. Potential Fish Passage Options for the Diablo Development
        i. Mike presented figures demonstrating potential fish passage facility locations and transport options for the Diablo Development
            1. Upstream Fish Passage Options at the town of Diablo
                a. Fish ladder to Diablo Dam
                b. Trap and transport
            2. Downstream Fish Passage Options at Diablo Dam
                a. Forebay collectors
                b. Gravity bypass
                    i. To point of release near Diablo Powerhouse
                c. Tributary collection
                    i. In-tributary collection weir(s)
                    ii. Head of reservoir passive collection system(s)
    d. Joint Brainstorming Session of the Diablo Development
        i. Theo shared the web link to the Mural platform to kick off the brainstorming exercise. AWS participants were encouraged to participate using the shared web link.
        ii. Mike guided and facilitated the Mural brainstorm session for the Diablo Development, posing questions and generating discussion amongst AWS participants
            1. Brainstorming topics included:
                a. Fish Collection/Entrance Locations (US/DS)
                b. Fish Release/Exit Locations (US/DS)
                c. Key Considerations (US/DS)
                d. Risks or Concerns (US/DS)
                e. Potential Technologies (US/DS)
                f. Data Gaps

g. Other
iii. AWS participants shared their thoughts, ideas, and concerns for the range of brainstorming topics
iv. See **Attachment A** for brainstorm results and discussion

5. Study Plan Progress and Schedule Update
    a. Reviewed Look-Ahead Schedule and Milestones for Workshop No. 3
        i. Revised Draft DCD submitted to LPs on 12/9/2021
        ii. FA-04 Workshop No. 3 on 12/16/2021
    b. Reviewed current tasks already in progress and next steps
        i. Continue formulating fish passage alternatives
        ii. Prepare Revised Draft DCD
        iii. Prepare ISR report
6. Future Discussion Topics/Agenda Items for Next Meeting
    a. Agenda Items for AWS 9 (11/29/21)
        i. Review results of alternatives setting exercise and discussion for the Diablo Development
        ii. Alternatives setting exercise and discussion for the Ross Development
    b. Future Discussion Topics/Requests/Questions
        i. AWS participants requested summary of passage options for Diablo and Ross developments before the next meeting
        ii. AWS participants asked if there will be a discussion of decision-making criteria to determine feasibility
            1. A discussion of factors influencing fish passage facility feasibility will be part of FA-04 Workshop No. 3

Agreements

1. A comprehensive range of fish passage alternatives and strategies should be considered and documented at this stage; all options should be considered up-front and eliminated in subsequent stages as feasibility is assessed.
2. Consultant Team will prepare next meeting's agenda to include:
    a. Review results of alternatives setting exercise and discussion for the Diablo Development
    b. Fish Passage Options brainstorming exercise and discussion for the Ross Development

Ongoing Discussion Topics

1. Formulation of fish passage facility alternatives for each passage strategy
2. Data collection and information needs
3. Linkages to other on-going studies to FA-04; study will be iterative and incorporate relevant information from other studies as it becomes available

Action Items

1. AWS participants to look for available data on average fish weights—Stan (SRSC), Logan (NMFS), Rick and Brian (USIT), Brock (WDFW)
2. Consultant team reiterated previous request for available data on Salish sucker and Pacific lamprey in the Skagit River, specifically in the bypass reach
3. Consultant Team to provide summary of passage alternatives for Diablo and Ross Developments before the next AWS meeting in preparation for the discussion; summary for Diablo will be in the form of meeting notes from AWS #8; summary for Ross will include a pre-view of the presentation for AWS #9

FA-04 Look-Ahead Schedule

Milestone/Activity	Anticipated Schedule
AWS Meeting #9	11/29/2021
Consultant Team to submit Revised Draft DCD to LPs	12/9/2021
AWS Meeting #10	12/13/2021
FA-04 Workshop No. 3	12/16/2021

Attachment A: Diablo Development Brainstorm Results and Discussion

The brainstorm session results and discussion for the Diablo Development are depicted in **Figure 1** and summarized in **Table 1**.

