Alouette Salmon Restoration Planning Post-Workshop Feedback
Conservation Science Section Comments

Recommendation 1 Sockeye Conservation Hatchery

The committee observed that, given current ocean survival, there would be no benefit of fish passage to salmon restoration without considerable supplementation to smolt production, and that a hatchery would be required to boost smolt production.

WLRS, Conservation Science Section (CSS) Feedback

- Alouette Sockeye are currently listed as a population of special concern. This population will undergo an assessment of conservation status by COSEWIC in 8 years and fish culture is currently considered by COSEWIC a threat to fish populations.
- COSEWIC considered the greatest threat to Alouette Sockeye is the loss of the water management program that enables ocean migration to allow expression of the anadromous life history.
- The Coquitlam Hatchery currently under construction will provide critical information to allow for evaluation of the benefits to Alouette Reservoir.
- Cultus lake Captive Rearing Program is effective as a conservation hatchery to preserve the gene pool and were not intended to rebuild the population.
- CSS believes the assumptions used in the modelling presented are optimistic and unlikely. There is currently no basis to believe marine survival will increase and we do not believe there is a scientific basis for no competition with wild stocks.
- The low number of wild fish available for broodstock raises concerns of genetic bottlenecks and need further discussion. In the context of low marine survival impact of population abundances and evidence to suggest hatchery fish have a lower ocean survival and return rate compared to wild fish, we feel a hatchery could further threaten Alouette Sockeye.
- CSS feel it is important to determine the cause of population decline and at what stage in the lifecycle the decline in survival is occurring. Without addressing these issues, even the most successful hatchery program cannot recover a population.
- CSS supports the return of anadromous sockeye salmon to the reservoir.

WLRS CSS Recommendations

1) WLRP CSS does not recommend the use of a hatchery to supplement in lake sockeye production at this time.

2) WLRS CSS recommends that if a hatchery is considered it must follow a scientific approach with a comprehensive monitoring program to evaluate effectiveness.

Recommendation 2 Downstream Flow Regime

The committee briefly reviewed habitat-flow relationships produced from a recent 2-D habitat model of the Lower Alouette River. The potential for significant improvements through modifications to current Ordered flows through Alouette Dam led to the committee recommending further review of the

Commented [SH1]: These are the recommendation Alf Leake is asking us to consider combining in some fashion.

This particular workshop series is focussed on fish passage. It is hoped that a sockeye hatchery will boost smolt production that will in turn lead to more returning adults to the Alouette watershed. Since currently less than 100 sockeye return annually to the reservoir, it is difficult to build a business case on sockeye alone for investment in fish passage. (2023-32 sockeye returned) Focussing on sockeye only is only seeing part of the picture because fish passage will provide benefits to other anadromous fish that also return. Perhaps the focus should be on ecosystem benefits rather than sockeye benefits thus perhaps negating the need for a hatchery.

downstream flow regime. These potential benefits will be evaluated further in the ASR WUPOR-FAA process.

WLRS, Conservation Science Section Feedback

- WLRS believes the habitat downstream above the hatchery represents critical, high value habitat, particularly for steelhead and previously has been identified by the Greater Georgia Basin Steelhead Project.

WLRS CSS Recommendations

1) WLRS CSS support this Instream Flow Evaluation be included in the ASR WUPOR-FAA review.

Recommendation 3 Habitat Restoration

The committee discussed several habitat improvement scenarios in tributaries upstream of Alouette Reservoir. Options to improve spawning and rearing habitats in Alouette Reservoir tributaries will continue to be explored.

WLRS, Conservation Science Section Feedback

- The CSS Representative was not in attendance when habitat improvement scenarios were discussed by the committee and the meeting minutes do not have sufficient details to shed light on the specifics of these discussions.
- It is unclear which species are the target.
- Prior to any restoration planning activities a FHAP should be carried out on all target tributaries (https://a100.gov.bc.ca/pub/acat/documents/r15711/Fish_Habitat_Assessment_Procedures_1229454360370_60d06fb366d66d9a96f0f58ea082db1abc58c0fc1e3805cd799cd37fc0143bdb.pdf)
- We suggest this recommendation should be expanded to include critical downstream habitat in the Alouette River downstream of the dam. In the early 2000's, the Province and others have invested significant time and resources into habitat improvements in the Alouette River and believes if the full benefits of fish passage are to be realized, the productivity of the Alouette River is critical. Nearly 20 years have passed since much of this work was done and some recent and significant flow events have occurred since (e.g., November 2021 atmospheric river) that may have been impacted. We suggest the Fish Habitat Assessment Procedure as detailed in Johnston and Slaney (1996) be conducted in the upper reaches of the Alouette River to determine if woody debris habitat structures previous installed are still present and functioning as intended.

WLRS CSS Recommendations

1) WLRS CSS supports the recommendation to continue discussion on habitat restoration options in tributaries above and below the Alouette Dam.

2) WLRA CSS recommends a Fish Habitat Assessment Procedure be completed to support further discussion of restoration options.

Recommendation 4 Entrainment (Tunnel) and Smolt Outmigration (Dam)

While Sockeye entrainment through the ALU power tunnel was considered in this process, recent updates from LGL indicated that Sockeye smolt entrainment risk is very low and unlikely to require mitigation. In addition, analyses completed as part of the entrainment study have identified potential drivers of smolt outmigration through Alouette Dam, which has been shared with the ASR WUPOR-FAA process for further consideration.

WLRS, Conservation Science Section Feedback

- As currently written, it is not clear if there is a committee recommendation regarding entrainment and smolt outmigration.
- Currently, the FAA states the Alouette Reservoir Nutrient Restoration Program is to compensate for the entrainment of fish through the low-level outlet and spillway of Alouette Dam, the diversion tunnel and adit gate, and the Alouette Generating Station, as a result of operations and/or project maintenance. While a goal related to compensation for entrainment is included in FAA's Annex 5 - Alouette Reservoir Fertilization Program: Memorandum of Understanding, 1998, this goal is specifically related to entrainment due to the Stave Falls Power Plant Replacement Project and should not be considered as compensation for entrainment in Alouette Reservoir. WLRS CSS not aware and did not agree to include compensation for Alouette Reservoir entrainment in the project gaols nor has the Nutrient Restoration MOU been updated to include compensation for entrainment in Alouette Reservoir.

WLRS CSS Recommendations

1) If the inlake population structure changes due to fish passage improvements, consideration should be taken to reproduce the study under such scenario.
2) WLRS CSS recommends that discussion for a future FAA for Alouette Reservoir must include consultation with the Ministry responsible for delivery of the nutrient restoration program if the nutrient restoration program is to be considered to provide compensation for entrainment of Alouette Reservoir.

Recommendation 5 Nutrient Restoration

The committee acknowledged the benefits of Alouette Reservoir nutrient restoration program to juvenile salmonid production and recommended that the program continue as planned until fisheries management objectives can be sustained without nutrient additions.

WLRS, Conservation Science Section Feedback

- WLRS CSS is aware of the goals for The Alouette Reservoir Nutrient Restoration Project as part of the Stave Falls Disposition Order to address incremental ecological consequences resulting from the Stave Falls Power Plant Replacement Project. These goals are outlined in the MOU with BCH and are not to be confused with fisheries management objectives.
- COSEWIC highlighted the importance of the nutrient restoration program for the conservation of Alouette sockeye genetics.

WLRS CSS Recommendations

1) WLRS CSS supports this recommendation to continue the Nutrient Restoration Program.
2) WLRS requests the fisheries management objectives be explicitly included in future reports and if not available, we support further discussion to develop/define these objectives for the Alouette Watershed.
3) WLRS CSS recommends any changes to the NR program be discussed with the Water Comptroller to ensure the intention of the Stave Falls Disposition Order are respected.

Recommendation 6 Fish Passage

This process evaluated a full suite of upstream and downstream fish passage options and identified a short list of feasible options to advance to detailed evaluation. The committee agreed on a preferred downstream option (D-2; upgraded spilling/extended outmigration window), as described in section ***Error! Reference source not found.*** *below. Section* ***Error! Reference source not found.*** *describes the remaining upstream options.*

WLRS, Conservation Science Section Feedback

- The number of spawners in Table 2 do not seem realistic relative to historical records of returning salmon completed by DFO.
- We note the returns for all fish species are similar regardless of fish passage alternative.
- We believe the cost of the operation and maintenance for the status quo includes in-kind support, but we suggest future documents include sufficient details to understand material.
- We believe the cost of alternative 1c and 1e are likely similar.
- We are concerned at the length of the Bypass pipe for effective passage and are concerned at previous challenges with the Whoosh alternative.

WLRS CSS Recommendations

1) WLRS CSS recommends alternative D-2: Upgraded spilling and extended outmigration window.
2) WLRS CSS supports further exploration of alternative 1e.

Recommendation 7 Uncertainties and Implementation Planning

While there were many uncertainties identified in the process, the committee expressed their interest to move forward with restoration actions and avoid delays while answering critical uncertainties. An implementation plan will be developed as part of the SRP documentation and will be shared with the committee for review and comment.

WLRS, Conservation Science Section Feedback

- No feedback

From: Katie O'Donnell(kodonnell@compassrm.com)
To: Harris, Shannon WLRS:EX (Shannon.Harris@gov.bc.ca)
Subject: Re: ARSRP - final survey
Sent: 08/15/2023 20:04:10
Attachments: 2023.05.25 Population Model Results v11 for ARSRP.pptx

Hi Shannon,

Habitat restoration was first discussed at the December workshop, and re-visited at the May workshop. There is not much detail in the December notes, as it was a fairly wide-ranging brainstorming discussion. I've attached ESSA's presentation from the May workshop, which was the basis for the discussion at the May workshop. ESSA's model results for alternative 1H included a hypothetical 5% improvement in upstream habitat. Again, we didn't get very specific in terms of what the habitat restoration could/should look like, but folks discussed some ideas for different locations (e.g., Gold Creek). If you have any specific ideas or concerns about improving upstream habitat (i.e., tributaries to Alouette Reservoir), it'd be great to include them in your survey response.

I think the ESSA presentation will also answer your question about the hatchery supplementation. Essentially, the model showed that under current marine survival, providing upstream fish passage would not lead to a self-sustaining (anadromous) sockeye population (slide 10). ESSA evaluated a few different levels of supplementation (slide 12). The committee generally supported this conclusion, and did support it being a short-term option (until the population was self-sustaining).

I hope this helps answer your questions! I am technically on leave this week and next week, but if you'd like to discuss anything when I'm back, let me know.

Thanks,
Katie

Katie O'Donnell, Ph.D. *(she/her)*
Associate // Ecologist / Decision Analyst
Compass Resource Management Ltd.
788 Beatty St. #302, Vancouver, BC V6B 2M1

From: Harris, Shannon WLRS:EX <Shannon.Harris@gov.bc.ca>
Sent: Tuesday, August 15, 2023 12:28 PM
To: Katie O'Donnell <kodonnell@compassrm.com>
Subject: Re: ARSRP - final survey

Hi Katie,
Can you please provide the meeting minutes where habitat restoration as discussed as well as any supporting materials?

I don’t recall these discussion but of course I don’t doubt they did occur.

Also-what is considered “considerable supplementation” and was there discussion about this being a short term management option. I did a quick look at the meeting minutes and I may have missed this but I didn’t see details on this discussion

Thank you.
Shannon

Get Outlook for iOS<https://aka.ms/o0ukef>

_____
From: Harris, Shannon WLRS:EX <Shannon.Harris@gov.bc.ca>
Sent: Thursday, August 10, 2023 9:10:14 AM
To: 'Katie O'Donnell' <kodonnell@compassrm.com>
Subject: Re: ARSRP - final survey

Hi Katie,
Our section has a meeting scheduled next Thursday to review the FP options. This will allow me to complete the survey on Friday 18th.

Shannon

Get Outlook for iOS<https://aka.ms/o0ukef>

_____
From: Harris, Shannon WLRS:EX <Shannon.Harris@gov.bc.ca>
Sent: Wednesday, August 9, 2023 9:57:38 AM
To: 'Katie O'Donnell' <kodonnell@compassrm.com>
Subject: RE: ARSRP - final survey

Thank you Katie.

Shannon

From: Katie O'Donnell <kodonnell@compassrm.com>
Sent: Wednesday, August 9, 2023 9:50 AM
To: Harris, Shannon WLRS:EX <Shannon.Harris@gov.bc.ca>
Subject: Re: ARSRP - final survey

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Hi Shannon,

We don't have a Sharepoint site set up, but I've attached the meeting minutes from the first 4 workshops here. The "Post-Workshop Memo" summarizes the key discussions from the fifth/final workshop. If there are any other presentations or reports that you'd find helpful, let me know and I'd be happy to send those along.

Thanks,

Katie

Katie O'Donnell, Ph.D. (she/her)

Associate // Ecologist / Decision Analyst

Compass Resource Management Ltd.

788 Beatty St. #302, Vancouver, BC V6B 2M1

From: Harris, Shannon WLRS:EX <Shannon.Harris@gov.bc.ca<mailto:Shannon.Harris@gov.bc.ca>>
Sent: Wednesday, August 9, 2023 9:37 AM
To: Katie O'Donnell <kodonnell@compassrm.com<mailto:kodonnell@compassrm.com>>
Subject: RE: ARSRP - final survey

Hi Katie,

Can you remind me if we have a sharepoint site with minute meetings for this? I missed a number of meetings and therefore completion of the final survey is difficult.

Thank you.

Shannon

From: Katie O'Donnell <kodonnell@compassrm.com<mailto:kodonnell@compassrm.com>>
Sent: Friday, June 23, 2023 11:05 AM
To: Bob Bocking <bbocking@lgl.com<mailto:bbocking@lgl.com>>; Ducharme, Scott <Scott.Ducharme@dfo-mpo.gc.ca<mailto:Scott.Ducharme@dfo-mpo.gc.ca>>; Elmar Plate <eplate@lgl.com<mailto:eplate@lgl.com>>; Gonzalez, Julian <julian.gonzalez@bchydro.com<mailto:julian.gonzalez@bchydro.com>>; Greta Borick-Cunningham <arms@alouetteriver.org<mailto:arms@alouetteriver.org>>; Hollick-Kenyon, Sandra <Sandra.Hollick-Kenyon@dfo-mpo.gc.ca<mailto:Sandra.Hollick-Kenyon@dfo-mpo.gc.ca>>; justin@leqamel.ca<mailto:justin@leqamel.ca>;s.22
s.22 >>; Megan Mathews <mmathews@lgl.com<mailto:mmathews@lgl.com>>; murray.manson@dfo-mpo.gc.ca<mailto:murray.manson@dfo-mpo.gc.ca>; Harris, Shannon WLRS:EX <Shannon.Harris@gov.bc.ca<mailto:Shannon.Harris@gov.bc.ca>>; Sophie Sparrow <sophie@alouetteriver.org<mailto:sophie@alouetteriver.org>>; Wendell Challenger <wchallenger@lgl.com<mailto:wchallenger@lgl.com>>
Cc: Dan Ohlson <dohlson@compassrm.com<mailto:dohlson@compassrm.com>>; Leake, Alf <alf.leake@bchydro.com<mailto:alf.leake@bchydro.com>>; jacqueline.chapman@bchydro.com<mailto:jacqueline.chapman@bchydro.com>
Subject: ARSRP - final survey

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Hi everyone,

As discussed at the May ARSRP workshop, we are sending a final survey to allow each organization to submit their comments/preferences. Your feedback will help us document the committee's recommendations within the Alouette Salmon Restoration Plan (SRP). The attached memo includes a recap of key discussions from the last 2 workshops, and instructions for completing the two-part survey.

We ask that each organization submit one (1) response to each part of the survey. Instructions and survey links are in the attached memo, and links are also included below.

* Final Survey Part 1<https://bit.ly/42TNy8C>: to capture each organization's final comments on our salmon restoration actions recommended from the last two workshops
* Final Survey Part 2<https://bit.ly/46hfBlb>: to capture each organization's final preferences for upstream fish passage improvements

We would appreciate responses by Friday, July 7 (2 weeks from today). Please let me know if you'll need additional time.

As always, let us know if you have any questions about this request.

Thanks,

Katie

Katie O'Donnell, Ph.D. (she/her)

Associate // Ecologist / Decision Analyst

Compass Resource Management Ltd.

788 Beatty St. #302, Vancouver, BC V6B 2M1

Life Cycling Modeling for Restoration Prioritization

Alouette River Salmonid Restoration Program (ARSRP)

UPDATE May 25, 2023

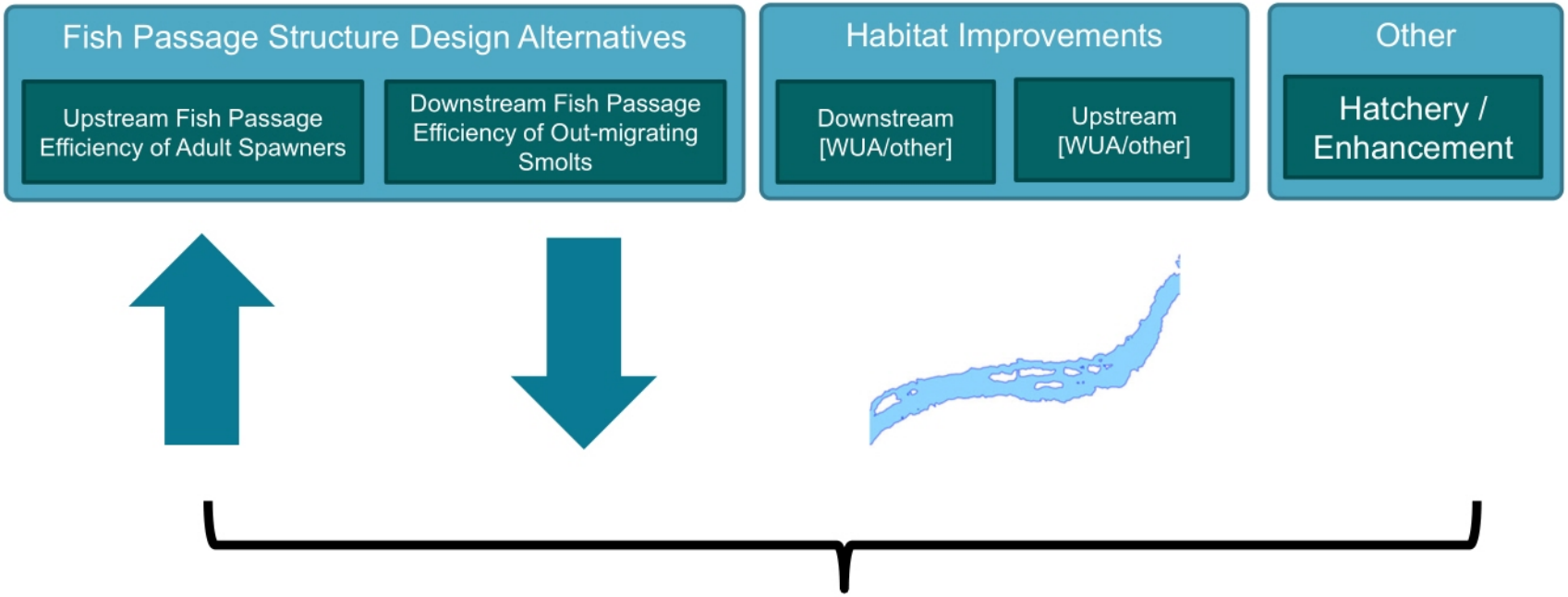
ESSA

Using population models to assess alternatives

- The Joe Model framework is a tool for evaluating different actions for outcomes related to fish population
  - Development of framework is a collaborative effort by Province, DFO, and collaborators
  - Excellent (simplified) modelling framework for assessing multiple species compared for multiple actions (*with limitations*)