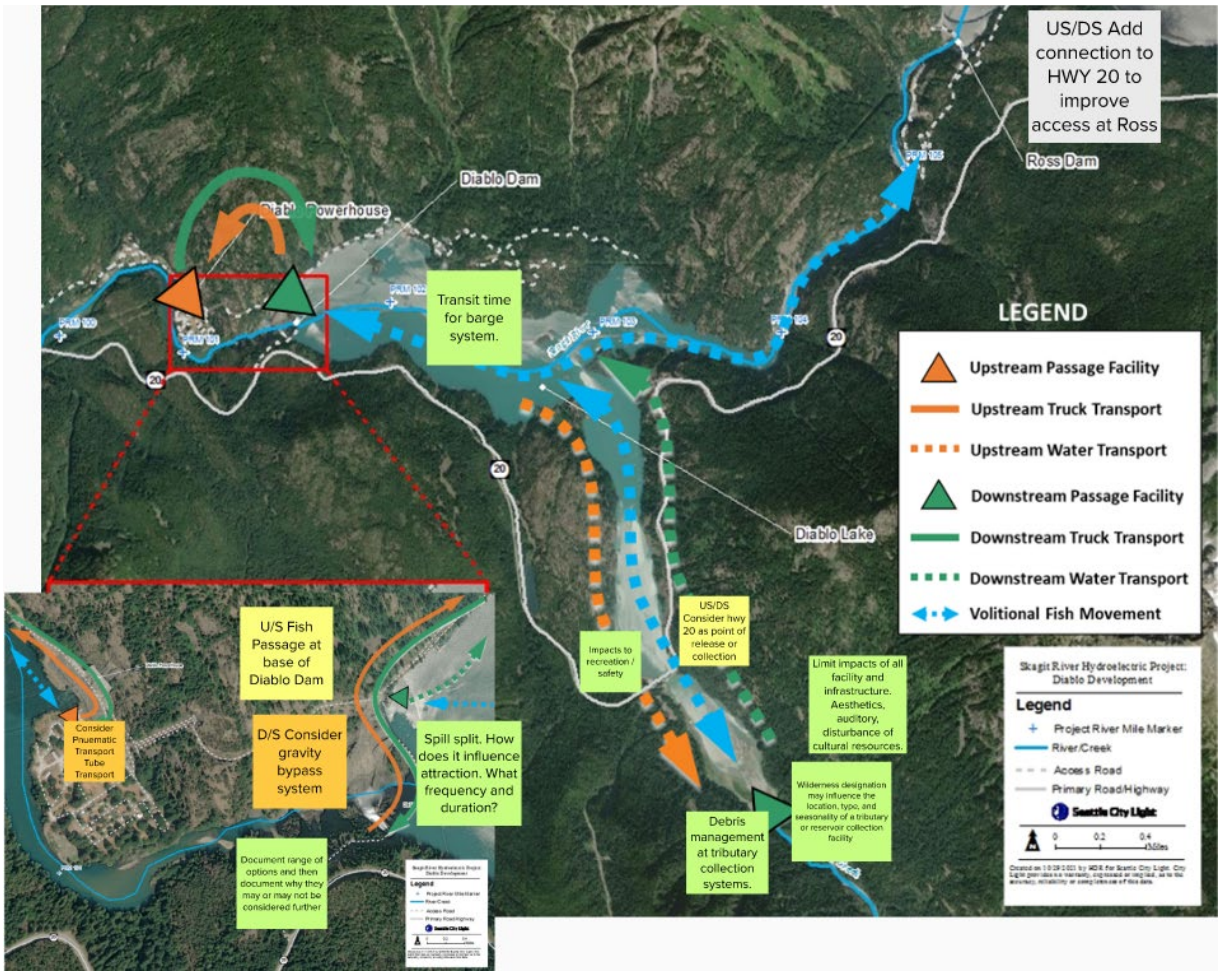

Figure 1. Mural Brainstorming Results for the Diablo Development

Table 1. Mural Brainstorming Results for the Diablo Development

Sticky Color	Brainstorming Topic	Comment
Green	Key Considerations	A key consideration for all passage options is to document the range of all options and provide justification for removal of options not considered further in the alternative formulation process.
Green	Key Considerations	A key consideration for passage within Diablo Reservoir is transit time for the barge system. Existing road infrastructure does not exist to Ross Dam.
Green	Key Considerations	A key consideration for passage at Diablo Dam is how spill is split between the spill gates, spill frequency and duration, and how attraction would be influenced by these operational patterns.
Green	Key Considerations	A key consideration for a potential tributary or reservoir collection system at Thunder Creek is debris management. There are potentially high magnitude, frequency, and duration of debris events that may negatively influence fish passage facility operation at the tributary level.
Green	Key Considerations	A key consideration for a potential tributary or reservoir collection facility at Thunder Creek is wilderness designation. This may influence the allowable location, type, and seasonality of the facility.

Green	Key Considerations	A key consideration for all potential passage facilities and infrastructure is to limit disturbance to cultural resources (aesthetics, auditory, etc.)
Green	Key Considerations	Key considerations for a potential tributary or reservoir collection facility at Thunder Creek are safety and impacts to recreation (e.g., boat launch and campgrounds located in the Thunder Arm vicinity).
Yellow	Fish Collection Location	For upstream transport collection, there is opportunity at the base of Diablo Dam.
Yellow	Fish Collection Location	For upstream and downstream transport, there is opportunity to site a facility at Hwy 20 crossing of Thunder Arm as a point of release or collection.
Orange	Potential Technologies	For upstream transport in the town of Diablo, consider the use of pneumatic transport tubes (Whooshh).
Orange	Potential Technologies	For downstream transport at Diablo Dam, consider a gravity bypass system.
Grey	Other	For upstream and downstream transport at the Ross Development, consider adding a connection to Hwy 20 to improve access.

Skagit River Hydroelectric Project
Seattle City Light (City Light)
FA-04 Fish Passage Study Agency Work Session[1]
Meeting Date – November 29, 2021

Summary of Discussion Topics, Agreements, Ongoing Discussions, and Action Items

Attendance

Licensing Participants (LPs):
Jeff Garnett, U.S. Fish and Wildlife Service (FWS)
Logan Negherbon, National Marine Fisheries Service (NMFS)
Stan Walsh, Skagit River System Cooperative (SRSC)
Amy Trainer, Swinomish Indian Tribe
Brian Lanouette, Upper Skagit Indian Tribe (USIT)
Rick Hartson, USIT
Kevin Lautz, WDFW

Seattle City Light (City Light):
Andrew Bearlin, City Light
Erin Lowery, City Light

Consultant Team:
Michael Garello, Consultant Team
Becky Holloway, Consultant Team
Jacob Venard, Consultant Team
Theo Malone, Consultant Team
Nicole Loo, Consultant Team

Summary of Discussion Topics

1. Greetings, Agenda Review, and Previous Action Items
    a. Becky began the meeting with a brief overview of the agenda
        i. No new topics were added or requested
    b. Action Item Review (from 11/15/21 meeting)
        i. Data on average fish weights—No new updates from LPs. Will keep action item open for LPs to continue looking into.
        ii. Data on Salish Sucker and Pacific Lamprey—No new updates from LPs. Will keep action item open for LPs to continue looking into.
2. Preliminary Draft DCD Comments
    a. Comments received from NMFS, USFWS, USIT, and Swinomish
        i. Comment responses are being incorporated into the Revised Draft DCD
        ii. Comment response matrix will be provided with the Revised Draft DCD to LPs on 12/9/21 (1 week before Workshop No. 3 on 12/16/21)
3. Review of Results of Options Setting Exercise and Discussion for the Diablo Development
    a. Mike reviewed the process and results of the brainstorming exercise and discussion for the Diablo Development
        i. Results were summarized in a figure and table in 11/15/21 meeting notes
    b. Mike presented figures demonstrating potential fish passage facility locations and options for the Diablo Development resulting from brainstorm session during previous AWS
        i. Upstream Fish Passage Options at the town of Diablo
            1. Fish ladder to Diablo Dam

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2. Trap and transport

ii. Downstream Fish Passage Options at Diablo Dam

1. Forebay collectors
    a. Fixed forebay collector likely given low reservoir fluctuation
2. Gravity bypass
    a. To point of release near Diablo Powerhouse
3. Tributary collection
    a. In-tributary collection weir(s)
    b. Head of reservoir passive collection system(s)

4. Fish Passage Options Formulation—Ross Development

a. Options Brainstorming and Formulation—Mike reviewed the goals and objectives for the options brainstorming and formulation process:

i. Continuation of the brainstorming process for fish passage options development

ii. Focus on range of technical options, criteria, and design considerations that influence alternative formulation

iii. Provide an open forum for brainstorming, discussion, and feedback with AWS participants

b. Review of Existing Conditions

i. Mike presented maps, illustrations, aerial figures, profile figures, and water surface fluctuation figures to provide an overview of the Upper Skagit System and the Ross Development

ii. Ross Reservoir exhibits high water surface fluctuation

1. Stan expressed concern that if facility is not designed for an absolute minimum water surface elevation, there could be extended periods of time where fish are not being passed
2. Mike responded that additional investigation is needed at each reservoir to understand why the minimum water surface elevation occurred. This investigation will occur at all dams. Regardless, floating surface collectors (FSC) are designed to operate over the range of anticipated conditions, including minimum water surface elevations

c. Potential Fish Passage Options for the Ross Development

i. Mike presented figures demonstrating potential fish passage facility locations and transport options for the Ross Development

1. Upstream Fish Passage Options at Ross Powerhouse
    a. Fish ladder to Ross Dam
    b. Trap and transport
2. Downstream Fish Passage Options at Ross Dam
    a. Forebay collectors
        i. FSS or FSC likely given high reservoir fluctuation
    b. Gravity bypass
        i. To point of release near Ross Powerhouse
    c. Tributary collection
        i. In-tributary collection weir(s)
        ii. Head of reservoir passive collection system(s)

d. Joint Brainstorming Session for the Ross Development

i. Theo shared the web link to the Mural platform to kick off the brainstorming exercise. AWS participants were encouraged to participate using the shared web link.