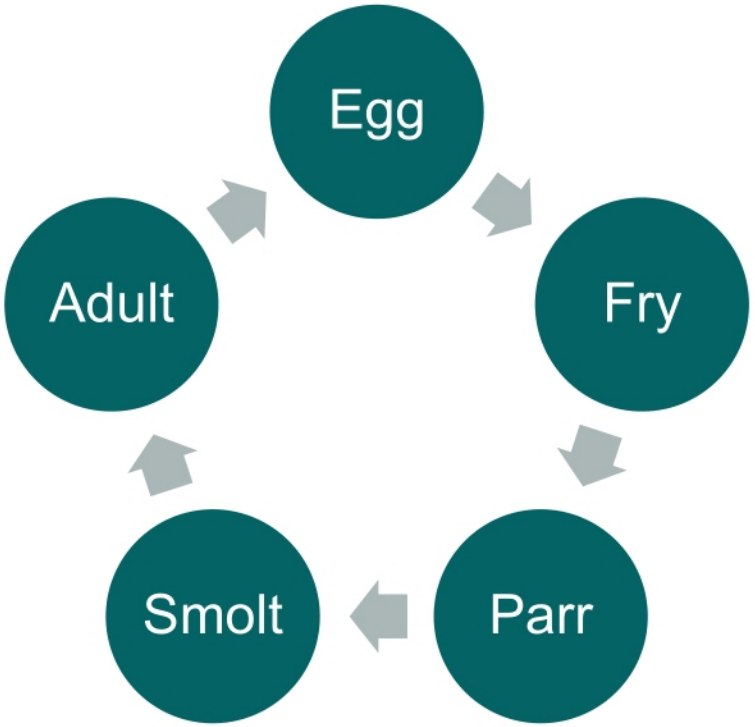
Species	Actions
• Sockeye • Chinook • Coho • Chum • Steelhead	• Fish passage • Habitat enhancement

Purpose & Scope



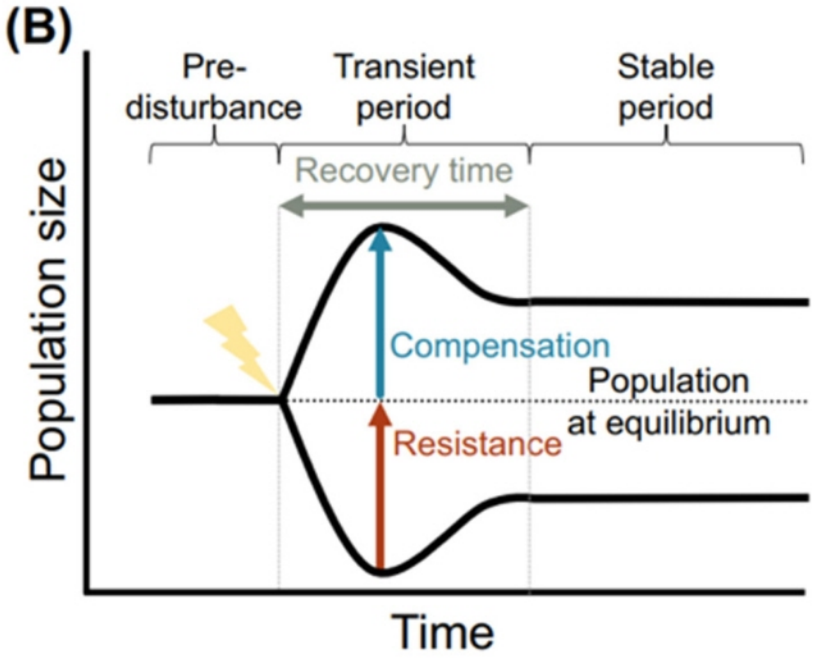
High-level assessments for multiple species within a life cycle modelling framework

Vital Rates
(Components of fitness)
e.g., egg to fry survival



Population-level Metrics
Abundance (Carrying Capacity)
Productivity (Growth Rate)

- For all species, results based on adult system capacity and intrinsic productivity were similar, so only system capacity is shown

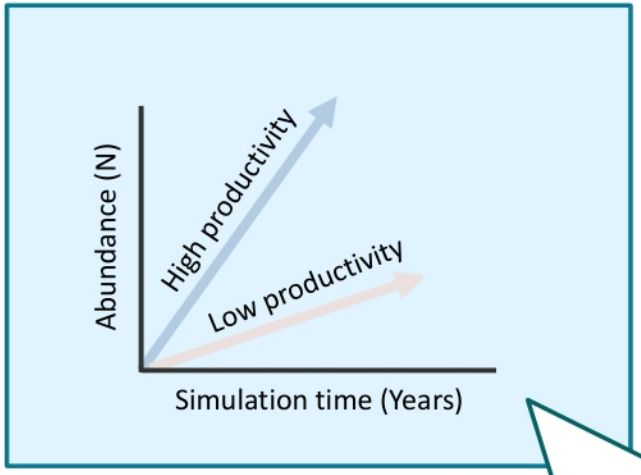


Trends in Ecology & Evolution

Capdevila et al 2020

Productivity (Growth Rate)

Intrinsic net reproductive rate



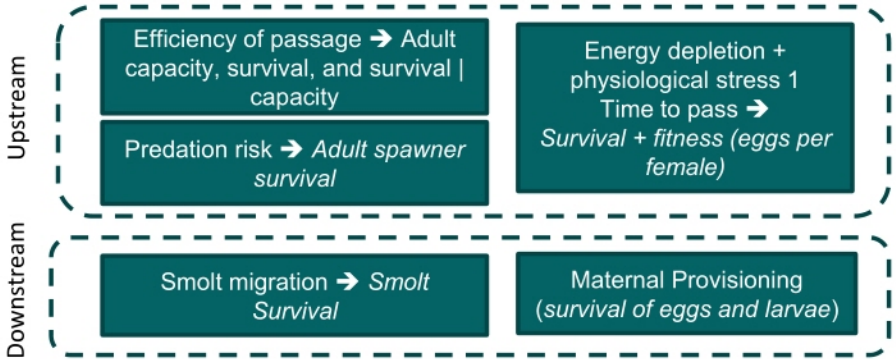
All productivity estimates strongly correlated spawner capacity estimates

Evaluating alternatives

- From prior workshops, we developed a set of alternatives
- We report out for each species, focusing on predicted abundance

Fishway Scenarios: Mechanisms

Fish Passage Efficiencies



McMILLEN JACOBS ASSOCIATES

Spilling – Status Quo

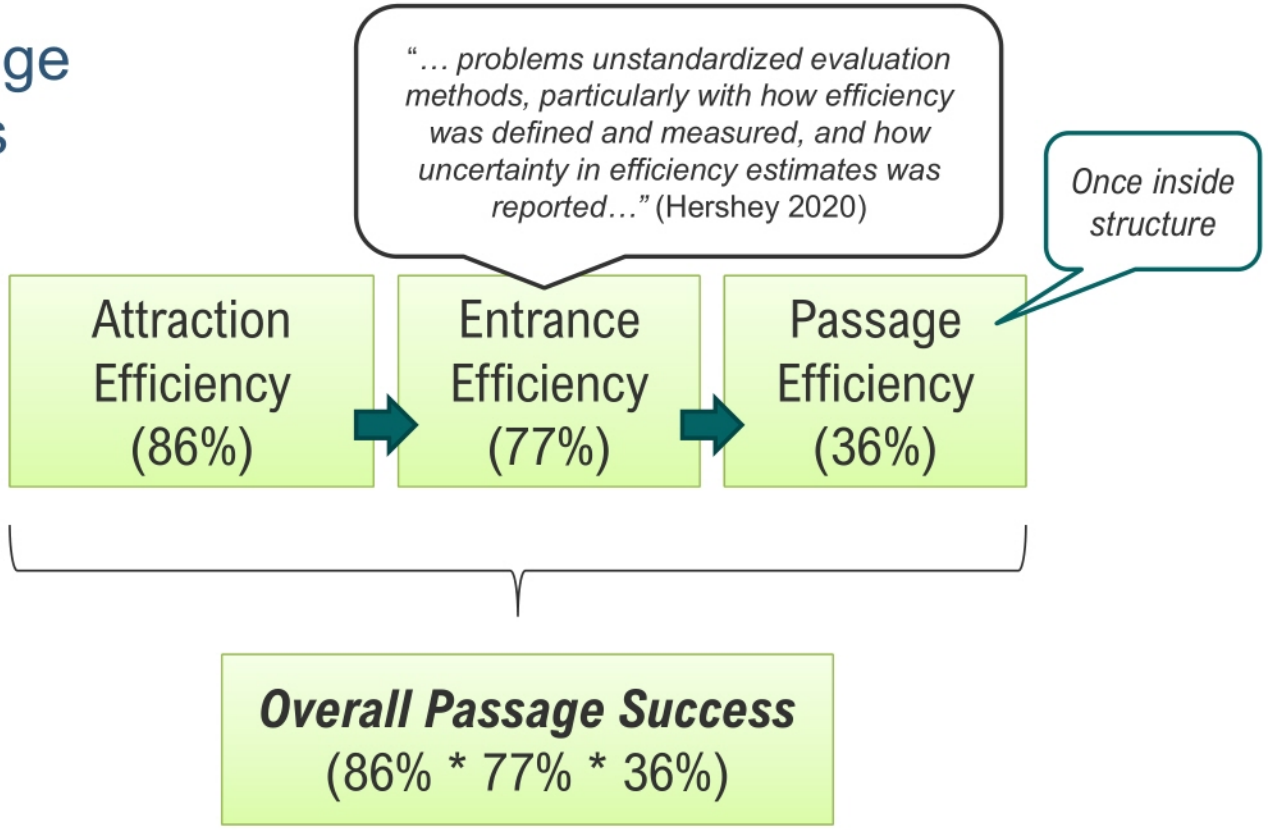
Velocity Barrier with Obermeyer gate

Floating Surface Collectors

Guidance Nets

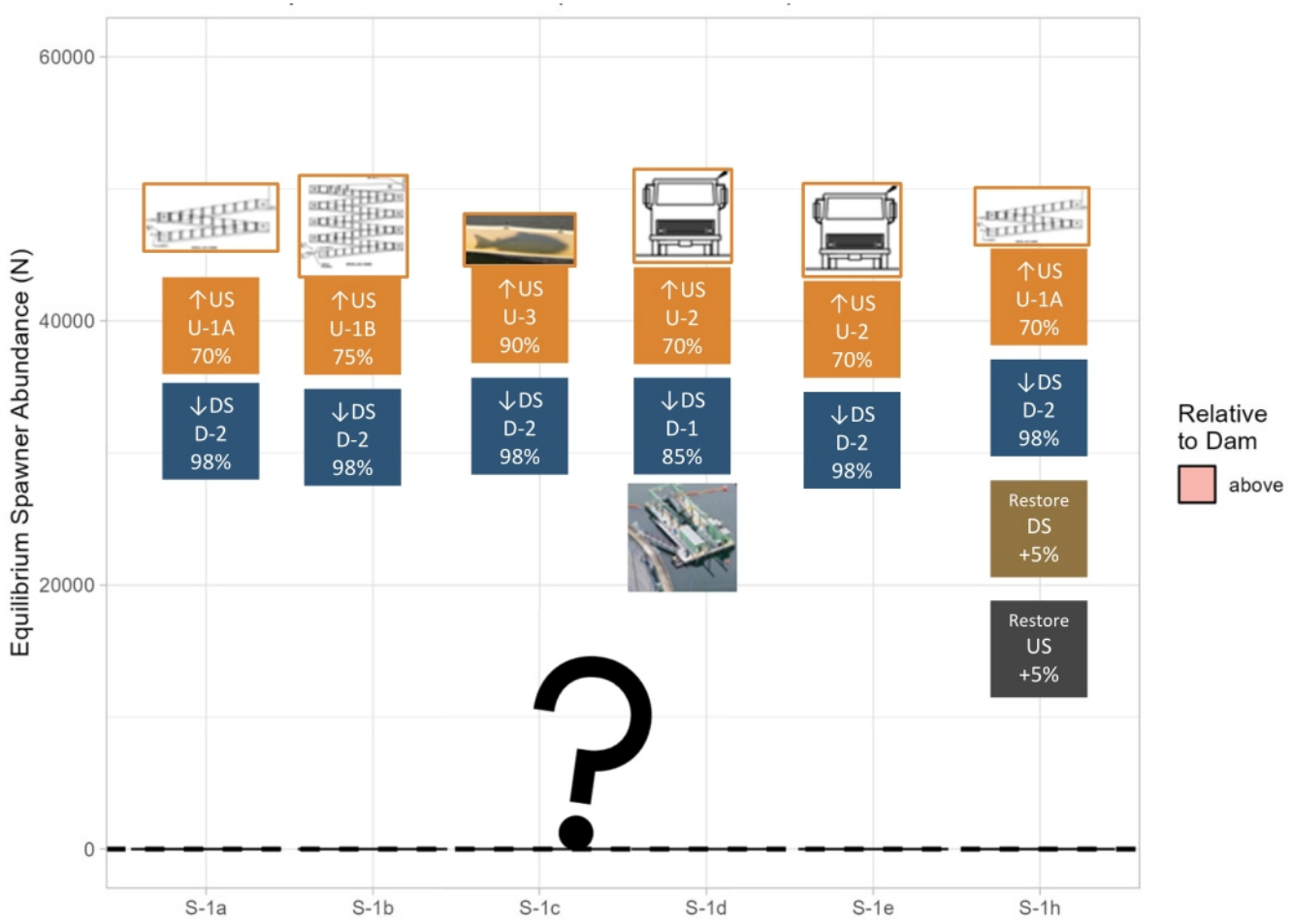
Fishway Scenarios

Fish Passage Efficiencies



SOCKEYE

Sockeye (anadramous)



Sockeye (anadramous)

- Chronically **low rate of smolting** (van Poorten 2020; Borick-Cunningham, 2018)
- Chronically **low survival rate of smolts**. ~0.025% relative to ~2.1% for other systems (van Poorten 2020; Borick-Cunningham, 2018)

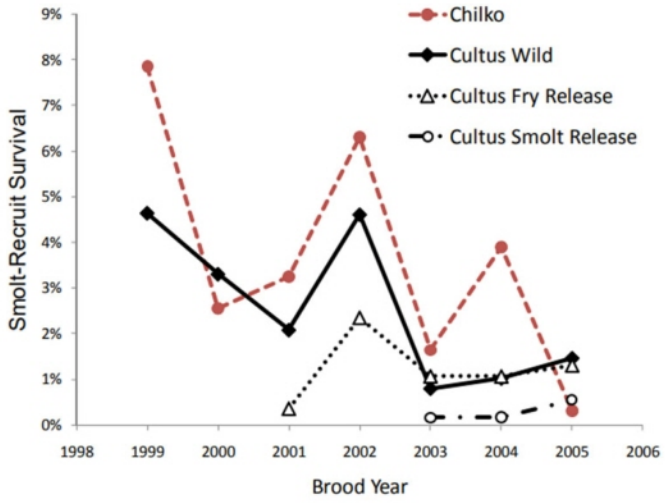
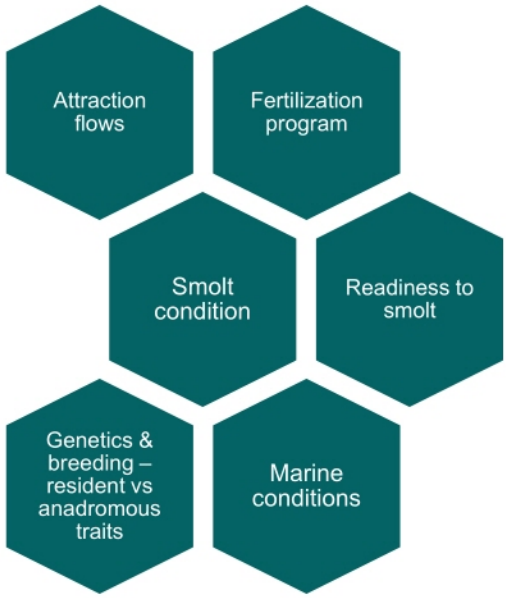
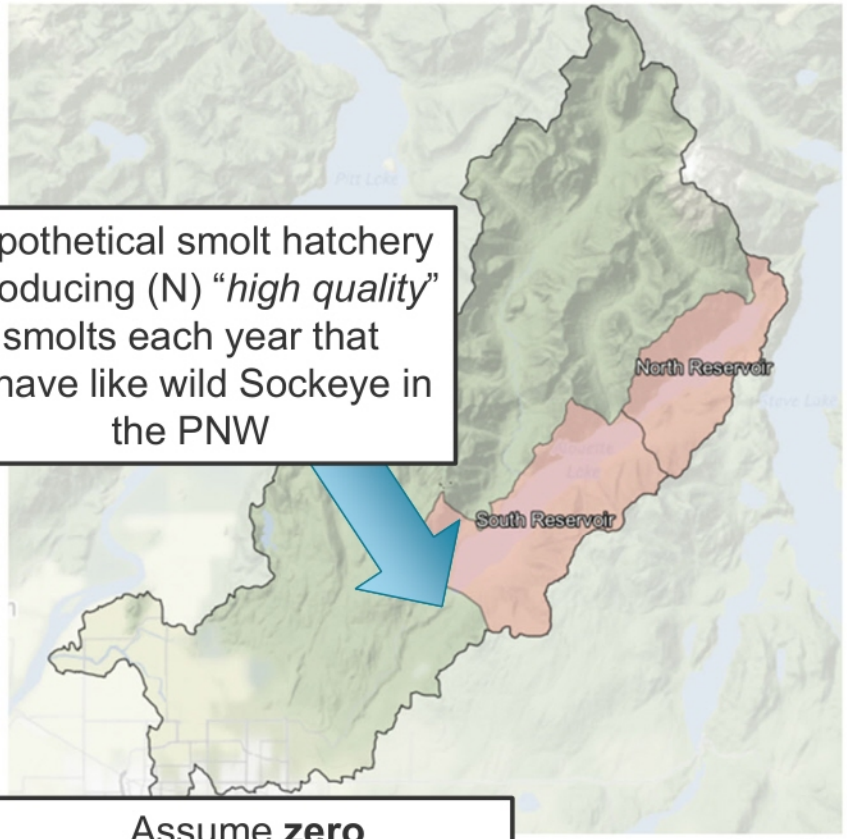


Figure 2. Recent smolt-recruit survival for Cultus Lake sockeye salmon, for wild smolts, smolts resulting from summer and fall fry releases to the lake, and from yearling smolt releases made in Sweltzer Creek, the outlet of Cultus Lake. Also shown are survival rates for Chilko Lake sockeye salmon, located in upper Fraser River basin.