ii. Mike guided and facilitated the Mural brainstorm session for the Ross Development, posing questions and generating discussion amongst AWS participants

1. Brainstorming topics included:
    a. Fish Collection/Entrance Locations (US/DS)
    b. Fish Release/Exit Locations (US/DS)
    c. Key Considerations (US/DS)
    d. Risks or Concerns (US/DS)
    e. Potential Technologies (US/DS)
    f. Data Gaps
    g. Other
iii. AWS participants shared their thoughts, ideas, and concerns for the range of brainstorming topics
iv. See **Attachment A** for brainstorm results and discussion

5. Study Plan Progress and Schedule Update
    a. Reviewed Look-Ahead Schedule and Milestones for Workshop No. 3
        i. Revised Draft DCD and comment matrix submitted to LPs on 12/9/2021
        ii. AWS No. 10 on 12/13/21
        iii. FA-04 Workshop No. 3 on 12/16/2021
    b. Reviewed current tasks already in progress and next steps
        i. Continue formulating fish passage options
        ii. Prepare Revised Draft DCD
        iii. Prepare ISR report
        iv. Prepare for Workshop No. 3
        v. Prepare for next AWS
6. Future Discussion Topics/Agenda Items for Next Meeting
    a. Agenda Items for AWS 10 (12/13/21)
        i. Review results of options setting exercise and discussion for the Ross Development
        ii. Discuss factors that influence the feasibility of potential fish passage options and alternative selection
        iii. Discuss methods for alternative development and selection

Agreements

1. A comprehensive range of fish passage options and strategies should be considered and documented at this stage; all options should be considered up-front and eliminated in subsequent stages as feasibility is assessed.
2. Consultant Team will prepare next meeting's agenda to include:
    a. Review results of options setting exercise and discussion for the Ross Development
    b. Discuss factors that influence the feasibility of potential fish passage options and alternative selection
    c. Discuss methods for alternative development and selection

Ongoing Discussion Topics

1. Formulation of fish passage facility options for each passage strategy
2. Data collection and information needs
3. Linkages to other on-going studies to FA-04; study will be iterative and incorporate relevant information from other studies as it becomes available

Action Items

1. AWS participants to look for available data on average fish weights—Stan (SRSC), Logan (NMFS), Rick and Brian (USIT), Brock (WDFW)

2. Consultant team reiterated previous request for available data on Salish sucker and Pacific lamprey in the Skagit River, specifically in the bypass reach

FA-04 Look-Ahead Schedule

Milestone/Activity	Anticipated Schedule
Consultant Team to submit Revised Draft DCD and comment matrix to LPs	12/9/2021
AWS Meeting #10	12/13/2021
FA-04 Workshop No. 3	12/16/2021

Attachment A: Ross Development Brainstorm Results and Discussion

The brainstorm session results and discussion for the Ross Development are depicted in **Figure 1** and summarized in **Table 1**.