Canadian Science Advisory Secretariat Science Advisory Report 2010/056

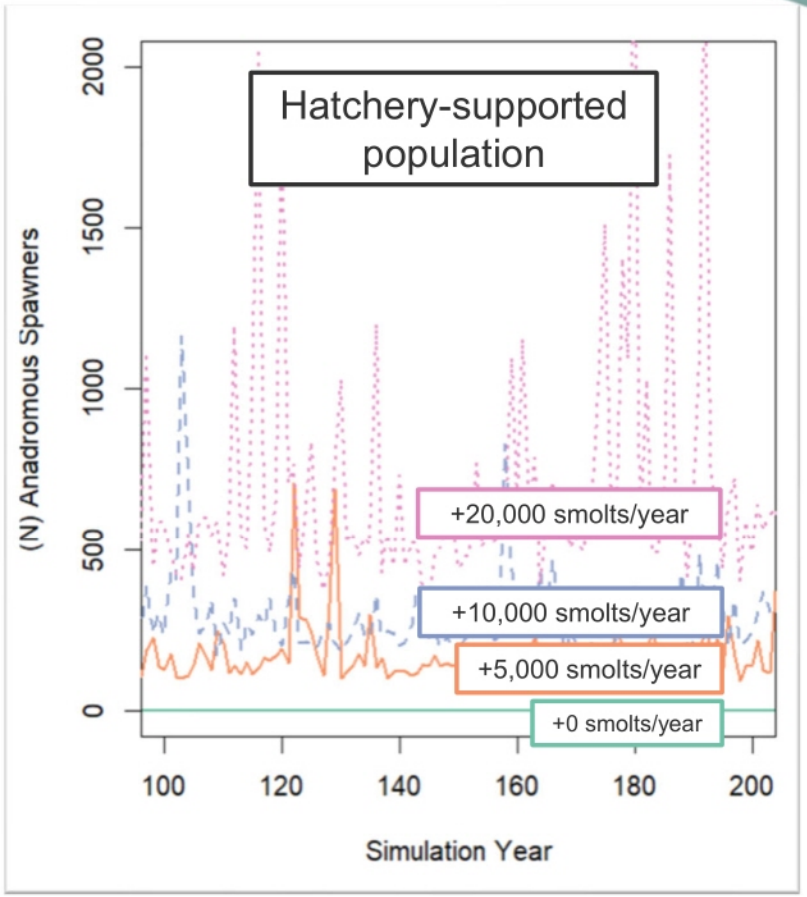


Hypothetical Sockeye Hatchery (this model)



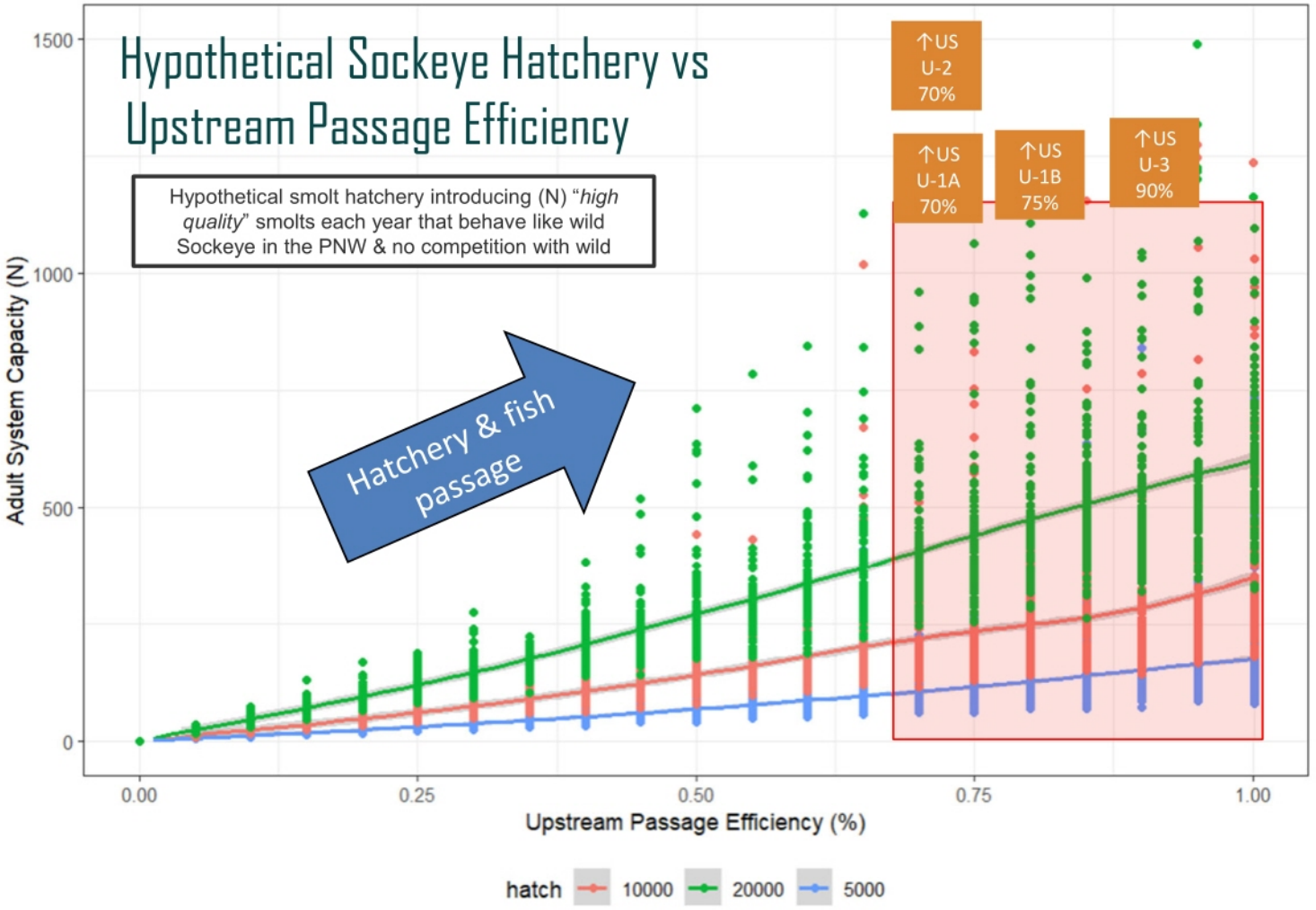
Hypothetical smolt hatchery introducing (N) "*high quality*" smolts each year that behave like wild Sockeye in the PNW

Assume **zero** interaction/competition with resident Sockeye



Hypothetical Sockeye Hatchery vs Upstream Passage Efficiency

Hypothetical smolt hatchery introducing (N) "*high quality*" smolts each year that behave like wild Sockeye in the PNW & no competition with wild

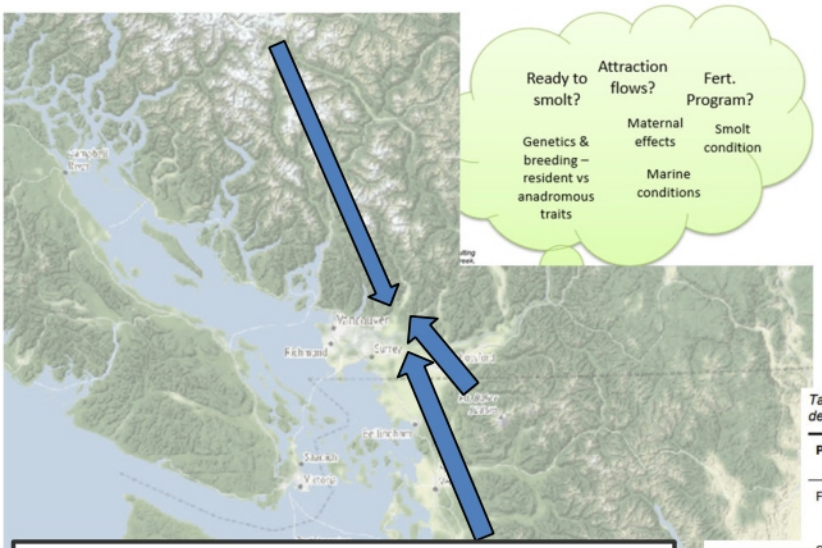


Hypothetical Sockeye Hatchery

- *Another model from Brett van Poorten accounting for breeding and competition between resident and anadromous Sockeye in the Alouette*
- **Results from:**
- van Poorten, B. T. (2020). Recovery tactics for sockeye blocked from anadromy evaluated through decision analysis and value of information. *Fisheries Research*, *230*, 105666.

Recovery tactic			Constant marine survival	
Passage	Stocking stage	Stocking rate	Targeted residents (thousands)	Anadromous returns
No passage	No stocking	0	18.6 (6.6 – 29.7)	30 (0 – 242)
No passage	Fry in reservoir	10,000	18.7 (5.1 – 31.9)	62 (1 – 381)
No passage	Fry in reservoir	25,000	19.0 (1.9 – 38.2)	114 (1 – 666)
No passage	Fry in reservoir	50,000	19.6 (0.1 – 57.6)	200 (2 – 1,195)
No passage	Smolts downstream	5000	18.6 (6.5 – 29.6)	42 (0 – 279)
No passage	Smolts downstream	10,000	18.6 (6.6 – 29.6)	58 (1 – 354)
No passage	Smolts downstream	15,000	18.5 (6.6 – 29.3)	85 (1 – 502)
Allow passage	No stocking	0	18.6 (6.1 – 30.6)	148 (0 – 819)
Allow passage	Fry in reservoir	10,000	18.9 (2.6 – 37.1)	338 (1 – 1,459)
Allow passage	Fry in reservoir	50,000	18.7 (0 – 74.0)	914 (2 – 4,725)
Allow passage	Smolts downstream	10,000	18.6 (5.6 – 31.7)	217 (1 – 1,162)
Allow passage	Smolts downstream	15,000	18.6 (4.8 – 32.5)	299 (1 – 1,602)

What happens if we created a self-sustaining anadromous Sockeye population?



Borrow life history parameters from neighboring systems to create a hypothetical self-sustaining Alouette anadromous Sockeye population – optimistic marine survival & assume 100% anadromous

Relating chronic toxicity responses to population-level effects: A comparison of population-level parameters for three salmon species as a function of low-level toxicity

Julann A. Spromberg, James P. Meador*

Environmental Conservation Division, Northwest Fisheries Science Center, National Marine Fisheries Service, NOAA, 2725 Montlake Blvd. East, Seattle, WA 98112, USA

Fisheries and Oceans Canada / Pêches et Océans Canada
Science / Sciences
Pacific Region
Canadian Science Advisory Secretariat
Science Advisory Report 2010/056

ASSESSMENT OF CULTUS LAKE SOCKEYE SALMON IN BRITISH COLUMBIA IN 2009 AND EVALUATION OF RECENT RECOVERY ACTIVITIES

Table 1. Life history parameters for Cultus Lake Sockeye Salmon. Mean and ranges for the recent period describe the data used in the forward projections. Historical data are provided for comparison.

Parameter	Mean	Range	Years	Historical Mean	Source and comment
Fecundity	3563	3088-3998	2002-2018	4094	Recent: hatchery broodstock records Historic: Foerster 1968.
Smolts/Spawner	31.6	1-107	1999-2016	76.2	Historical data 1925-1990, years intermittent.
Smolt-Recruit survival	0.026	0.009-0.055	1999-2016	0.081	Recruit is pre-fishery abundance. Historical 1950-1990

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DOI: 10.1002/naf...

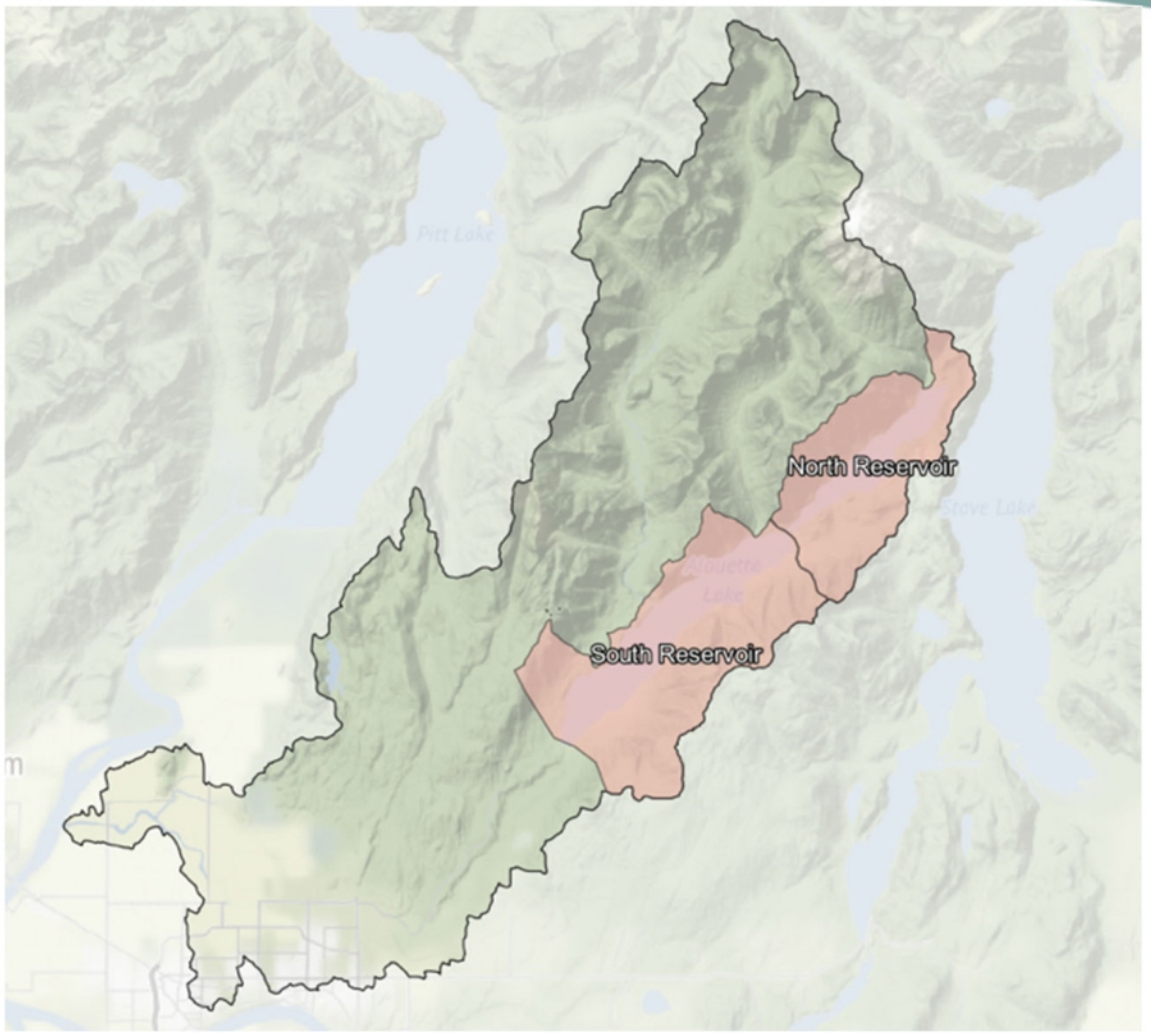
ARTICLE

Life Cycle Model Reveals Sensitive Life Stages and Evaluates Recovery Options for a Dwindling Pacific Salmon Population

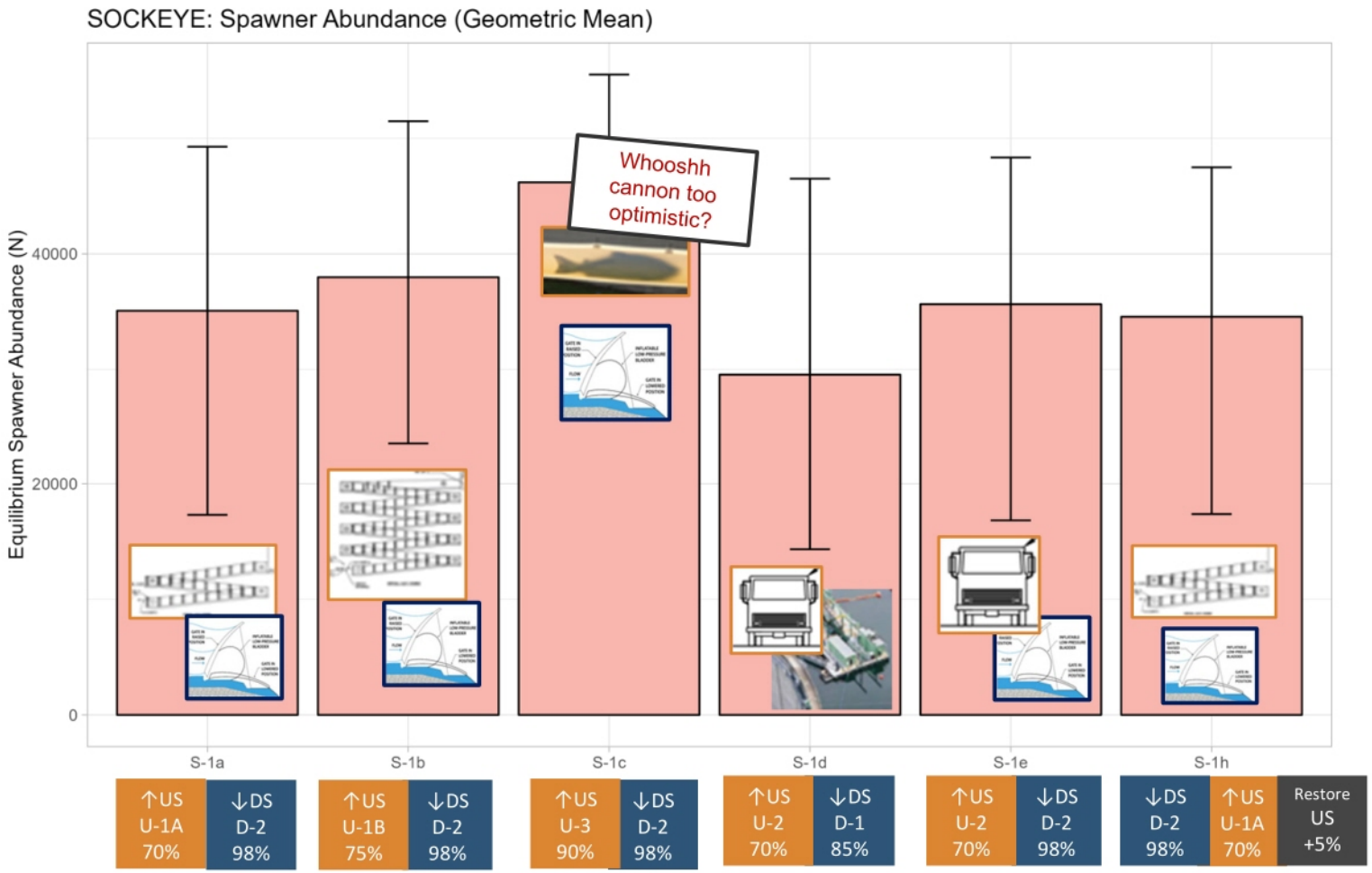
Neala W. Kendall*
Washington Department of Fish and Wildlife, 1111 Washington Street SE, Olympia, Washington 98501, USA

Julia Unrein and Carol Volk
Seattle Public Utilities, 700 5th Avenue, Suite 4900, Post Office Box 34018, Seattle, Washington 98124, USA

David A. Beauchamp
U.S. Geological Survey, Western Fisheries Research Center, 6505 Northeast 65th Street, Seattle, Washington 98115, USA


North Reservoir
South Reservoir

(Hypothetical) self-sustaining anadromous Sockeye population



Sockeye

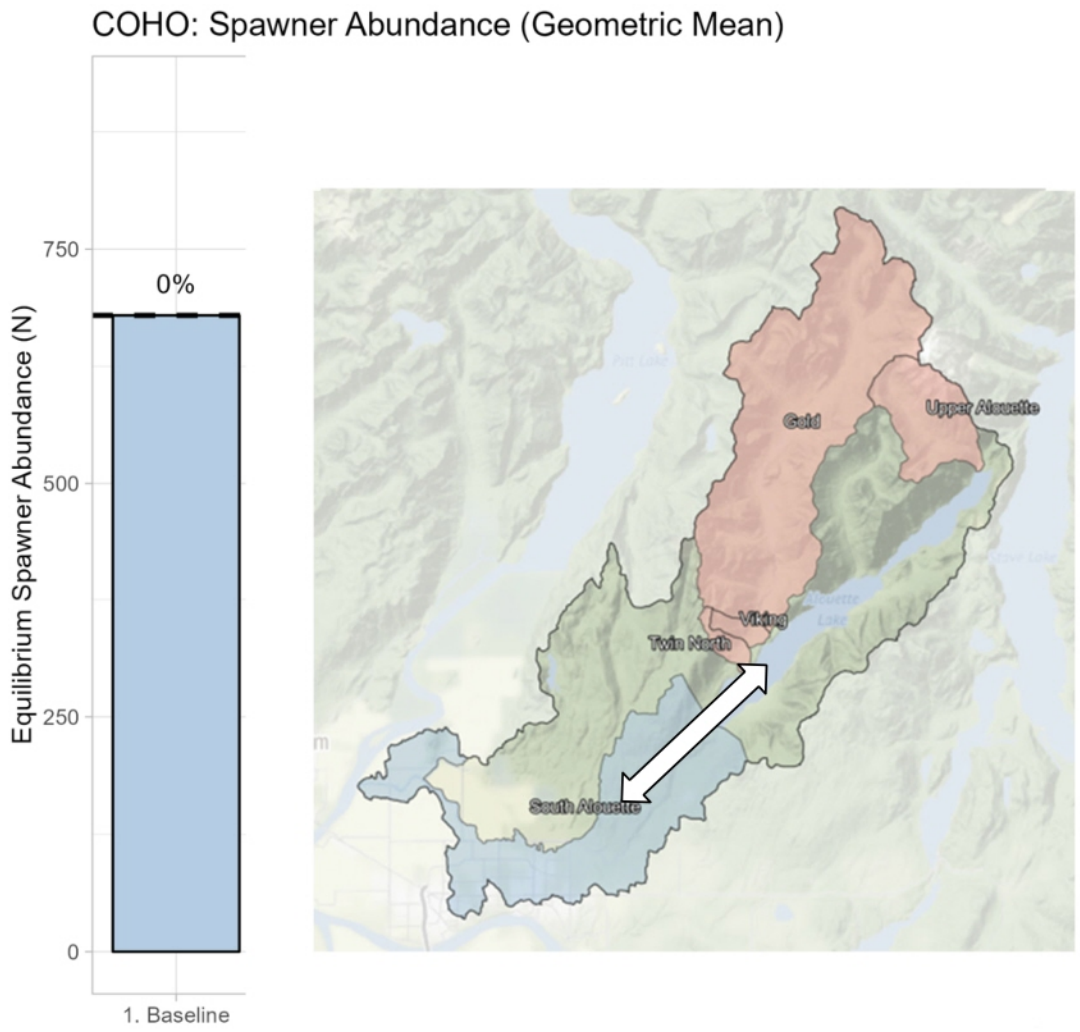
- At current low smolting rates and low smolt survival (0.025%), a hatchery is required
- If smoltification rates increased & smolt survival improved:
  - Options with higher passage efficiency are better but...
  - the rank order of project alternatives is within uncertainty estimates around each structure.
  - We did not identify any project alternatives that were unviable / unfeasible (*within the life cycle model*)

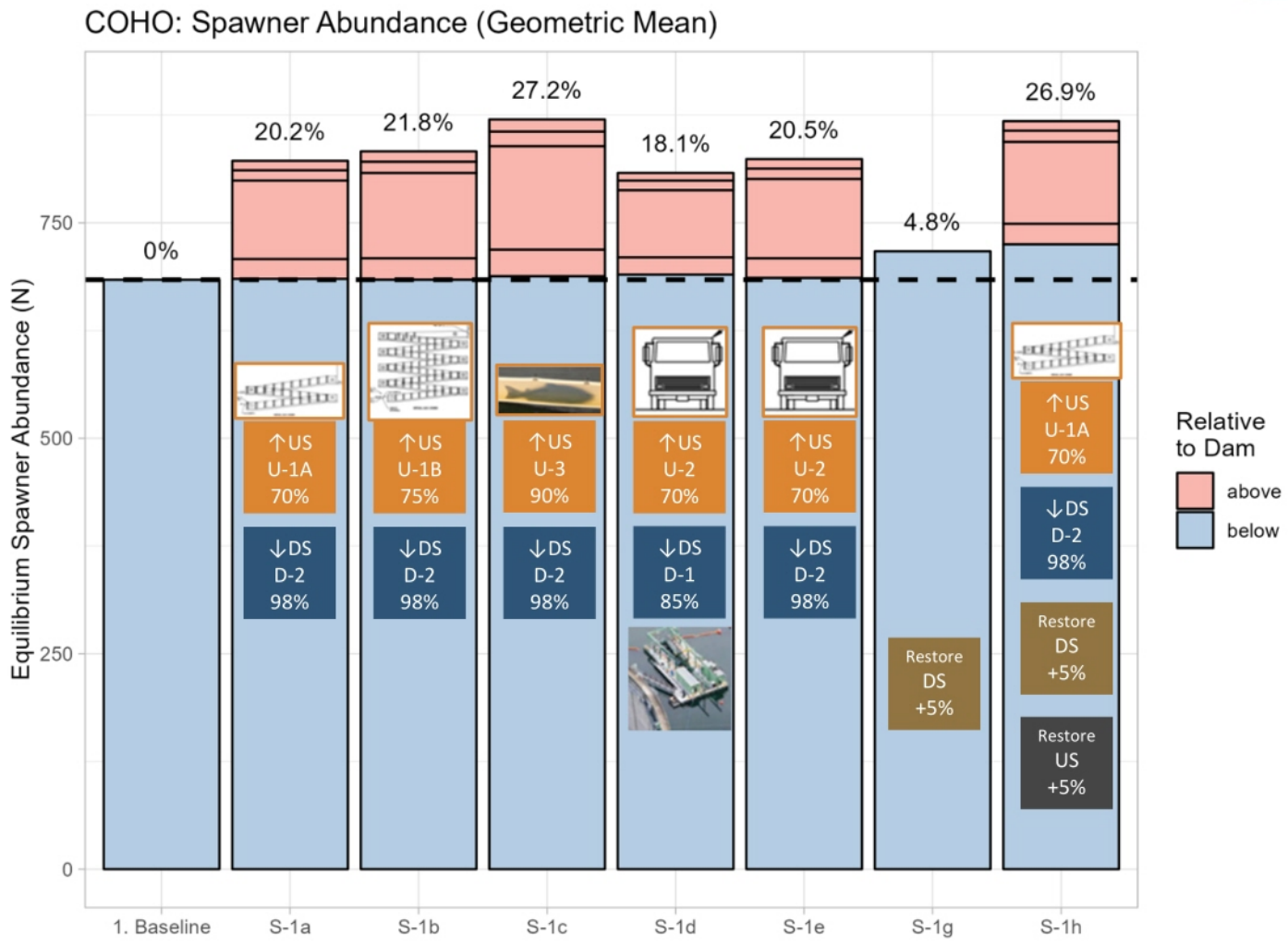
Sockeye model limitations

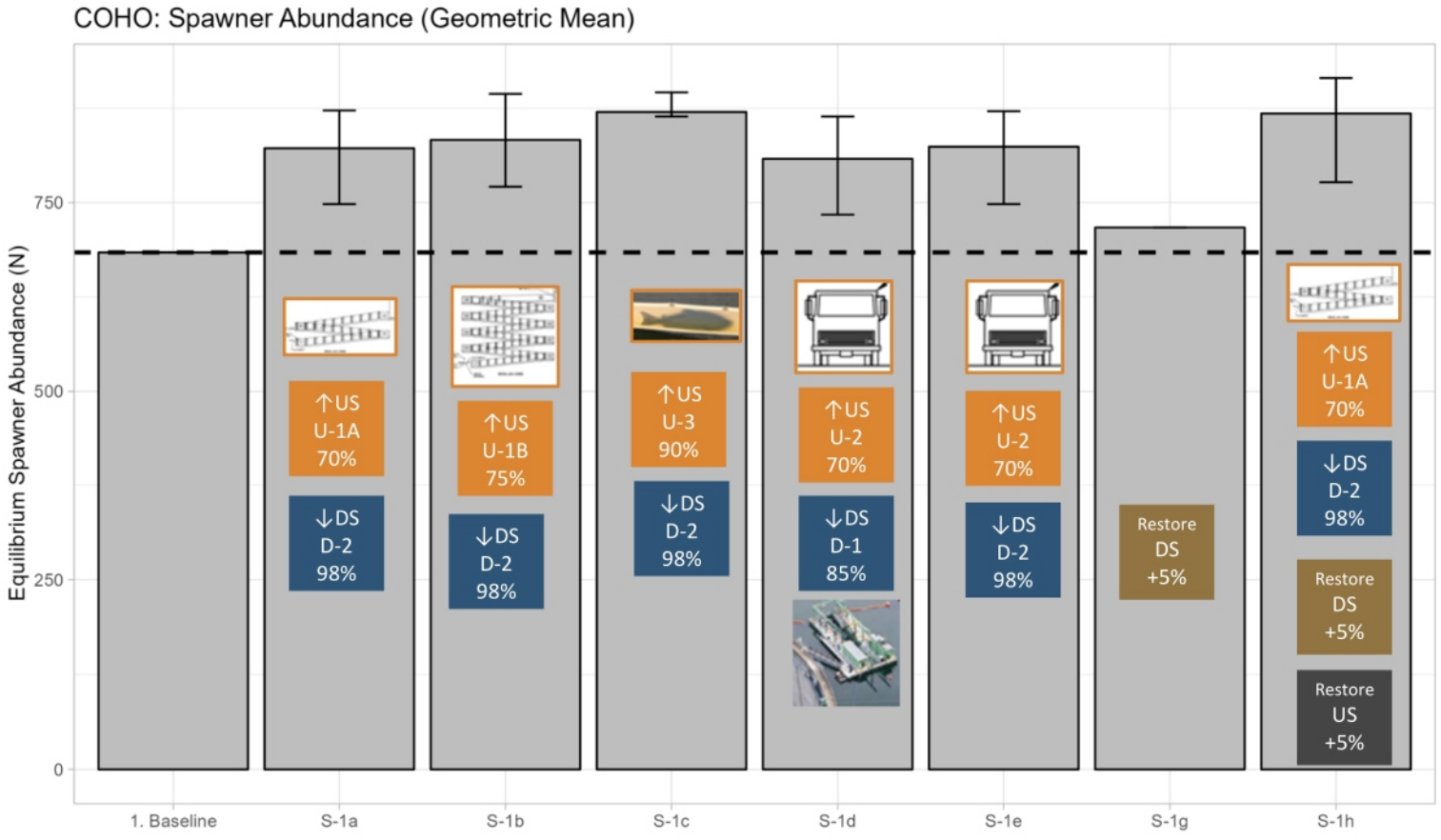
Important caveats & limitations of Joe Model

- The life cycle model simulates a hypothetical population in the reservoir with a high propensity of anadromy.
- This LCM **does not** consider % anadromous vs resident or the heritability of anadromy.
- In these simulations a population of anadromous sockeye climbs to a presumed habitat limit.
- van Poorten (2018/2020) provides more comprehensive review of the heritability anadromy, lake productivity and stocking intensity of Alouette Sockeye.
- Science gaps (e.g., Challenger et al 2022 (LGL) also propose model with key physical drivers of smolt outmigration)

COHO


COHO: Spawner Abundance (Geometric Mean)
Equilibrium Spawner Abundance (N)
750
500
250
0
0%
1. Baseline
Gold
Upper Alouette
Viking
Twin North
South Alouette


COHO: Spawner Abundance (Geometric Mean)
Equilibrium Spawner Abundance (N)
750
500
250
0
0%
20.2%
21.8%
27.2%
18.1%
20.5%
4.8%
26.9%
↑US U-1A 70%
↓DS D-2 98%
↑US U-1B 75%
↓DS D-2 98%
↑US U-3 90%
↓DS D-2 98%
↑US U-2 70%
↓DS D-1 85%
↑US U-2 70%
↓DS D-2 98%
Restore DS +5%
↑US U-1A 70%
↓DS D-2 98%
Restore DS +5%
Restore US +5%
1. Baseline
S-1a
S-1b
S-1c
S-1d
S-1e
S-1g
S-1h
Relative to Dam
above
below

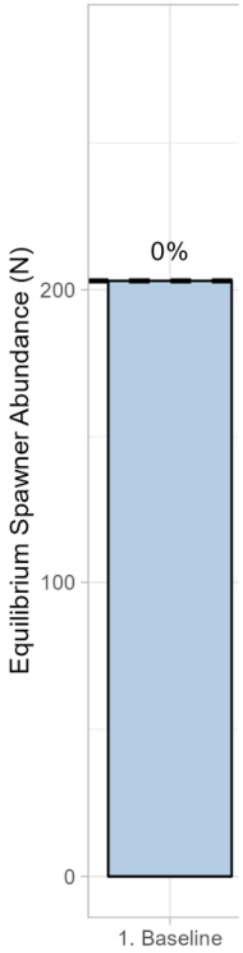

COHO: Spawner Abundance (Geometric Mean)
Equilibrium Spawner Abundance (N)
750
500
250
0
↑US U-1A 70%
↓DS D-2 98%
↑US U-1B 75%
↓DS D-2 98%
↑US U-3 90%
↓DS D-2 98%
↑US U-2 70%
↓DS D-1 85%
↑US U-2 70%
↓DS D-2 98%
Restore DS +5%
↑US U-1A 70%
↓DS D-2 98%
Restore DS +5%
Restore US +5%
1. Baseline
S-1a
S-1b
S-1c
S-1d
S-1e
S-1g
S-1h

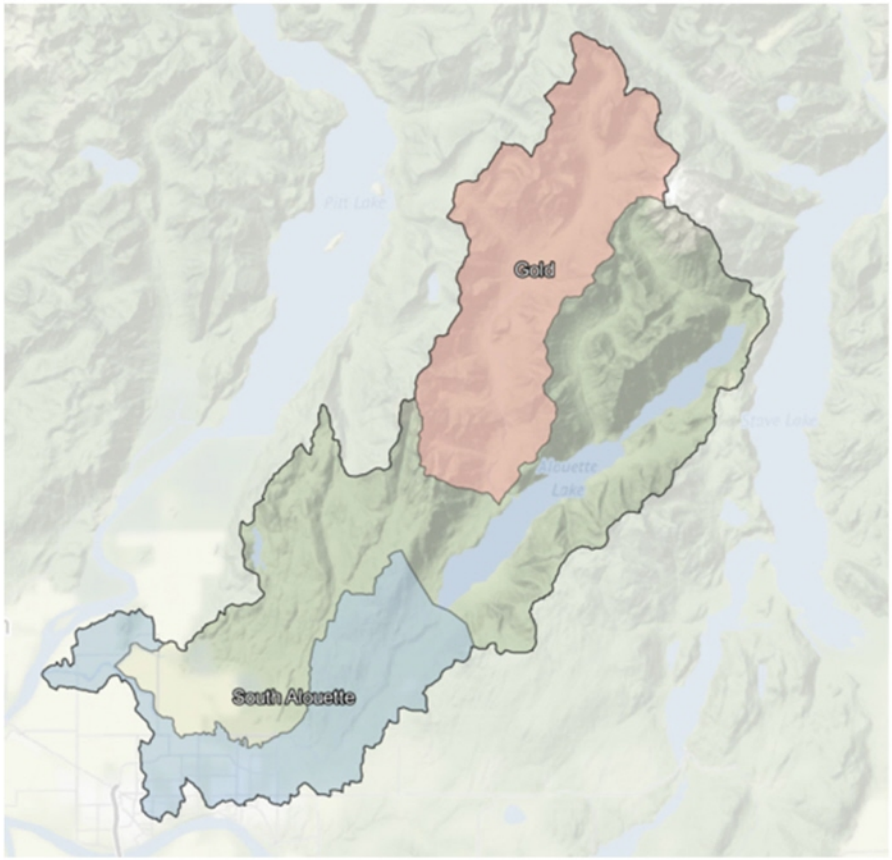
Coho Salmon

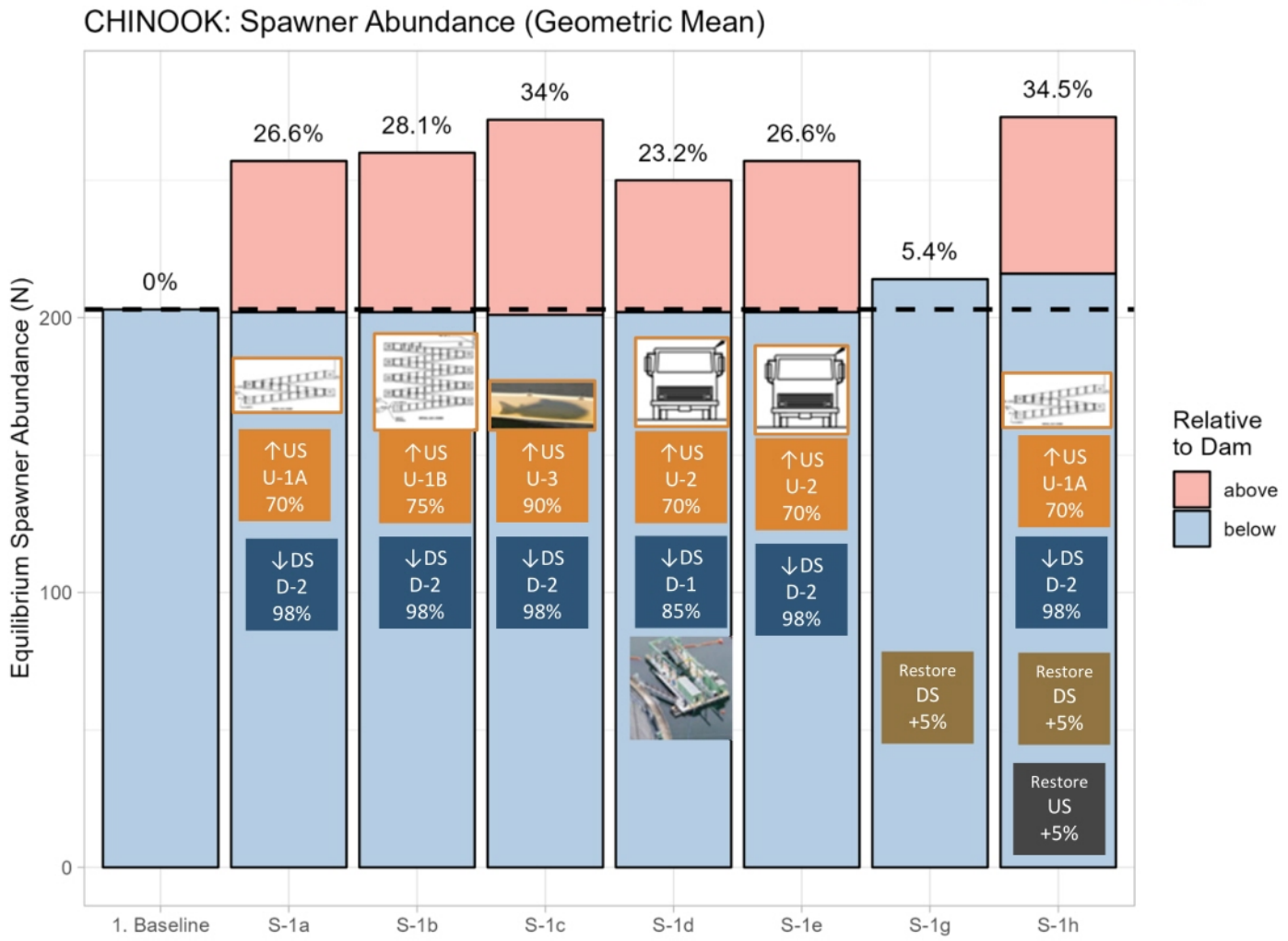
- Are there tipping points in passage efficiencies rates (US/DS)?
- How far could we go with habitat improvements in the South Alouette?