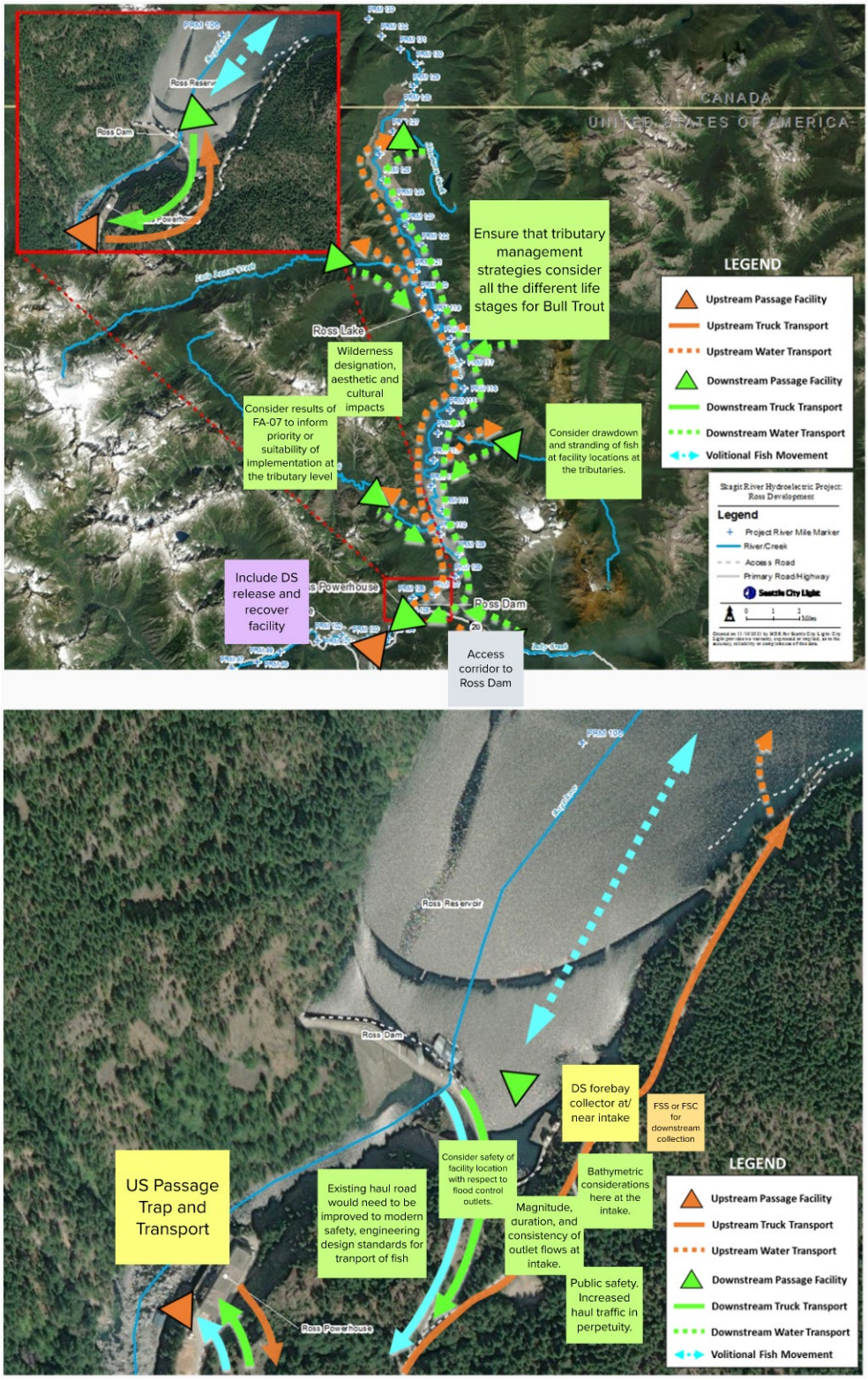


Figure 1. Mural Brainstorming Results for the Ross Development

Table 1. Mural Brainstorming Results for the Ross Development

Sticky Color	Brainstorming Topic	Comment
Green	Key Considerations	A key consideration for potential tributary facilities is wilderness designation. This may influence the allowable location, type, and seasonality of the facility.
Green	Key Considerations	A key consideration for all potential passage facilities and infrastructure is to limit disturbance to cultural resources (aesthetics, auditory, etc.)
Green	Key Considerations	Key considerations for potential tributary facilities are the results of FA-07. These results will inform the priority or suitability of implementation at the tributary level.
Green	Key Considerations	A key consideration for potential tributary facilities is the drawdown and stranding of fish at the tributaries.
Green	Key Considerations	A key consideration for tributary management strategies are all the different life stages of bull trout.
Green	Key Considerations	A key consideration for downstream passage at Ross Dam is the magnitude, duration, and consistency of outlet flows at the intake structure.
Green	Key Considerations	A key consideration for downstream passage at Ross Dam is the bathymetry at the intake.
Green	Key Considerations	A key consideration for downstream passage at Ross Dam is the safety of the facility location with respect to the flood control outlets.
Green	Key Considerations	A key consideration for both upstream and downstream passage at the Ross Development is that the existing haul road would need to be improved to modern safety, engineering, and design standards for the transport of fish.
Green	Key Considerations	A key consideration for both upstream and downstream passage at the Ross Development is public safety on the haul road. Haul traffic would be increased in perpetuity.
Yellow	Fish Collection Location	For downstream transport collection, there is opportunity at/near the intake structure in the Ross Reservoir forebay.
Yellow	Fish Collection Location	For upstream transport collection, there is opportunity in the vicinity of Ross Powerhouse.
Purple	Fish Release Location	A downstream release and recover facility should be included downstream of Ross Dam.
Orange	Potential Technologies	For downstream transport at Ross Dam, consider the use of a Floating Screen Structure (FSS) or Floating Surface Collector (FSC)
Grey	Other	For upstream and downstream transport at the Ross Development, consider adding a connection to Hwy 20 to improve access.

Skagit River Hydroelectric Project
Seattle City Light (City Light)
FA-04 Fish Passage Study Agency Work Session[1]
Meeting Date – December 13, 2021

Summary of Discussion Topics, Agreements, Ongoing Discussions, and Action Items

Attendance

Licensing Participants (LPs):
Jeff Garnett, U.S. Fish and Wildlife Service (FWS)
Logan Negherbon, National Marine Fisheries Service (NMFS)
Ashley Rawhouser, National Park Service (NPS)
Stan Walsh, Skagit River System Cooperative (SRSC)
Brian Lanouette, Upper Skagit Indian Tribe (USIT)
Rick Hartson, USIT
Brock Applegate, Washington Department of Fish and Wildlife (WDFW)
Kevin Lautz, WDFW
Duncan Pfeifer, WDFW

Seattle City Light (City Light):
Andrew Bearlin, City Light
Erin Lowery, City Light

Consultant Team:
Michael Garello, Consultant Team
Becky Holloway, Consultant Team
Bao Le, Consultant Team
Jacob Venard, Consultant Team
Theo Malone, Consultant Team
Nicole Loo, Consultant Team

Summary of Discussion Topics

1. Greetings, Agenda Review, and Previous Action Items
    a. Becky began the meeting with a brief overview of the agenda
        i. Discussion topics for today's meeting are meant to serve as a precursor for discussions to be had and continued during Workshop 3 on Thursday, 12/16/21
    b. Action Item Review (from 11/29/21 meeting)
        i. Data on average fish weights—No new updates from LPs. Will keep action item open for LPs to continue looking into.
            1. Stan Walsh provided some information on target species on 12/14/21
        ii. Data on Salish Sucker and Pacific Lamprey—Will keep action item open for LPs to continue looking into.
            1. Ashley R. provided Salish Sucker collection locations in the Skagit Basin via email shortly after the meeting on 12/13/21
2. Revised Draft DCD Comments
    a. Revised Draft DCD and comment matrix submitted to LPs on 12/9/21
    b. Comments requested back from LPs by 1/6/22
    c. Feedback on Revised Draft DCD and from Workshop 3 and 1/10/22 AWS discussions will be incorporated into Final DCD

[1] Note that Agency Work Sessions are not facilitated by Triangle and Associates. In general, these meetings are technically focused discussions comprised of a small group of City Light/Consultant Team and LP technical staff. The intent of these meetings is to address high priority technical action items to ensure the larger Triangle-facilitated meetings can occur on schedule. Summaries are informal and only capture any agreements, remaining issues, and action items resulting from discussions. These notes are not intended to be formal records of the meeting.

d. Becky encouraged AWS participants to review **Attachment E: Comment Response Table** of the Revised Draft DCD before Workshop No. 3 for a good overview on how LP comments were incorporated and responded to

3. Review Potential Fish Passage Options Resulting from Previous Brainstorming Exercise for the Ross Development
    a. Mike reviewed the process and results of the brainstorming exercise and discussion for the Ross Development
        i. Results were summarized in a figure and table in 11/29/21 meeting notes
    b. Mike presented figures demonstrating potential fish passage facility locations and options for the Ross Development resulting from brainstorm session during previous AWS
        i. Upstream Fish Passage Options at Ross Powerhouse
            1. Fish ladder to Ross Dam—likely not an option that can be implemented without a complex ladder exit system due to high headwater fluctuation
            2. Trap and transport
        ii. Downstream Fish Passage Options at Ross Dam
            1. Forebay collectors
                a. FSS or FSC likely given high reservoir fluctuation
            2. Gravity bypass
                a. To point of release near Ross Powerhouse
            3. Tributary collection
                a. In-tributary collection weir(s)
                b. Head of reservoir passive collection system(s)—likely not feasible due to reservoir drawdown
    c. Mike discussed key considerations, data gaps, and themes influencing fish passage option selection and development and presented summary tables for potential options for the Ross, Diablo, and Gorge Developments that depict various combinations of facility locations, fish passage strategies, and fish passage technologies
4. Factors that Influence the Technical Feasibility of Potential Fish Passage Options
    a. Mike presented feasibility factors used to evaluate whether physical and operational characteristics of a particular fish passage option will meet specific objectives
        i. Feasibility Factor 1: Ability to Meet Engineering, Constructability, and Operational Constrains
        ii. Feasibility Factor 2: Ability to Operate in conjunction with Existing Uses
        iii. Feasibility Factor 3: Ability to Meet Usual and Customary Fish Passage Performance Standards
        iv. Feasibility Factor 4: Adaptability
    b. These factors are based on previous experience from developing high dam fish passage at other facilities
    c. This discussion of feasibility factors is meant to help narrow the full list of options considered to date for each facility to those that are likely to be technically feasible to build and operate
    d. These feasibility factors will be further discussed during Workshop 3
5. Methods for Alternative Development and Selection
    a. Mike provided an overview of the option review and selection process
        i. Review suitability for all upstream and downstream technologies considered
        ii. Technologies that are suited to known operational environments at each development will advance to the next phase of study
        iii. Qualitatively winnow options down to those that best represent the range of fish passage facilities and fish management strategies
    b. Mike provided a preview of the upstream and downstream fish passage technology suitability tables that will be further discussed during Workshop 3