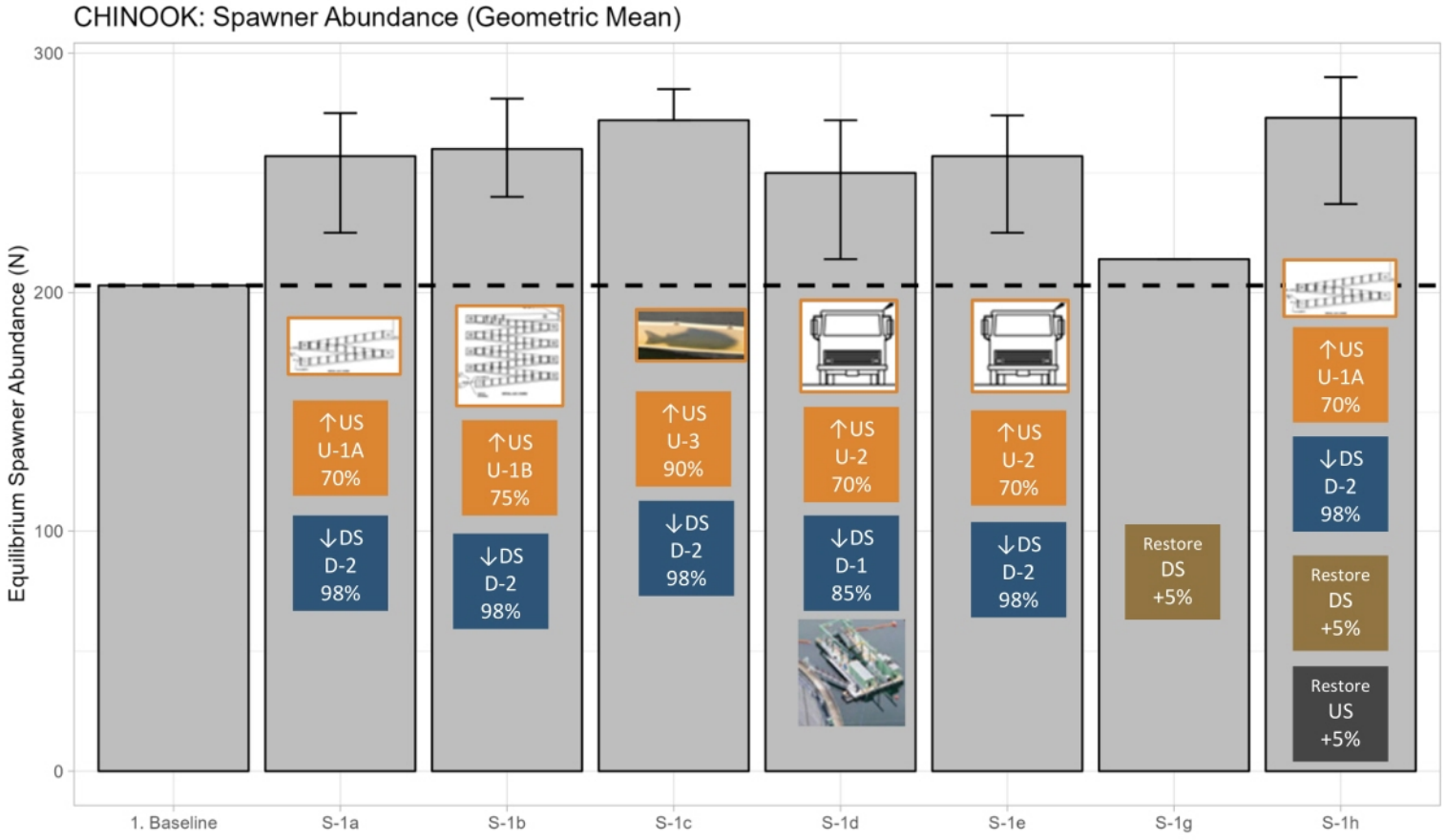
CHINOOK

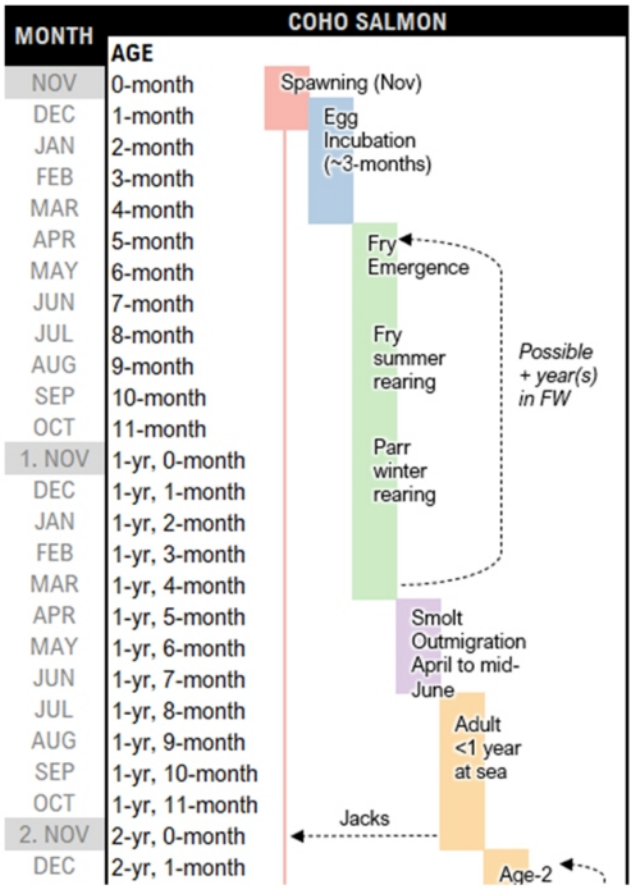
CHINOOK: Spawner Abundance (Geometric Mean)

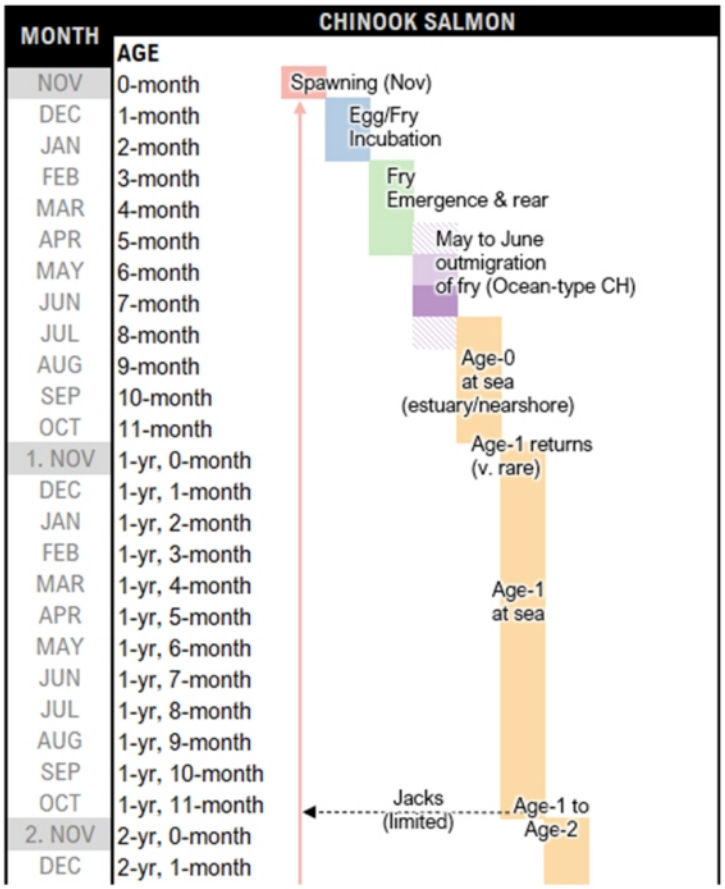





CHINOOK: Spawner Abundance (Geometric Mean)
Equilibrium Spawner Abundance (N)
200
100
0
0%
26.6%
28.1%
34%
23.2%
26.6%
5.4%
34.5%
↑US U-1A 70%
↓DS D-2 98%
↑US U-1B 75%
↓DS D-2 98%
↑US U-3 90%
↓DS D-2 98%
↑US U-2 70%
↓DS D-1 85%
↑US U-2 70%
↓DS D-2 98%
Restore DS +5%
↑US U-1A 70%
↓DS D-2 98%
Restore DS +5%
Restore US +5%
1. Baseline
S-1a
S-1b
S-1c
S-1d
S-1e
S-1g
S-1h
Relative to Dam
above
below

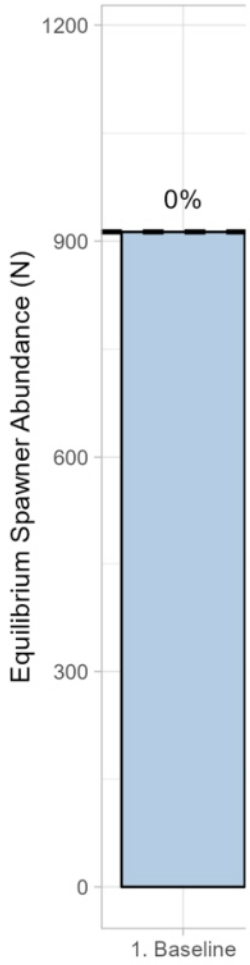

CHINOOK: Spawner Abundance (Geometric Mean)
Equilibrium Spawner Abundance (N)
300
200
100
0
↑US U-1A 70%
↓DS D-2 98%
↑US U-1B 75%
↓DS D-2 98%
↑US U-3 90%
↓DS D-2 98%
↑US U-2 70%
↓DS D-1 85%
↑US U-2 70%
↓DS D-2 98%
Restore DS +5%
↑US U-1A 70%
↓DS D-2 98%
Restore DS +5%
Restore US +5%
1. Baseline
S-1a
S-1b
S-1c
S-1d
S-1e
S-1g
S-1h

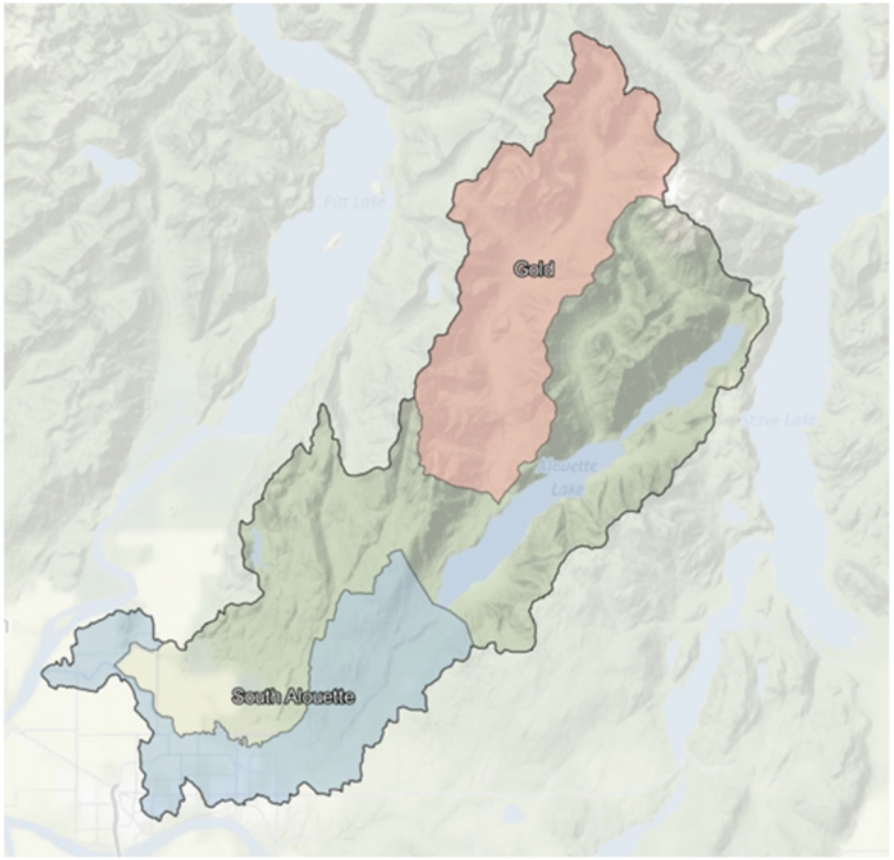

MONTH
COHO SALMON
AGE
NOV 0-month
DEC 1-month
JAN 2-month
FEB 3-month
MAR 4-month
APR 5-month
MAY 6-month
JUN 7-month
JUL 8-month
AUG 9-month
SEP 10-month
OCT 11-month
1. NOV 1-yr, 0-month
DEC 1-yr, 1-month
JAN 1-yr, 2-month
FEB 1-yr, 3-month
MAR 1-yr, 4-month
APR 1-yr, 5-month
MAY 1-yr, 6-month
JUN 1-yr, 7-month
JUL 1-yr, 8-month
AUG 1-yr, 9-month
SEP 1-yr, 10-month
OCT 1-yr, 11-month
2. NOV 2-yr, 0-month
DEC 2-yr, 1-month
Spawning (Nov)
Egg Incubation (~3-months)
Fry Emergence
Fry summer rearing
Parr winter rearing
Possible + year(s) in FW
Smolt Outmigration April to mid-June
Adult <1 year at sea
Jacks
Age-2

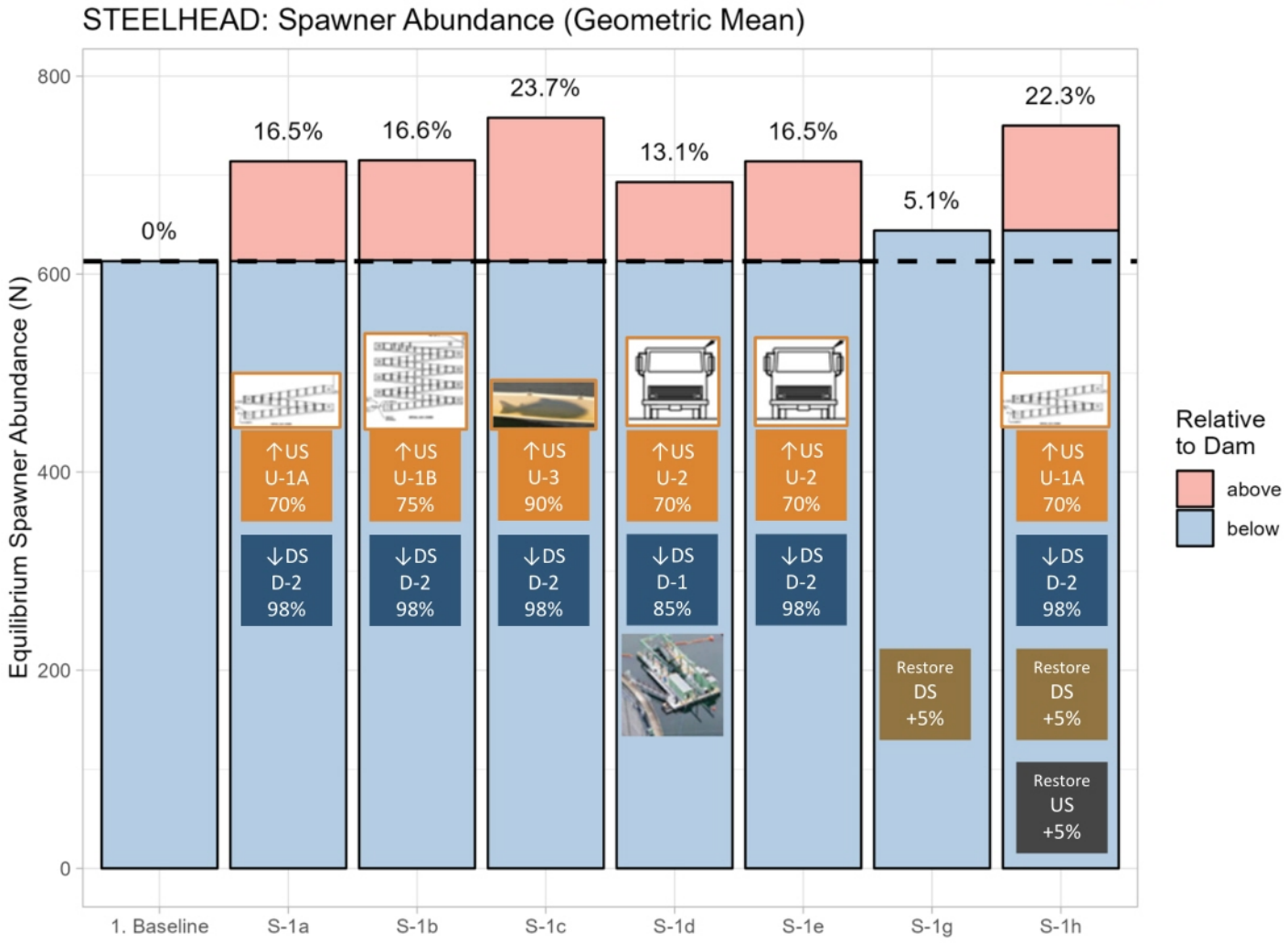

MONTH
CHINOOK SALMON
AGE
NOV 0-month
DEC 1-month
JAN 2-month
FEB 3-month
MAR 4-month
APR 5-month
MAY 6-month
JUN 7-month
JUL 8-month
AUG 9-month
SEP 10-month
OCT 11-month
1. NOV 1-yr, 0-month
DEC 1-yr, 1-month
JAN 1-yr, 2-month
FEB 1-yr, 3-month
MAR 1-yr, 4-month
APR 1-yr, 5-month
MAY 1-yr, 6-month
JUN 1-yr, 7-month
JUL 1-yr, 8-month
AUG 1-yr, 9-month
SEP 1-yr, 10-month
OCT 1-yr, 11-month
2. NOV 2-yr, 0-month
DEC 2-yr, 1-month
Spawning (Nov)
Egg/Fry Incubation
Fry Emergence & rear
May to June outmigration of fry (Ocean-type CH)
Age-0 at sea (estuary/nearshore)
Age-1 returns (v. rare)
Age-1 at sea
Jacks (limited)
Age-1 to Age-2

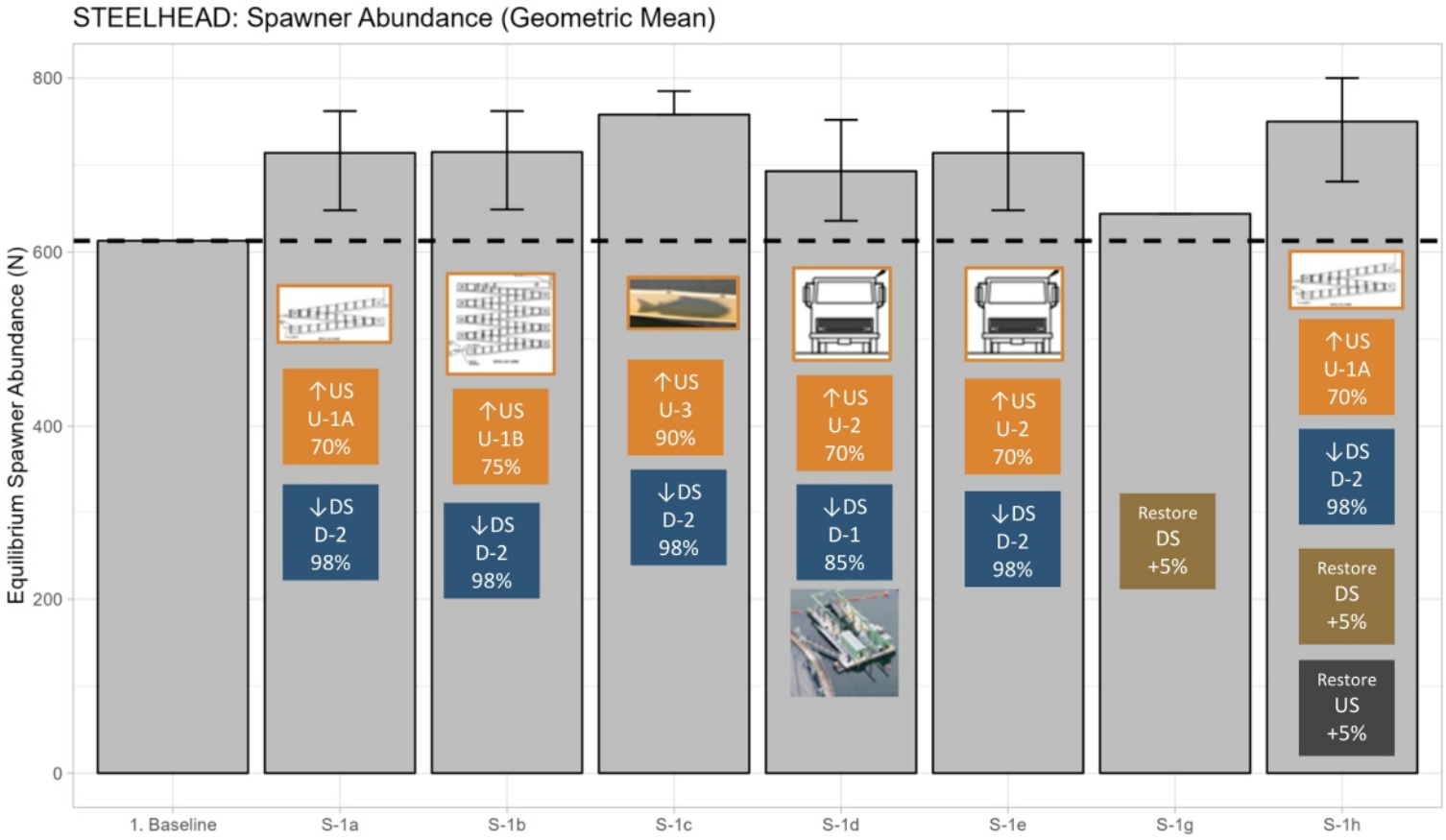
STEELHEAD

STEELHEAD: Spawner Abundance (Geometric Mean)