c. Mike asked the AWS group to share their thoughts on the option selection process/development of the range of options
    i. AWS participants reiterated that they would like the rationale behind the elimination of options from consideration to be explained and documented
6. Study Plan Progress and Schedule Update
    a. Reviewed Look-Ahead Schedule and Milestones
        i. FA-04 Workshop No. 3 on 12/16/2021
        ii. Initiate Final Draft DCD and Concept Development Report (December 2021 – January 2022)
        iii. AWS Meeting No. 11 on 1/10/2022
        iv. AWS Meeting No. 12 on 1/24/2022
        v. Final Draft DCD delivered to LPs on 1/31/2022
7. Future Discussion Topics/Agenda Items for Next Meeting
    a. Agenda Items for AWS 11 (1/10/22)
        i. Discuss Revised Draft DCD Comments received to date
        ii. Review fish passage options and discussion from Workshop 3
        iii. Refine fish passage options to be carried into Stage 2 of the Fish Passage Facilities Alternatives Assessment
            1. Refine and gain consensus on passage technologies and facility locations
            2. Discuss options that will likely be eliminated from further consideration

Agreements

1. A comprehensive range of fish passage alternatives and strategies should be considered and documented at this stage; all options should be considered up-front and eliminated in subsequent stages as feasibility is assessed.
2. Consultant Team will prepare next meeting's agenda

Ongoing Discussion Topics

1. Formulation of fish passage facility options for each passage strategy
2. Data collection and information needs
3. Linkages to other on-going studies to FA-04; study will be iterative and incorporate relevant information from other studies as it becomes available

Action Items

1. AWS participants to look for available data on average fish weights—Stan (SRSC), Logan (NMFS), Rick and Brian (USIT), Brock (WDFW)
2. Consultant team reiterated previous request for available data on Salish sucker and Pacific lamprey in the Skagit River, specifically in the bypass reach

FA-04 Look-Ahead Schedule

Milestone/Activity	Anticipated Schedule
FA-04 Workshop No. 3	12/16/2021
Initiate Final Draft DCD and Concept Development Report	December 2021 – January 2022
AWS Meeting No. 11	1/10/2022
AWS Meeting No. 12	1/24/2022
Final Draft DCD submitted to LPs	1/31/2022

Skagit River Hydroelectric Project
Seattle City Light (City Light)
FA-04 Fish Passage Study Agency Work Session[1]
Meeting Date – January 10, 2022

Summary of Discussion Topics, Agreements, Ongoing Discussions, and Action Items

Attendance

Licensing Participants (LPs):
Ashley Rawhouser, National Park Service (NPS)
Stan Walsh, Skagit River System Cooperative (SRSC)
Amy Trainer, Swinomish Indian Tribe
Jeff Garnett, U.S. Fish and Wildlife Service (USFWS)
Brian Lanouette, Upper Skagit Indian Tribe (USIT)
Rick Hartson, USIT
Kevin Lautz, WDFW

Seattle City Light (City Light):
Andrew Bearlin, City Light
Erin Lowery, City Light

Consultant Team:
Michael Garello, Consultant Team
Becky Holloway, Consultant Team
Bao Le, Consultant Team
Jacob Venard, Consultant Team
Theo Malone, Consultant Team
Nicole Loo, Consultant Team

Summary of Discussion Topics

1. Greetings, Agenda Review, and Previous Action Items
    a. Becky began the meeting with a brief overview of the agenda
    b. Action Item Review (from 12/13/21 meeting)
        i. Data on average fish weights—Received from Stan Walsh
        ii. Data on Salish Sucker and Pacific Lamprey—Received data from Ashley Rawhouser
2. Revised Draft DCD Comments
    a. Revised Draft DCD and comment matrix submitted to LPs on 12/9/21
    b. Comments requested back from LPs by 1/6/22
    c. Feedback on Revised Draft DCD and from Workshop 3 and 1/10/22 AWS discussions will be incorporated into Final DCD
    d. Comments received to date: WDFW responded and indicated that they have no comments. USFWS and NPS provided comments for consideration.
3. Review of Fish Passage Options and Discussion from Workshop 3
    a. Mike reviewed the results and conclusions of the fish passage option development process presented during Workshop 3
    b. Mike reviewed and summarized the 3 potential fish passage options from Workshop 3
        i. Option 1: Multi-Objective—Robust arrangement of a broad range of facilities that is highly adaptable to numerous biological goals and fish management strategies
            1. Upstream Passage

[1] Note that Agency Work Sessions are not facilitated by Triangle and Associates. In general, these meetings are technically focused discussions comprised of a small group of City Light/Consultant Team and LP technical staff. The intent of these meetings is to address high priority technical action items to ensure the larger Triangle-facilitated meetings can occur on schedule. Summaries are informal and only capture any agreements, remaining issues, and action items resulting from discussions. These notes are not intended to be formal records of the meeting.

a. Trap and transport at each development
2. Downstream Passage
a. Forebay collector at each development
b. Head of reservoir tributary collector(s)—TBD
c. Trap and transport fish transit

ii. Option 2: Reservoir Bypass—Focused strategy using available habitat upstream of Ross Dam
1. Upstream Passage
a. Trap and transport at Gorge Powerhouse only
2. Downstream Passage
a. Forebay collector at Ross intake forebay only
b. Trap and transport fish transit

iii. Option 3: Volitional—Emphasis on volitional upstream and downstream fish migration and self-selection with potential for inter-project reservoir transit; limits trap and haul
1. Upstream Passage
a. Fish ladder at Gorge and Diablo Dams
b. Trap and transport at Ross Dam
2. Downstream Passage
a. Forebay collector at each development
b. Downstream bypass pipe

4. Reformulation of Fish Passage Options
a. Mike re-emphasized that the options selected to be carried into the Concept Development Report (Stage 2 of the Fish Passage Facilities Alternatives Assessment) are meant to bracket the range of possibilities and that options not selected for further evaluation will be documented with explanations as to why.
b. Effectively, options selected for further evaluation are captured in the original Multi-Objective option, plus two separate sub-options to accommodate fish ladders at Gorge and Diablo Dams as well as a trap and transport facility at the base of Gorge Dam.
c. Based upon feedback and discussions with LPs during Workshop 3, Mike proposed to move forward with Option 1: Multi-Objective with several renditions/sub-options:
i. Option 1A: Multi-Objective as presented
1. Upstream Passage Facilities (trap and haul)
a. Gorge Powerhouse
b. Diablo Powerhouse
c. Ross Powerhouse
2. Downstream Passage Facilities (trap and haul)
a. Gorge
i. Fixed forebay collector at dam intake
ii. Hwy 20 at Stetattle Creek
b. Diablo
i. Fixed forebay collector at dam intake
ii. Hwy 20 at Thunder Creek
c. Ross
i. FSC/FSS at forebay of dam intake
ii. Various tributary collectors

ii. Option 1B: Multi-Objective with an upstream collection option near the base of Gorge Dam
1. Upstream Passage Facilities
a. Same as Option 1A, but instead of collection at Gorge Powerhouse, collection facility at Gorge Dam