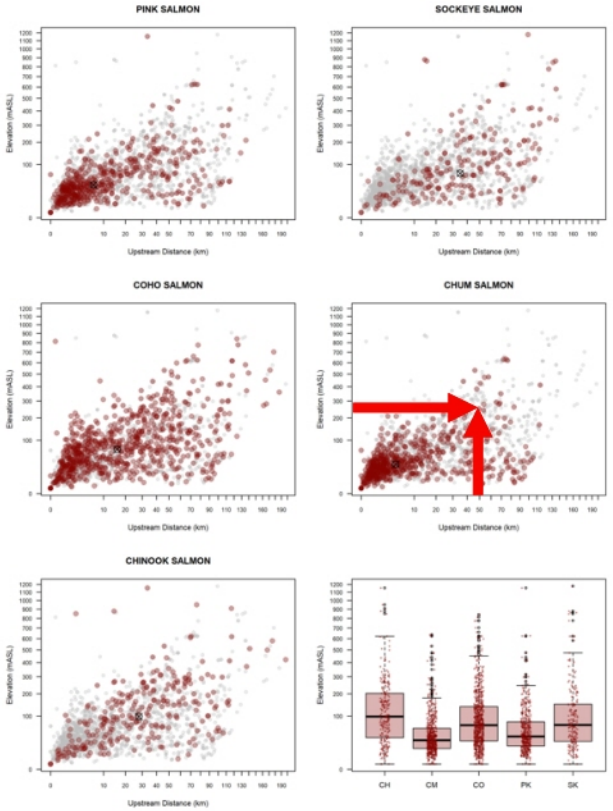


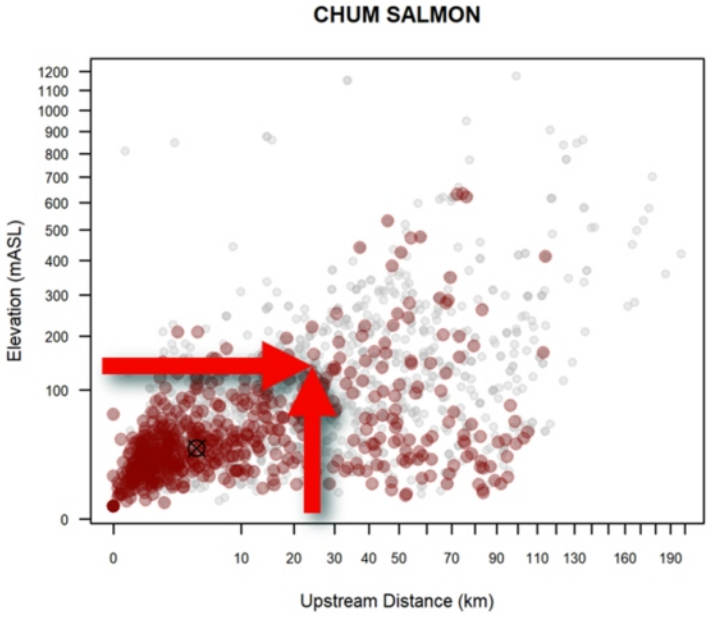

STEELHEAD: Spawner Abundance (Geometric Mean)
Equilibrium Spawner Abundance (N)
800
600
400
200
0
0%
16.5%
16.6%
23.7%
13.1%
16.5%
5.1%
22.3%
↑US U-1A 70%
↓DS D-2 98%
↑US U-1B 75%
↓DS D-2 98%
↑US U-3 90%
↓DS D-2 98%
↑US U-2 70%
↓DS D-1 85%
↑US U-2 70%
↓DS D-2 98%
Restore DS +5%
↑US U-1A 70%
↓DS D-2 98%
Restore DS +5%
Restore US +5%
1. Baseline
S-1a
S-1b
S-1c
S-1d
S-1e
S-1g
S-1h
Relative to Dam
above
below


STEELHEAD: Spawner Abundance (Geometric Mean)
Equilibrium Spawner Abundance (N)
800
600
400
200
0
↑US U-1A 70%
↓DS D-2 98%
↑US U-1B 75%
↓DS D-2 98%
↑US U-3 90%
↓DS D-2 98%
↑US U-2 70%
↓DS D-1 85%
↑US U-2 70%
↓DS D-2 98%
Restore DS +5%
↑US U-1A 70%
↓DS D-2 98%
Restore DS +5%
Restore US +5%
1. Baseline
S-1a
S-1b
S-1c
S-1d
S-1e
S-1g
S-1h

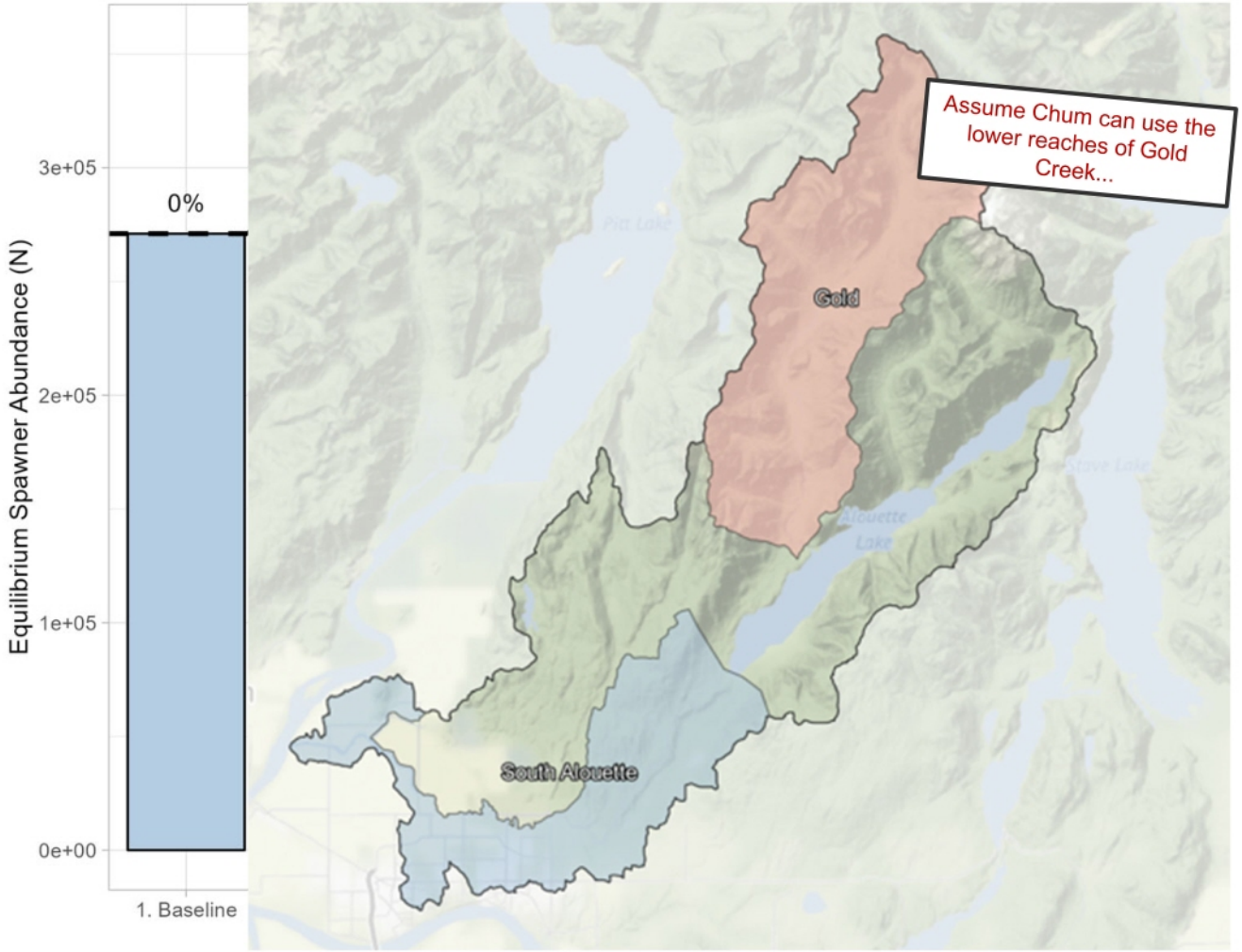
CHUM

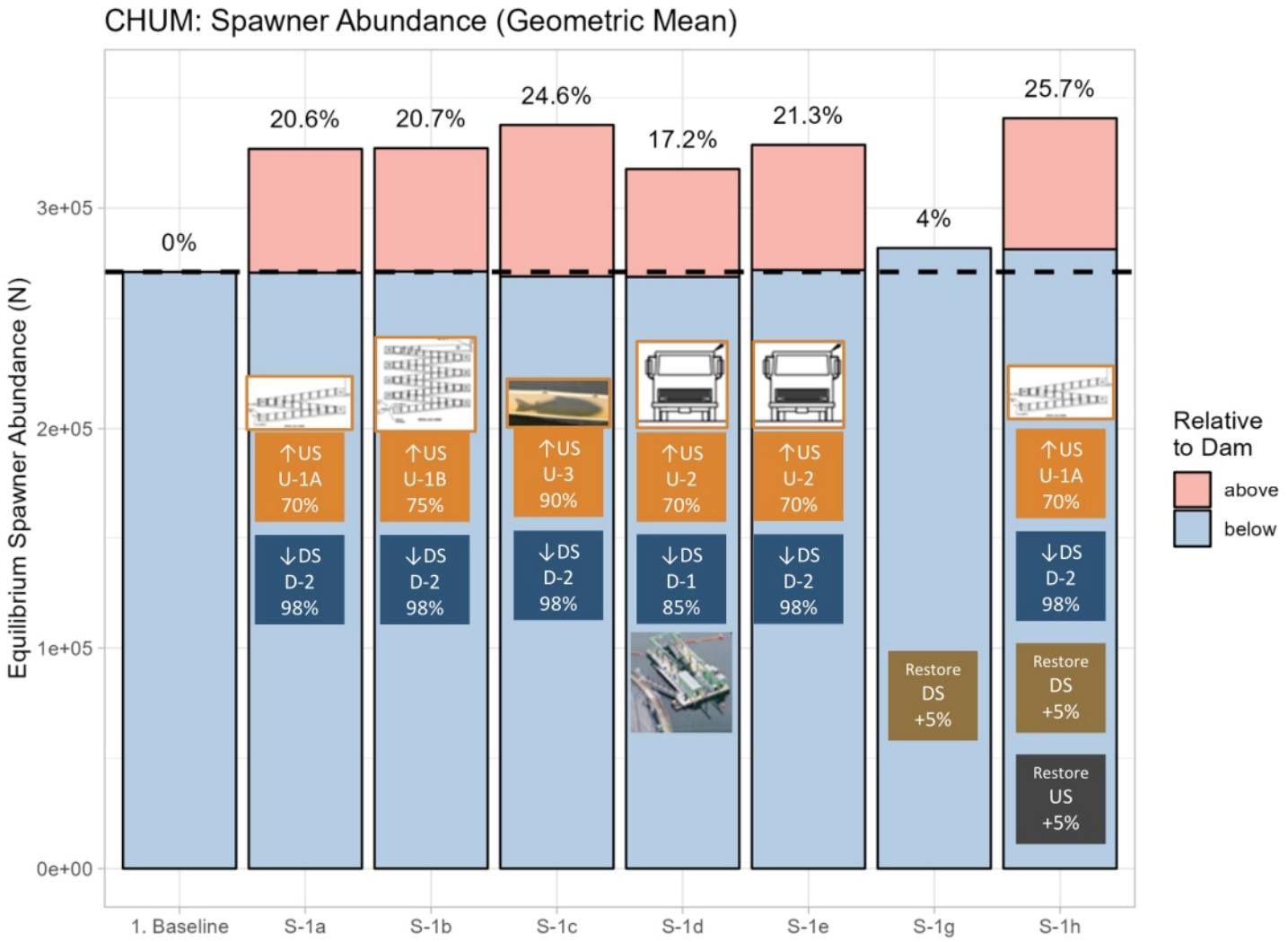
Chum in the Upper Alouette?

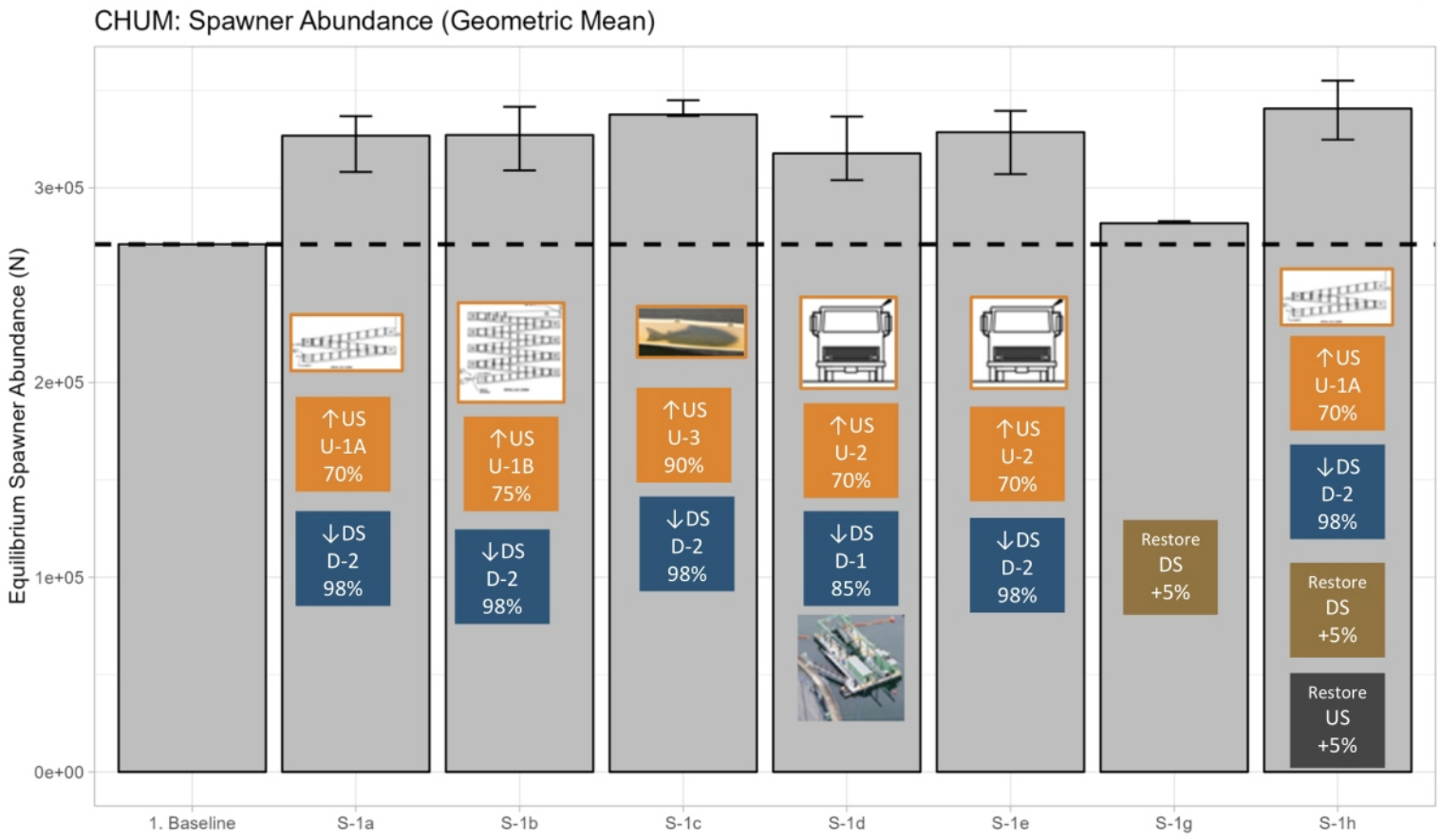




Chum in the Upper Alouette




CHUM: Spawner Abundance (Geometric Mean)
Equilibrium Spawner Abundance (N)
3e+05
2e+05
1e+05
0e+00
0%
20.6%
20.7%
24.6%
17.2%
21.3%
4%
25.7%
↑US U-1A 70%
↓DS D-2 98%
↑US U-1B 75%
↓DS D-2 98%
↑US U-3 90%
↓DS D-2 98%
↑US U-2 70%
↓DS D-1 85%
↑US U-2 70%
↓DS D-2 98%
Restore DS +5%
↑US U-1A 70%
↓DS D-2 98%
Restore DS +5%
Restore US +5%
1. Baseline
S-1a
S-1b
S-1c
S-1d
S-1e
S-1g
S-1h
Relative to Dam
above
below

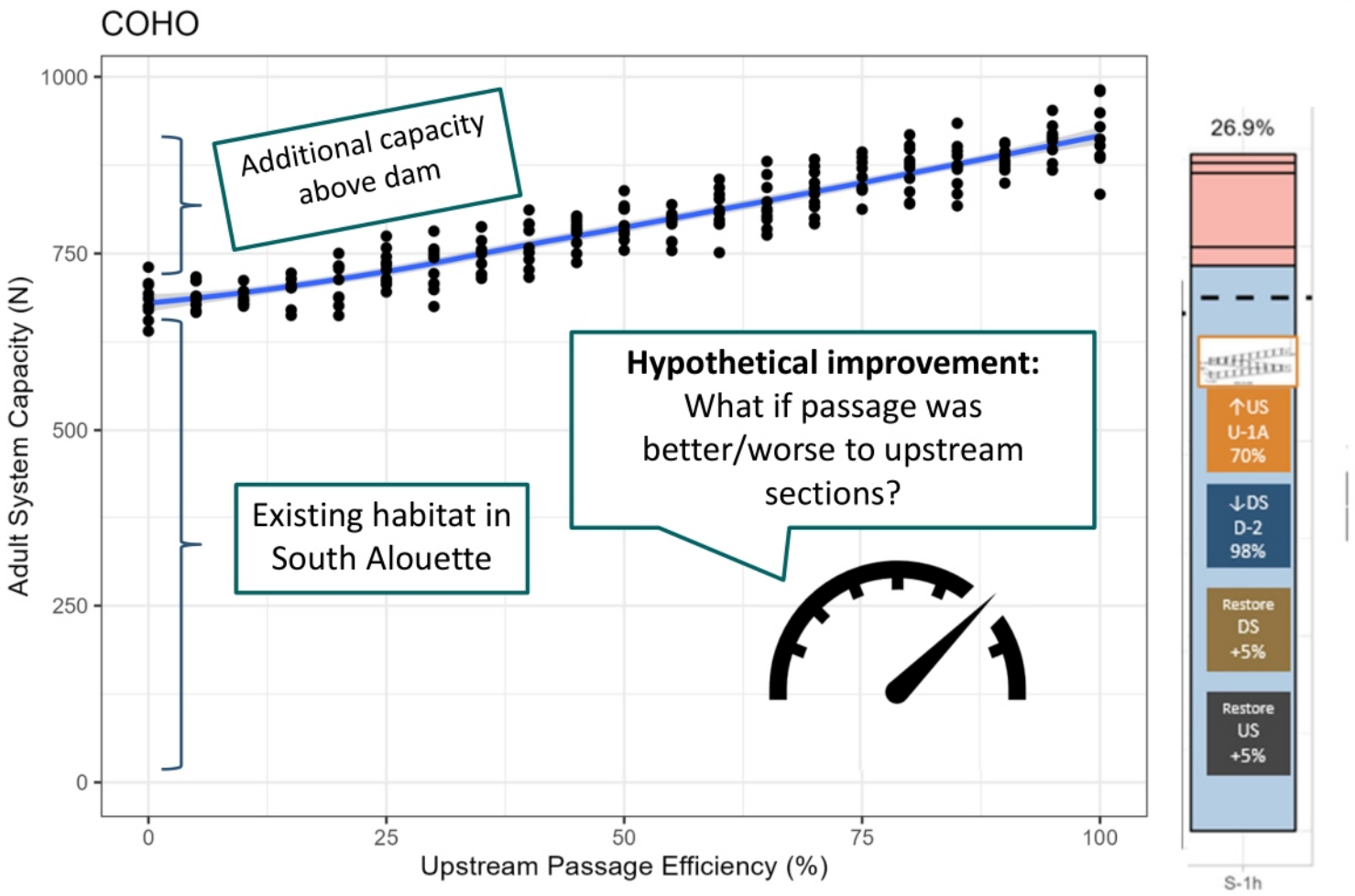

CHUM: Spawner Abundance (Geometric Mean)
Equilibrium Spawner Abundance (N)
3e+05
2e+05
1e+05
0e+00
1. Baseline
S-1a
S-1b
S-1c
S-1d
S-1e
S-1g
S-1h
↑US U-1A 70%
↓DS D-2 98%
↑US U-1B 75%
↓DS D-2 98%
↑US U-3 90%
↓DS D-2 98%
↑US U-2 70%
↓DS D-1 85%
↑US U-2 70%
↓DS D-2 98%
Restore DS +5%
↑US U-1A 70%
↓DS D-2 98%
Restore DS +5%
Restore US +5%