2. Downstream Passage Facilities
    a. Same as Option 1A

iii. Option 1C: Multi-Objective with fish ladders at Gorge and Diablo with downstream bypass pipes/channels at each dam
1. Upstream Passage Facilities
    a. Fish ladders at Gorge and Diablo
2. Downstream Passage Facilities
    a. Bypasses at all dams

d. Mike opened the discussion to the group for their comments/thoughts on the proposed approach of moving forward with Options 1A-C
    i. General consensus amongst AWS participants was that they liked the comprehensiveness of this approach and the broad range of options that could be pieced together like an "a la carte menu"
    ii. Ashley R. asked about how considerations on the broad range of species and life histories would be incorporated into the options. Mike responded that a lot of that discussion would go under performance and suitability and how compatible the options are with fish species based on past performance history at other similar facilities. The final deliverable for the Fish Passage Study (Fish Passage Assessment Report, to be initiated in summer 2022, as stated in the RSP) will assess the ability of each option to meet each of the four feasibility factors discussed in the DCD and at length in Workshop 3.
e. Mike summarized technologies not yet considered as part of future evaluation and asked AWS participants if those technologies should be added, such as:
    i. Pneumatic Fish Transport Tube – Whooshh
    ii. Fish Passes – Fish lifts, fish elevators, or hydraulic locks.
f. AWS participants responded with acknowledgement the challenges associated with these two technologies and requested that the reason for elimination be documented in the Final DCD.
g. Mike presented options and technologies recommended to be eliminated from further consideration based upon apparent fatal flaws or conditions that posed significant feasibility concerns:
    i. Technologies recommended for elimination from further consideration:
        1. Turbine passage
        2. Surface spill
        3. Fixed In-Tributary Collectors
    ii. Options recommended for elimination from further consideration:
        1. Upstream:
            a. Fish ladder at Ross
        2. Downstream
            a. Fixed collector at Ross
    iii. Mike asked the group if there were any objections to elimination of these technologies and options
        1. No objections from AWS participants, but participants reiterated that justification for the elimination of options/technologies from further evaluation must be provided and documented
h. Mike asked the group for concurrence to move forward with the evaluation of Options 1A-C in Concept Development Report (Stage 2 of the Fish Passage Facilities Alternatives Assessment)
    i. AWS participants did not express any objections—concurrence gained
    ii. Several "thumbs up" emojis were posted to the WebEx virtual meeting

5. Study Plan Progress and Schedule Update

a. Reviewed Look-Ahead Schedule and Milestones
    i. Complete Final Draft DCD and start Concept Development Report (December 2021 – February 2022)
    ii. AWS Meeting No. 12 on 1/24/2022
    iii. Final Draft DCD delivered to LPs on or about 2/11/2022
6. Future Discussion Topics/Agenda Items for Next Meeting
    a. Agenda Items for AWS 12 (1/24/22)
        i. Discuss Revised Draft DCD comments received
        ii. Review outline and schedule for Concept Development Report
        iii. Review process for development of concept designs for fish passage facilities
        iv. Progress report on Fish Passage Assessment of Existing Features in Bypass Reach

Agreements

1. Options 1A-C are to move forward and be evaluated as part of the Concept Development Report (Stage 2 of the Fish Passage Facilities Alternatives Assessment).
2. Options and technologies that were eliminated from further consideration will be documented with explanations in the Final DCD.

Ongoing Discussion Topics

1. Refinements of fish passage facility options for each passage strategy
2. Data collection and information needs
3. Linkages to other on-going studies to FA-04; study will be iterative and incorporate relevant information from other studies as it becomes available

Action Items

1. Becky to circle back with Ash regarding provided information on *O. mykiss*
2. Consultant Team to send out a copy of today's presentation
3. Consultant Team to prepare and send out next meeting's agenda

FA-04 Look-Ahead Schedule

Milestone/Activity	Anticipated Schedule
Complete Final Draft DCD and start Concept Development Report	December 2021 – February 2022
AWS Meeting No. 12	1/24/2022
Final Draft DCD submitted to LPs	2/11/2022

FISH PASSAGE TECHNICAL STUDIES INTERIM REPORT

ATTACHMENT E

PHOTOGRAPH LOG FOR EXISTING FEATURES 1 AND 2 IN GORGE BYPASS REACH

Figure E-1. Feature 1 at approximately 700 cubic feet per second (cfs) on June 28, 2021.

Figure E-2. Feature 2 at approximately 700 cfs on June 28, 2021.

Figure E-3. Feature 1 at approximately 2,200 cfs on June 28, 2021.

Figure E-4. Feature 2 at approximately 2,000 cfs on June 28, 2021.

Figure E-5. **Feature 1 at approximately 6,700 cfs on June 29, 2021. (Camera was knocked off alignment. Subsequent spill event photos are shifted. See dot for common point.)**

Figure E-6. **Feature 2 at approximately 6,500 cfs on June 29, 2021.**

Figure E-7. Feature 1 at approximately 5,400 cfs on June 30, 2021.

Figure E-8. Feature 2 at approximately 5,300 cfs on June 30, 2021.

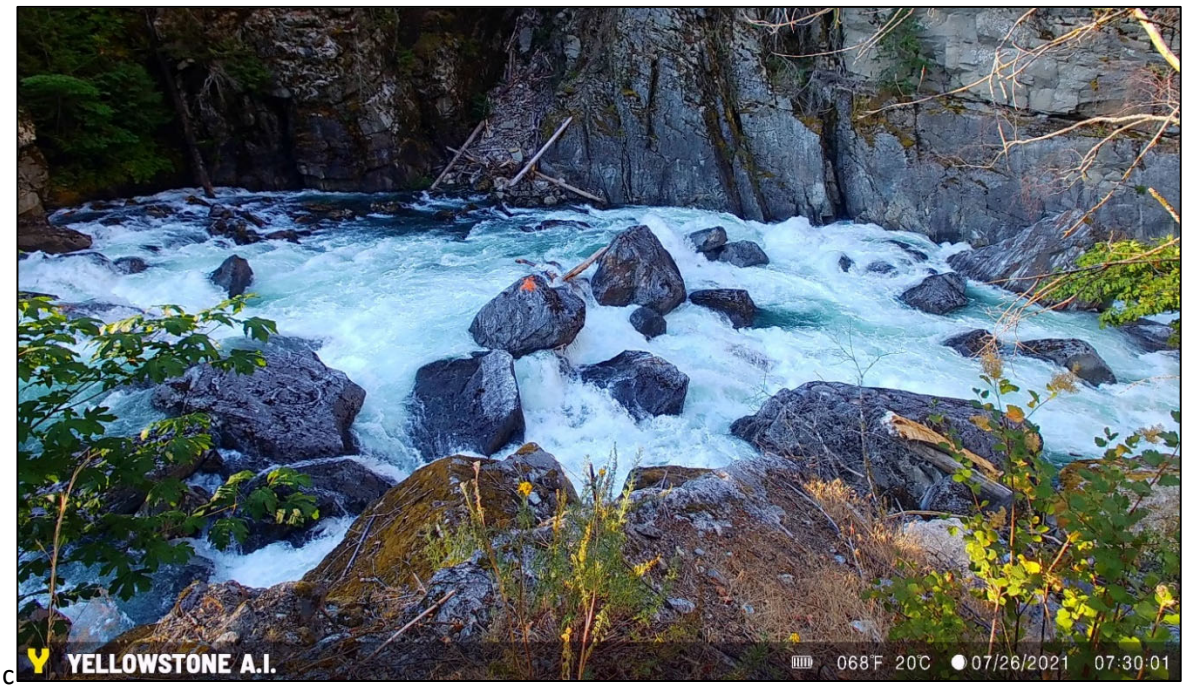
Figure E-9. Feature 1 at approximately 2,800 cfs on July 1, 2021.

Figure E-10. Feature 2 at approximately 2,800 cfs on July 1, 2021.

Figure E-11. Feature 1 at approximately 2,300 cfs on July 2, 2021.

Figure E-12. Feature 2 at approximately 2,300 cfs on July 2, 2021.

Figure E-13. **Feature 1 at approximately 1,100 cfs on July 26, 2021. (Camera realigned, see dot for common point.)**



C

Figure E-14. **Feature 2 at 1,100 cfs on July 26, 2021. (Camera replaced, see paint on rock for common point.)**

Figure E-15. Feature 1 at approximately 500 cfs on July 27, 2021.

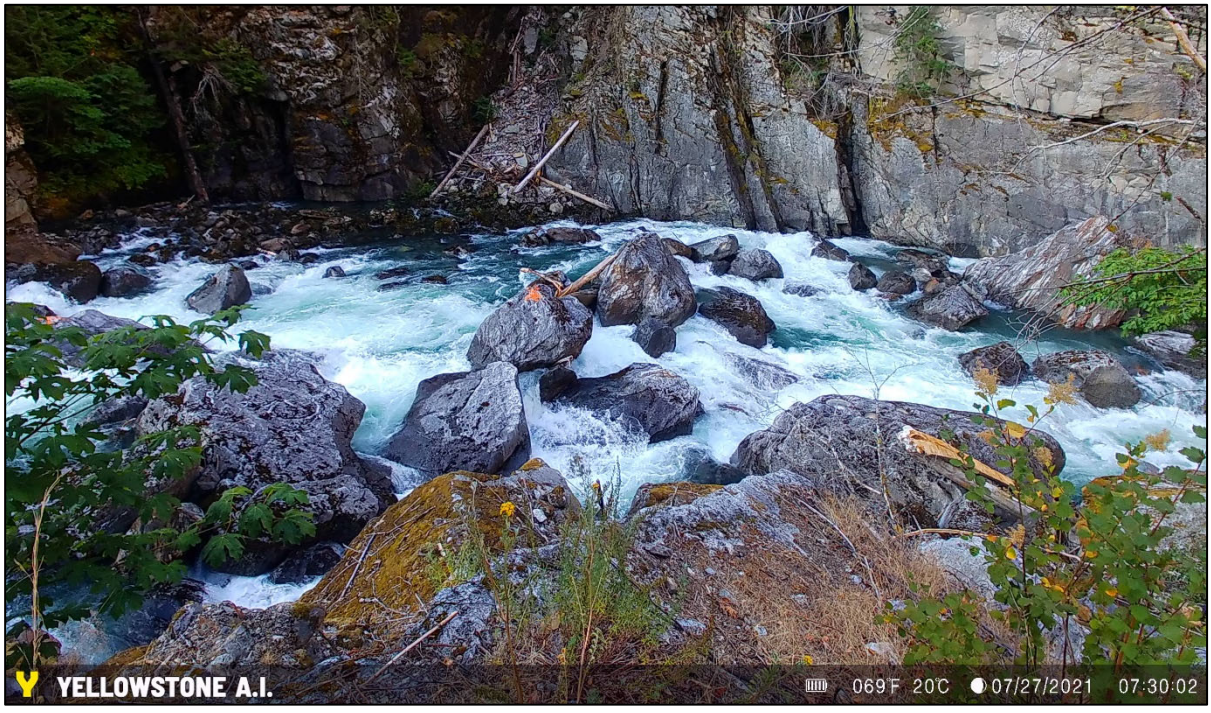


Figure E-16. Feature 2 at approximately 500 cfs on July 27, 2021.

Figure E-17. Feature 1 at approximately 300 cfs on July 28, 2021.

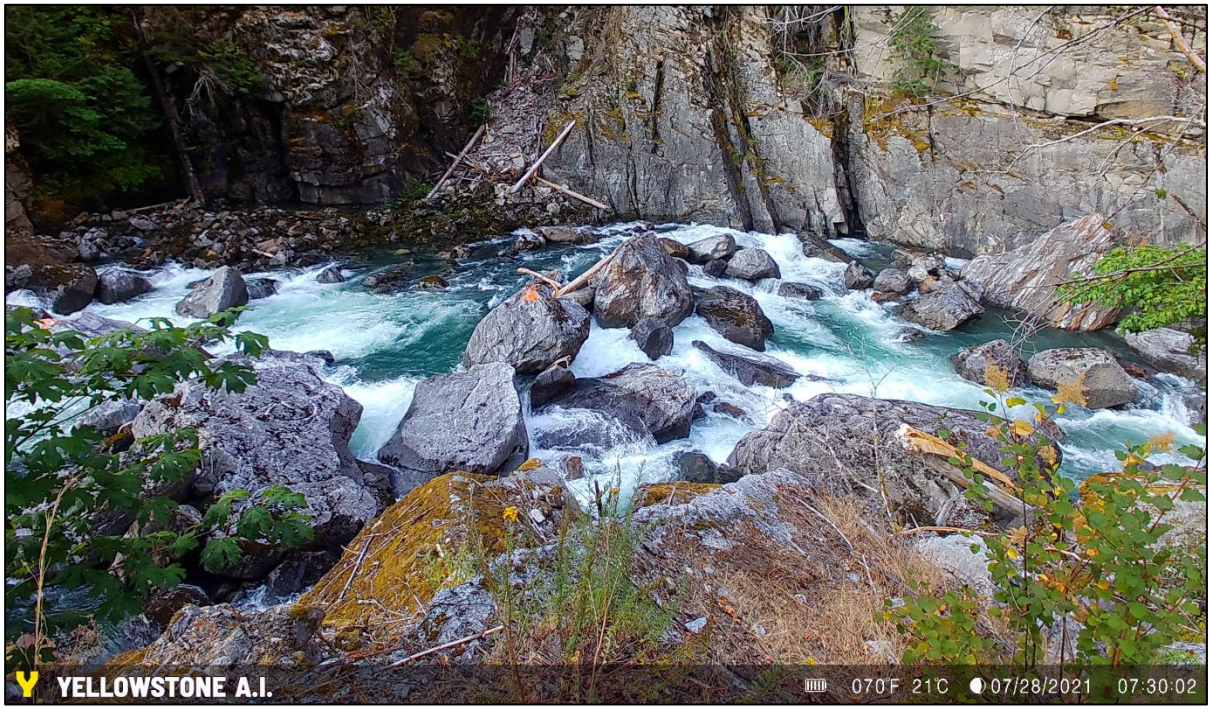


Figure E-18. Feature 2 at approximately 300 cfs on July 28, 2021.