SENSITIVITY ANALYSES

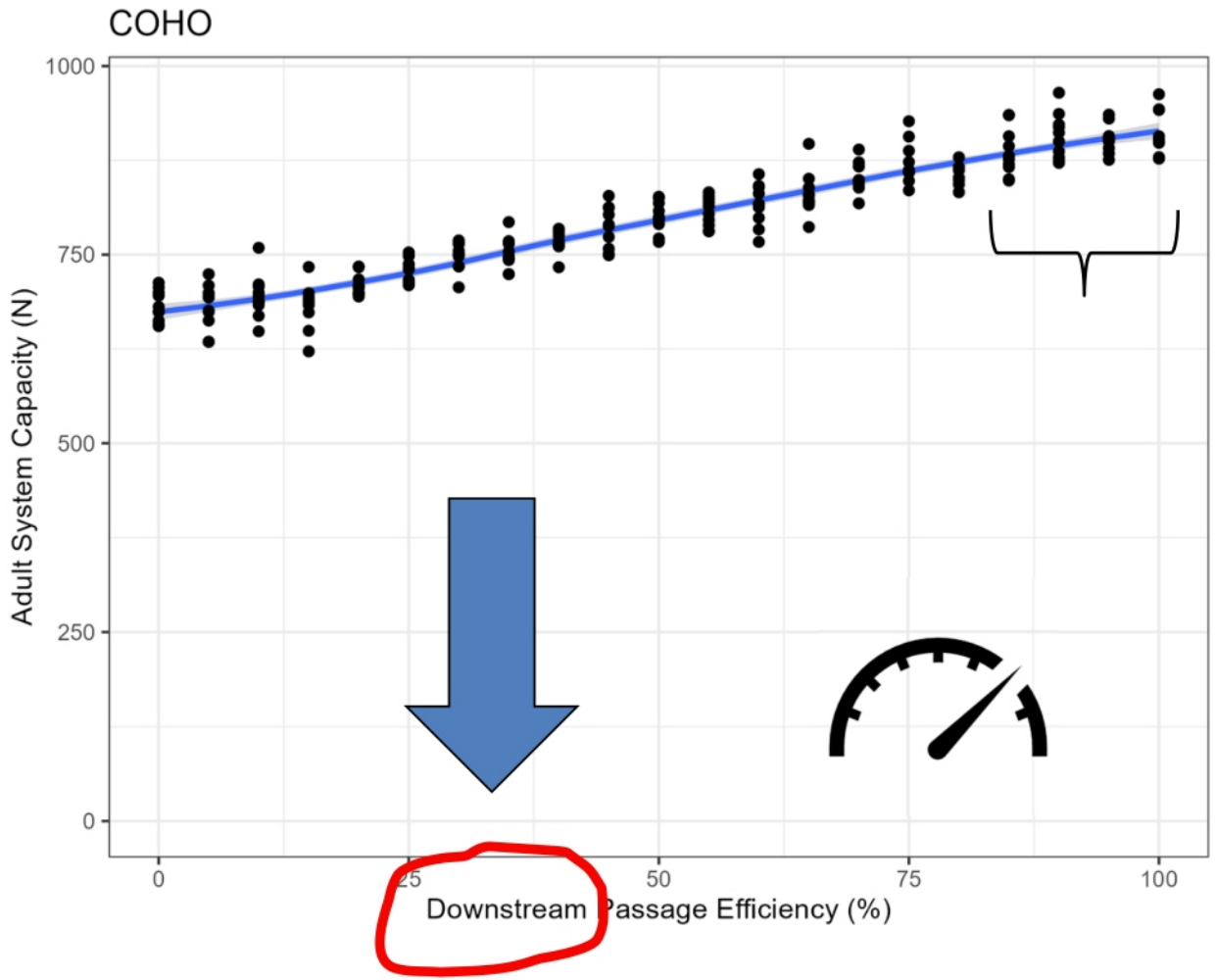
Sockeye | Coho | Chinook | Steelhead | Chum

Sensitivity Analyses

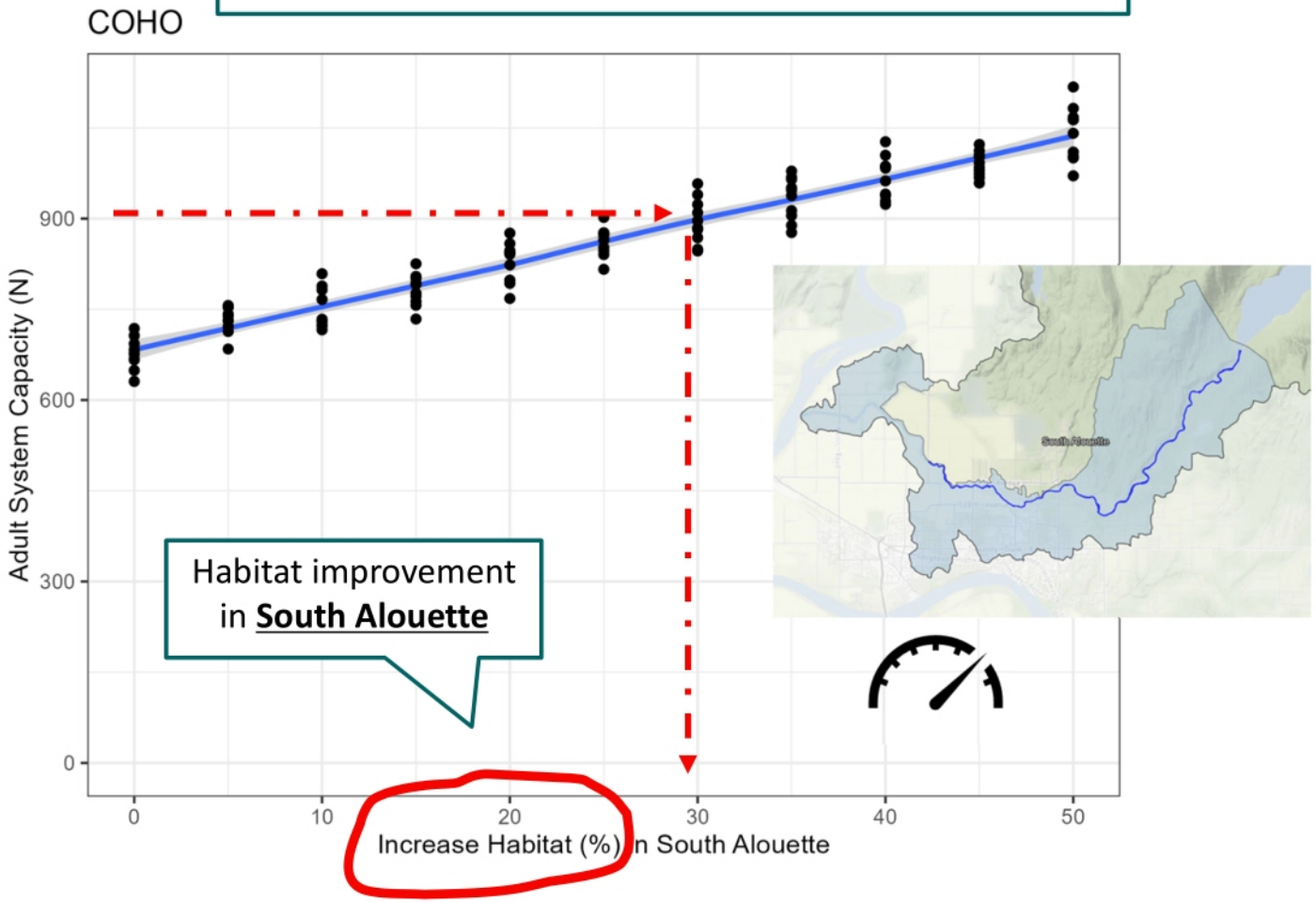
- For each species, vary fish passage efficiency and habitat creation and review changes in projected adult abundance.

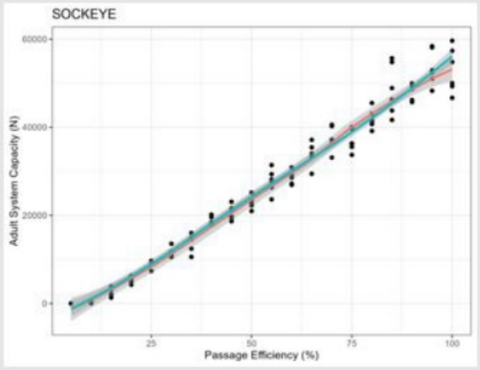

COHO
Adult System Capacity (N)
1000
750
500
250
0
0
25
50
75
100
Upstream Passage Efficiency (%)
Additional capacity above dam
Existing habitat in South Alouette
Hypothetical improvement:
What if passage was better/worse to upstream sections?
26.9%
↑US
U-1A
70%
↓DS
D-2
98%
Restore
DS
+5%
Restore
US
+5%
S-1h

Hypothetical improvement DS



Hypothetical improvement to habitat in the South Alouette





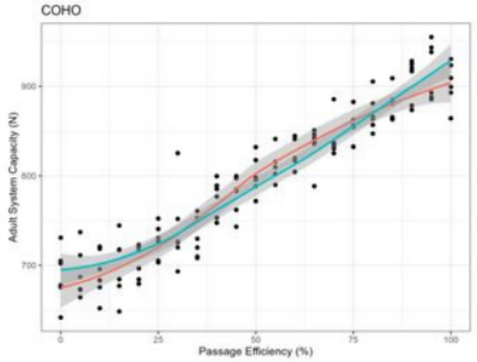
Coho

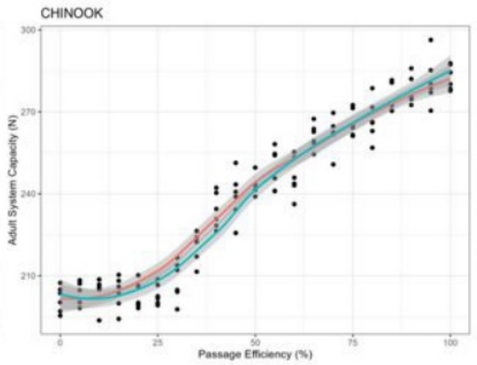
Chinook

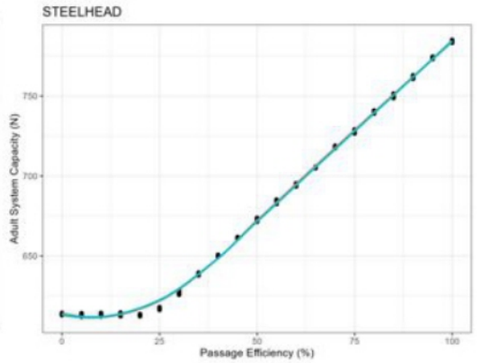
Steelhead

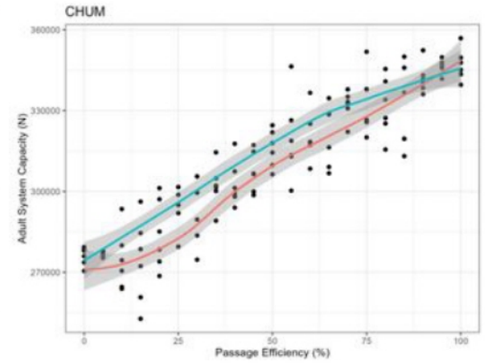
Chum

Downstream Upstream

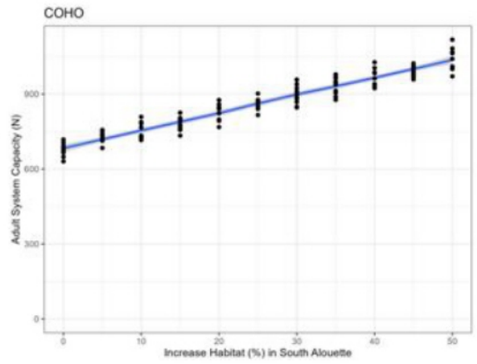


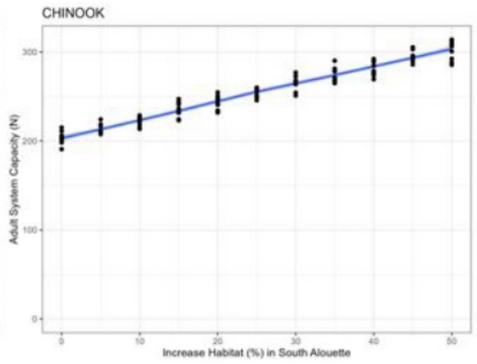


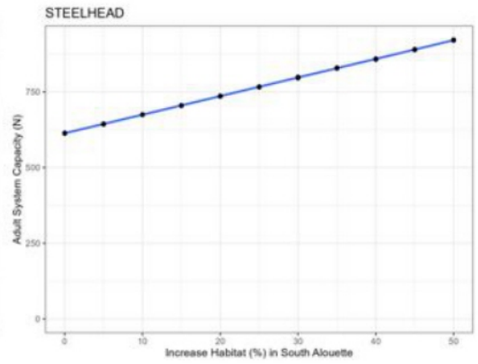


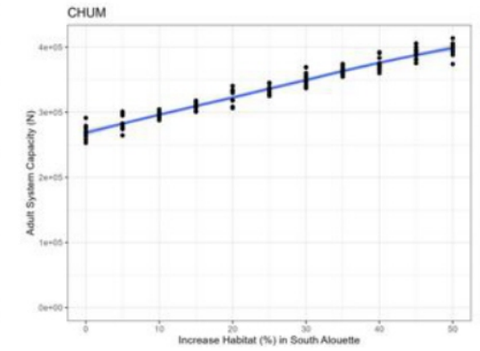


Habitat Creation









SUMMARY

Summary

- A viable anadromous Sockeye population requires hatchery input with the current survivorship of 0.025%
- The rank order of alternatives based on fish population outcomes does not change for the different species assessed
  - Aside from sockeye, this suggests that one species can be used as a surrogate for other alternatives at this level of evaluation
- Overall, fish passage alternatives are similar in their performance because of high uncertainty
- Fish inputs feed into the larger decision-making process, where other values are considered

Considerations

- Special considerations for Sockeye.
- Species profiles (hypothetical populations) vs real-world demographic constraints.
- Potential for additional tuning of parameters (Chum/Steelhead)
- Relative habitat quality/capacity US of dam?
- Whoosh Cannon overly optimistic
- Planning for a staged approach

Next steps:

- Incorporate feedback from committee.
- Technical report

Feedback?

ESSA

From: Katie O'Donnell(kodonnell@compassrm.com)
To: Harris, Shannon WLRS:EX (Shannon.Harris@gov.bc.ca)
Subject: Re: ARSRP - final survey
Sent: 08/09/2023 16:49:31
Attachments: ARSRP_9Feb22 workshop notes_v1.0.docx, ARSRP_29Sept22 workshop notes_v0.2.docx, ARSRP_Dec2022 workshop notes_v0.2.docx, ARSRP_Mar2023 workshop notes_v0.1.docx, ARSRP_PostFinalWorkshopMemo_v1.0.docx

Hi Shannon,

We don't have a Sharepoint site set up, but I've attached the meeting minutes from the first 4 workshops here. The "Post-Workshop Memo" summarizes the key discussions from the fifth/final workshop. If there are any other presentations or reports that you'd find helpful, let me know and I'd be happy to send those along.

Thanks,
Katie

Katie O'Donnell, Ph.D. *(she/her)*
Associate // Ecologist / Decision Analyst
Compass Resource Management Ltd.
788 Beatty St. #302, Vancouver, BC V6B 2M1

From: Harris, Shannon WLRS:EX <Shannon.Harris@gov.bc.ca>
Sent: Wednesday, August 9, 2023 9:37 AM
To: Katie O'Donnell <kodonnell@compassrm.com>
Subject: RE: ARSRP - final survey

Hi Katie,
Can you remind me if we have a sharepoint site with minute meetings for this? I missed a number of meetings and therefore completion of the final survey is difficult.

Thank you.
Shannon

From: Katie O'Donnell <kodonnell@compassrm.com>
Sent: Friday, June 23, 2023 11:05 AM
To: Bob Bocking <bbocking@lgl.com>; Ducharme, Scott <Scott.Ducharme@dfo-mpo.gc.ca>; Elmar Plate <eplate@lgl.com>; Gonzalez, Julian <julian.gonzalez@bchydro.com>; Greta Borick-Cunningham <arms@alouetteriver.org>; Hollick-Kenyon, Sandra <Sandra.Hollick-Kenyon@dfo-mpo.gc.ca>; justin@leqamel.ca; s.22 ›; Megan Mathews <mmathews@lgl.com>; murray.manson@dfo-mpo.gc.ca; Harris, Shannon WLRS:EX <Shannon.Harris@gov.bc.ca>; Sophie Sparrow <sophie@alouetteriver.org>; Wendell Challenger <wchallenger@lgl.com>
Cc: Dan Ohlson <dohlson@compassrm.com>; Leake, Alf <alf.leake@bchydro.com>; jacqueline.chapman@bchydro.com
Subject: ARSRP - final survey

Hi everyone,

As discussed at the May ARSRP workshop, we are sending a final survey to allow each organization to submit their comments/preferences. Your feedback will help us document the committee's recommendations within the Alouette Salmon Restoration Plan (SRP). The attached memo includes a recap of key discussions from the last 2 workshops, and instructions for completing the two-part survey.

We ask that each organization submit one (1) response to each part of the survey. Instructions and survey links are in the attached memo, and links are also included below.

- Final Survey Part 1: to capture each organization's final comments on our salmon restoration actions recommended from the last two workshops
- Final Survey Part 2: to capture each organization's final preferences for upstream fish passage improvements

We would appreciate responses by **Friday, July 7** (2 weeks from today). Please let me know if you'll need additional time.

As always, let us know if you have any questions about this request.

Thanks,
Katie

Katie O'Donnell, Ph.D. *(she/her)*
Associate // Ecologist / Decision Analyst
Compass Resource Management Ltd.
788 Beatty St. #302, Vancouver, BC V6B 2M1

Alouette River Salmon Restoration Plan (ARSRP)

Committee Meeting Summary

March 8–9, 2023

Meeting Summary

This was the fourth of a planned series of ARSRP workshops to develop a salmon restoration plan for the Alouette River watershed. The group met to (1) review the initial suite of alternatives (i.e., full life-cycle restoration options), including conceptual designs of the short-listed fish passage options, (2) review preliminary results of fish life-cycle modeling, and (3) discuss the performance of the initial set of alternatives by reviewing the consequence table, and (4) identify alternatives to eliminate, modify, or carry forward.

Participants	
ARSRP Committee Members: Greta Borick-Cunningham – ARMS Ken Stewart – ARMS Sophie Sparrow – ARMS Alf Leake – BCH Jacqueline Chapman – BCH Murray Manson – DFO Justin Laslo – Leq'a:mel FN Megan Mathews – LGL Shannon Harris – BC WLRS	**Facilitation Team:** Katie O'Donnell – Compass Resource Management Dan Ohlson – Compass Resource Management **Guests**: Julian Gonzalez – BCH Emily Thwaites – BCH Jenny Lynne – DFO Brian Ma – ESSA Matthew Bayly – ESSA Wendell Challenger – LGL Elmar Plate – LGL Vincent Autier – McMillen Jacobs

Action Items	
1	McMillen Jacobs will finalize the Conceptual Design Report.
2	ESSA will finalize results for 2 other species (Chum, Steelhead), refine scenarios to reflect feedback from the workshop, and continue to refine estimates of fish passage efficiencies.
3	The project team (led by Compass) will add several objectives/measures to the consequence table, including public safety, "volitionality," and several other fish passage metrics.
4	BC Hydro will review and update all costs to reflect life cycle costs and other project costs.