Figure E-19. Feature 1 at approximately 60 cfs on July 29, 2021.

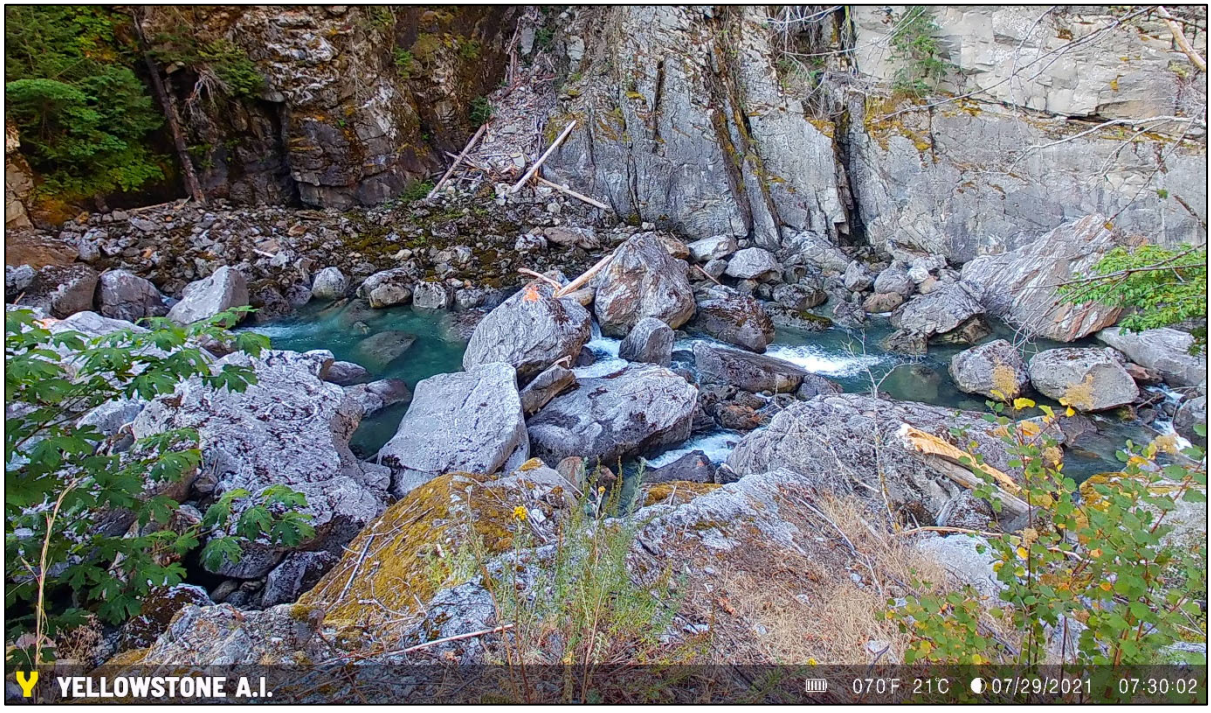


Figure E-20. Feature 2 at approximately 60 cfs on July 29, 2021.

Figure E-21. Feature 1 at base flow on July 29, 2021.

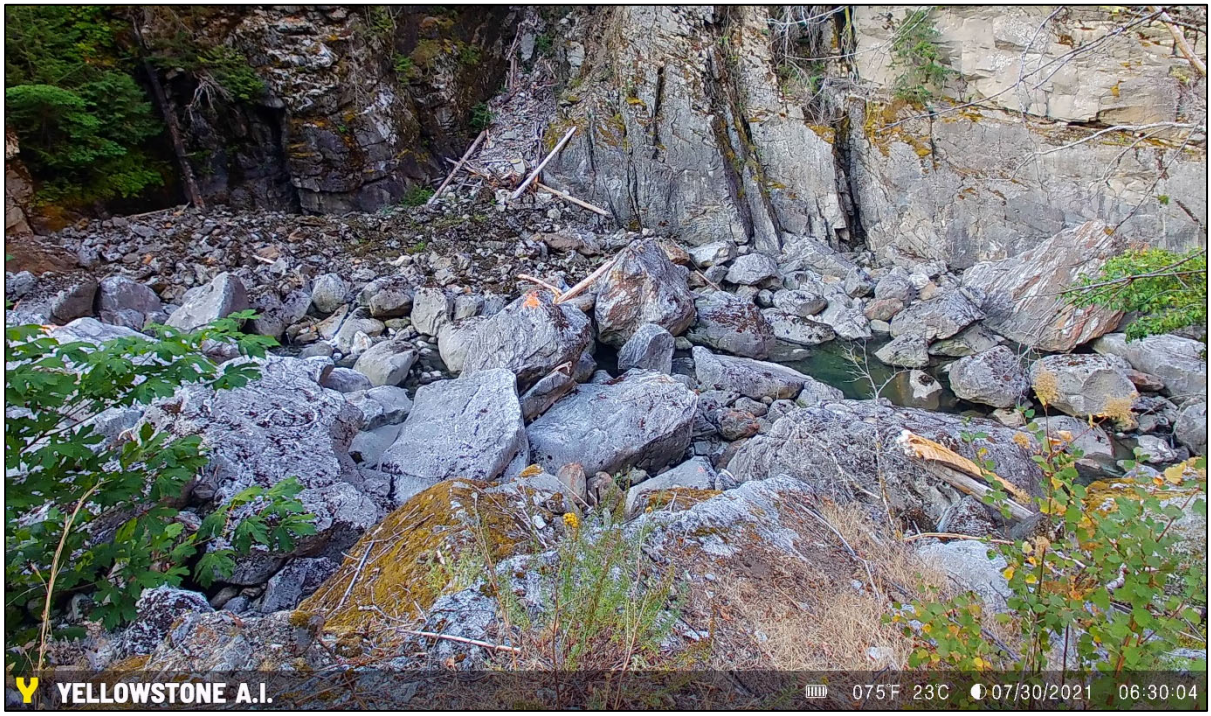


Figure E-22. Feature 2 at base flow on July 29, 2021.