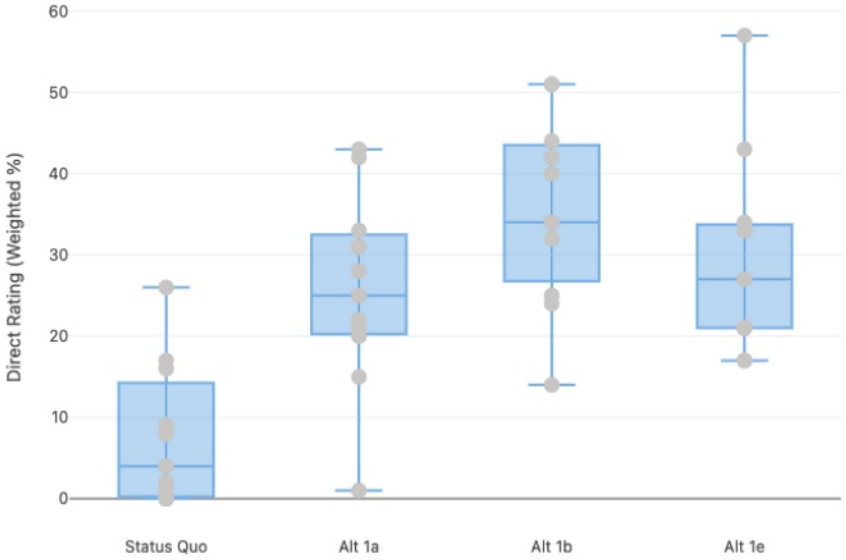
Supporting Documents

	Document	Author	File name
Documents sent as pre-reading materials			
1	Alouette Reservoir Fish Passage Options Evaluation – Conceptual Design Report	McMillen Jacobs	BC Hydro – ALU – Conceptual Design Report Rev B
2	ARSRP Workshop #4 Pre-reading memo	Compass	ARSRP_PreRead_March2023_v0.1
3	Performance Measure Information Sheets	Compass	Detailed PM Info Sheets
Slide decks from workshop presentations			
4	Alouette Reservoir Fish Passage Options Evaluation – Conceptual Design	McMillen Jacobs	MJ Presentation Workshop 4
5	ESSA Life-Cycle Modeling results	ESSA	2023.03.08 DRAFT Population Model Results v3

Summary of Discussions and Outcomes

TOPIC	DESCRIPTION
	March 8 (Day #1)
Kick-off: Intros, Agenda Review, and SDM Recap	Justin Laslo (Leq'a:mel FN) opened the meeting. Katie O'Donnell (Compass) facilitated introductions and reviewed the agenda for Day 1. Katie then gave a brief presentation to highlight key information from the pre-reading memo (doc #2). The presentation reminded the committee about the overall context and scope of this process, reviewed the initial suite of alternatives that the committee had begun developing at the December workshop, and previewed the structure of the consequence table that would be populated and discussed in a later session. Katie also reviewed the workshop objectives and discussed the workshop series schedule, which was updated to include a fifth workshop.
Fish Passage Options – Conceptual Designs	Vincent Autier (McMillen Jacobs) presented the conceptual designs for the fish passage options (4 upstream, 2 downstream) that were short-listed at the previous workshop: **Upstream Options** • **U-1A**: Vertical Slot Ladder (h = 300 mm) around left bank with exit pools • **U-1B**: Vertical Slot Ladder (h = 230 mm) with bypass pipe • **U-2**: Fully Upgraded Trap and Haul Facility with vertical slot ladder • **U-3**: Pneumatic Fish Transport Tube (Whooshh) **Downstream Options** • **D-1**: Floating surface collector (FSC) with guidance nets • **D-2**: Upgraded spilling (Obermeyer Gate) The draft conceptual design report (doc #1) was sent to the committee prior to the workshop. In the presentation (doc #4), Vincent gave an overview of each option, including technical drawings and photos of similar applications. He also presented an alternative evaluation that summarized the benefits and drawbacks of each option. Throughout the session, committee members asked a number of clarifying questions, which were addressed within the workshop. For example, to enable the group to better understand the false weir and bypass pipe involved in upstream option U-1B, Vincent provided additional photos and diagrams. Following the workshop, McMillen Jacobs will finalize the Conceptual Design Report.
Flow Study	Alf Leake (BCH) gave a brief progress update on the Alouette River flow-habitat study, which was commissioned by the ARSRP and the Alouette-Stave-Ruskin Water Use Plan Order Review (ASR WUPOR) process. While the study is still being finalized, draft results have been made available to BCH. For the purposes of developing the salmon restoration plan (SRP), an internal BCH team interpreted the habitat-flow relationships in the draft report to identify a flow regime that balanced habitat needs for all salmonid life histories present in the river for respective months of the year. This flow regime has not been vetted through any rigorous consultative discussions external to BCH, nor has it been evaluated against other watershed interests; the flow regime is therefore being considered for SRP evaluation purposes only. BC Hydro intends to review the outcomes of the flow study within technical discussions associated with the ASR WUPOR process, where the study outcomes, target fish species and potential trade-offs with other watershed interests will be discussed and a final flow regime will be recommended.

TOPIC	DESCRIPTION
Fish Life-cycle Modeling – Initial (Draft) Results	Matthew Bayly and Brian Ma (ESSA) presented draft results from their fish life-cycle modeling efforts (doc #5). They presented two metrics for each species: (1) spawner abundance, which represents the hypothetical *capacity* of a population under various scenarios, and (2) net reproductive rate, which represents the hypothetical *productivity* of a population. Both metrics are species-specific estimates of resilience; they are useful to gauge the magnitude of benefit for a proposed alternative with respect to a cumulative life cycle model for Pacific salmon. The life cycle modelling framework involves simulations under future hypothetical "what if" scenarios (alternatives). The initial results were available for Coho, Chinook, and Sockeye for most alternatives (see results in doc #5). Following the workshop, ESSA will finalize results for 2 other species (Chum, Steelhead) and refine scenarios to reflect feedback from the committee. They will also continue to refine estimates of passage efficiencies across fishway alternatives, which are a major driver of the estimates of capacity and productivity.
Consequence Table – Results and Discussion	Compass then walked through the consequence table by showing draft results for each objective. The committee had a wide-ranging discussion, which helped begin to identify areas of agreement, points of clarification, and components that needed refinement or further development. These points are compiled below, as discussion on these themes continued on Day #2.
March 9 (Day #2)	
Consequence Table Discussion	On Day #2 of the workshop, Katie and Dan (Compass) facilitated further discussion of the consequence table. The group began to compare alternatives head-to-head, which is useful for highlighting key differences and potential trade-offs. *Comparing downstream passage options* – The group first looked at Alts 1D vs. 1E. Both alternatives included the same upstream option (U-2), but different downstream options. Alt 1D included the FSC (D-1), while Alt 1E included the upgraded spilling option (D-2). Alt 1E outperformed 1D on most fish objectives, and the costs associated with 1E were much lower. The committee also expressed other concerns with the FSC that were not yet captured in the consequence table (i.e., aesthetics, public safety). Given these factors, the committee agreed that Alt 1D was dominated by Alt 1E, and Alt 1D was eliminated from further consideration. *Comparing upstream passage options* – The group then compared the 4 remaining alternatives with different upstream passage options: Alt 1A (with upstream option U-1A), Alt 1B (with upstream option U-1B), Alt 1C (with upstream option U-3), and Alt 1E (with upstream option U-2). All 4 alternatives included the same downstream option (D-2). Key points from the discussion included: • In comparing the 2 vertical slot ladder options (U-1A and U-1B), committee members noted pros and cons of each. While U-1B would enable more species to pass because of the smaller hydraulic drop per pool, there were concerns about the potential for de-watering the fishway in the event of a power failure. Members noted potential dam safety concerns associated with upstream option U-1A, which would involve a trench around the left abutment of the dam; however, several members preferred the "fully volitional" nature of the option. • Several committee members expressed concerns with the steeppass entrance ladder component of upstream option U-3 (Whooshh), including its efficiency, durability, and vulnerability to vandalism. The committee suggested switching to a vertical slot ladder entrance (like in U-2) and including a back-up for the Whooshh system (e.g., the upgraded trap-and-haul facility). The committee agreed to further consider a hybrid

TOPIC	DESCRIPTION
	Whooshh/trap-and-haul (U-2/U-3) option, and eliminated the Whooshh alternative with the steeppass entrance (Alt 1C). The committee then completed a preliminary preference assessment to rank the 4 alternatives with different upstream passage options: (1) Status Quo, (2) Alt 1A (upstream option U-1A), (3) Alt 1B (upstream option U-1B), and (4) a modified Alt 1E (with a hybrid U-2/U-3 option described above). Of 11 participants (8 committee members, 3 guest/technical experts) who completed the assessment, 6 people preferred Alt 1B, 3 people preferred Alt 1E, and 2 people preferred Alt 1A.  During a subsequent discussion, several members noted that they did not consider costs during their ranking. Several others mentioned remaining uncertainties that could affect their rankings, which helped identify additional tasks to complete before the next workshop. The project team will refine the consequence table to reflect several additional interests identified by the committee, including: • Adding an objective regarding recreation/aesthetics/public safety • For fish passage options, adding metrics to capture the "volitionality" of each option, demonstrated success of the option in similar systems, adaptability to climate change, and future scalability • BC Hydro will review and update all costs to reflect total project costs and life cycle costs The group decided on dates for the next workshop, which will be held May 15-16.

compass

Alouette Salmon Restoration Planning Post-Workshop Memo

On 25–26 May 2023, the ARSRP committee held the fifth and final of a series of workshops to develop a salmon restoration plan (SRP) for the Alouette River watershed. The workshop series followed a structured decision making (SDM) framework, which evaluated potential alternatives (i.e., management actions) against a set of objectives determined by the committee. The scope involved deciding on the best set of actions to promote the restoration of all salmonid species and life stages in the Alouette watershed.

This memo is intended to support ARSRP committee members having further discussions within their respective organizations, to support the completion of a final survey of each organization's support for the restoration options discussed in the previous workshops. The response to the survey will inform the summary of the committee's preferences in the report being prepared summarizing the workshop outcomes.

Materials that follow include:

- Recap of key discussions from workshops #4 and #5
- Summary of evaluations of fish passage improvement options
- Instructions for completing the final preference surveys

1 Recap of Key Discussions from Workshops #4 and #5

During the development of the Alouette SRP, the ARSRP committee reviewed several unique combinations of restoration activities, including:

- different upstream and downstream fish passage improvement options;
- the operation of a sockeye conservation hatchery and the expansion of other hatchery operations;
- improvements to Lower Alouette River flows; and
- improvements to Alouette Reservoir tributary habitats.

The box below summarizes the emerging recommendations across the full spectrum of salmon restoration activities, which were reviewed and discussed in the workshop series. In survey #1, you will be asked to provide any comments or key considerations regarding these emerging recommendations. This feedback will help the project team with documenting the committee's preferences in the Alouette SRP, which is currently being drafted.

Box 1: Recommendations emerging from the workshop series

- *Sockeye conservation hatchery* – The committee observed that, given current ocean survival, there would be no benefit of fish passage to salmon restoration without considerable supplementation to smolt production, and that a hatchery would be required to boost smolt production.
- *Downstream flow regime* – The committee briefly reviewed habitat-flow relationships produced from a recent 2-D habitat model of the Lower Alouette River. The potential for significant improvements through modifications to current Ordered flows through Alouette Dam led to the committee recommending further review of the downstream flow regime. These potential benefits will be evaluated further in the ASR WUPOR-FAA process.
- *Habitat restoration* – The committee discussed several habitat improvement scenarios in tributaries upstream of Alouette Reservoir. Options to improve spawning and rearing habitats in Alouette Reservoir tributaries will continue to be explored.
- *Entrainment (Tunnel) and Smolt Outmigration (Dam)* – While Sockeye entrainment through the ALU power tunnel was considered in this process, recent updates from LGL indicated that Sockeye smolt entrainment risk is very low and unlikely to require mitigation. In addition, analyses completed as part of the entrainment study have identified potential drivers of smolt outmigration through Alouette Dam, which has been shared with the ASR WUPOR-FAA process for further consideration.

- *Nutrient Restoration* – The committee acknowledged the benefits of Alouette Reservoir nutrient restoration program to juvenile salmonid production, and recommended that the program continue as planned until fisheries management objectives can be sustained without nutrient additions.
- *Fish Passage* – This process evaluated a full suite of upstream and downstream fish passage options, and identified a short list of feasible options to advance to detailed evaluation. The committee agreed on a preferred downstream option (D-2; upgraded spilling/extended outmigration window), as described in section 2.1 below. Section 2.2 describes the remaining upstream options.
- *Uncertainties and Implementation Planning* – While there were many uncertainties identified in the process, the committee expressed their interest to move forward with restoration actions and avoid delays while answering critical uncertainties. An implementation plan will be developed as part of the SRP documentation and will be shared with the committee for review and comment.

2 Fish Passage Improvement Alternatives

At workshop #4 (March 2023), the committee reviewed the initial suite of alternatives, including conceptual designs of the short-listed fish passage options. These options included:

Downstream Options

- **D-1**: Floating surface collector (FSC) with guidance nets
- **D-2**: Upgraded spilling (Obermeyer Gate) and extended outmigration window

Upstream Options

- **U-1A**: Vertical Slot Ladder (h = 300 mm) around left bank with exit pools
- **U-1B**: Vertical Slot Ladder (h = 230 mm) with bypass pipe
- **U-2**: Fully Upgraded Trap and Haul Facility with vertical slot ladder entrance
- **U-3**: Pneumatic Fish Transport Tube (Whooshh)

Alternatives 1A, 1B, 1C, 1D, and 1E each included a unique combination of upstream and downstream passage options, as summarized in the table here.

	Status Quo	Alt 1A	Alt 1B	Alt 1C	Alt 1D	Alt 1E
Upstream	SQ	U-1A	U-1B	U-3	U-2	U-2
Downstream	SQ	D-2	D-2	D-2	D-1	D-2

2.1 Comparing downstream passage improvement alternatives

The group first compared alternatives 1D vs. 1E. Both alternatives included the same upstream option (U-2), but different downstream options. Alt 1D included the FSC (D-1), while Alt 1E included the upgraded spilling option (D-2). Alt 1E outperformed 1D on most fish objectives, and the costs associated with 1E were much lower (Figure 1). The committee also expressed other concerns with the FSC that were not yet captured in the consequence table (e.g., aesthetics, public safety).

Following workshop #4, the project team developed an additional performance measure to represent these interests (see detailed PM Info Sheet for Public Use: Safety/Vandalism/Aesthetics). At workshop #5, the committee confirmed that Alt 1D was dominated by Alt 1E, and Alt 1D, and thus the floating surface collector for downstream passage, was eliminated from further consideration (Figure 1).

Objective		Unit	Alt 1d Trap & Haul + Surface Collector	Alt 1e Trap & Haul + Obermeyer
Fish				
Sockeye (anadromous) Capacity	median	# spawners	30,710	36,040
Chinook Capacity	median	# spawners	250	257
Coho Capacity	median	# spawners	808	824
Steelhead Capacity	median	# spawners	693	714
Chum Capacity	median	# spawners	317,698	328,616
Fish passage				
Fish Passage "volitionality"		1 to 7	3.2	4.4
Future adaptability (climate change)		1 to 3	2	3
Proven success		1 to 3	2.5	3
Cultural Resources & Heritage Protection				
Alouette Cultural Heritage Protection	Median	d/yr	152.2	156.3
Flood Risk				
Alouette Dam Releases	Median	days	0	0
Public Use				
Alouette Reservoir User Days	median	d/yr	106	106.2
Safety/Vandalism/Aesthetics		1 to 7	2.7	4.0
Cost				
Construction	median + 100%	$K	297,757	25,423
Operations & Maintenance		$K/yr	1126	712

Figure 1. Head-to-head comparison of alternatives 1D and 1E, which differ only in terms of their downstream fish passage component. Alternative 1D is selected (highlighted in blue); under Alternative 1E, cells in green indicate better performance, while those in white indicate similar performance. At workshop #5, the ARSRP committee confirmed that Alternative 1D should be eliminated from consideration.

2.2 Comparing upstream passage improvement alternatives

The group then compared the 4 alternatives with different upstream passage options: Alternatives 1A, 1B, 1C, and 1E. All 4 alternatives included the same downstream option (D-2 – upgraded spilling with Obermeyer gate).

Following workshop #4, BC Hydro's Dam Safety team highlighted significant seismic and feasibility concerns for option U-1A due to the need to trench through the earth fill portion of the dam. This option would potentially destabilize the dam structure during construction and seismic event(s). Consequently, it was recommended that U-1A be removed from consideration (a technical memo from Dam Safety was requested by the committee to document this outcome).

At workshop #5, the group compared the remaining alternatives with different upstream passage options, which are briefly described below.

- **Status Quo**: Includes the current trap-and-truck operation for upstream fish passage, and the current spilling operations for downstream fish passage.
- **Alternative 1B:** This alternative includes upstream fish passage option U-1B, which is a vertical slot fish ladder with a hydraulic drop of 230 mm per pool, a false weir, and a bypass pipe to transfer fish into the reservoir.
- **Alternative 1C**: This alternative includes upstream fish passage option U-3, which is a pneumatic fish transport tube system (Whooshh). This option was initially designed with a steeppass fish ladder, but the committee expressed concerns with this component. At workshop #5, the committee evaluated this alternative with the stipulation that the entrance ladder would be the same as in Alt 1E (i.e., a vertical slot ladder).

- **Alternative 1E**: This alternative includes upstream fish passage option U-2, which is a fully upgraded trap-and-haul facility, including a vertical slot ladder leading to a trapping pool, and water-to-water transfer of fish into a transport truck.

The committee used the consequence table below (Figure 2) as a basis for comparing options. The fish life cycle modeling results also showed that the range of predicted fish population outcomes (i.e., low and high estimates) for Alternatives 1B, 1C, and 1E were all overlapping. In other words, the analysis did not result in a clear "winner" according to model's fish capacity predictions.

After the resulting discussions, ARSRP committee members completed an initial survey to indicate their preferred upstream fish passage improvement option(s). This memo provides the reference material to support each organization's final preference for upstream fish passage.

Objective	Less Preferred → More Preferred		Unit	Status Quo	Alt 1b Bypass pipe + Obermeyer	Alt 1c Whooshh + Obermeyer	Alt 1e Trap & Haul + Obermeyer
Fish							
Sockeye (anadromous) Capacity	median		# spawners	0	38,933	47,600	36,040
Chinook Capacity	median		# spawners	203	260	275	257
Coho Capacity	median		# spawners	684	833	870	824
Steelhead Capacity	median		# spawners	613	715	758	714
Chum Capacity	median		# spawners	271,017	327,127	337,658	328,616
Fish passage							
Fish Passage "volitionality"			1 to 7	4.0	4.7	4.6	4.4
Future adaptability (climate change)			1 to 3	3	2.5	3	3
Proven success			1 to 3	3	3	2.5	3
Cultural Resources & Heritage Protection							
Alouette Cultural Heritage Protection	Median		d/yr	152.2	154.9	156.3	156.3
Flood Risk							
Alouette Dam Releases	Median		days	0	0	0	0
Public Use							
Alouette Reservoir User Days	median		d/yr	106	104.1	106.2	106.2
Safety/Vandalism/Aesthetics			1 to 7	4.0	3.4	3.2	4.0
Cost							
Construction	median + 100%		$K	0	69,653	21,752	25,423
Operations & Maintenance			$K/yr	90	486	294	712

Figure 2. Consequence table comparing the remaining alternatives with different upstream fish passage options, which ARSRP committee members used to determine preferred alternatives.

Note 1: The estimate of Sockeye capacity under Status Quo (capacity = 0) reflects the modeling result that, under current conditions (i.e., marine survival) and operations (i.e., current trap-and-truck, no Sockeye hatchery), establishing a self-sustaining population of anadromous Sockeye is unlikely. The Sockeye capacity estimates for 1B, 1C, and 1E assume improved marine survival.

Note 2: The O&M cost for Status Quo is an estimated annual cost of current trap-and-truck operations.

Note 3: The Construction cost for Alt 1C is based on the initial design (i.e., steeppass ladder). Revising the design to include a vertical slot ladder would increase the cost (likely similar to the cost of Alt 1E), but exact estimates were not available at the time of the workshop.

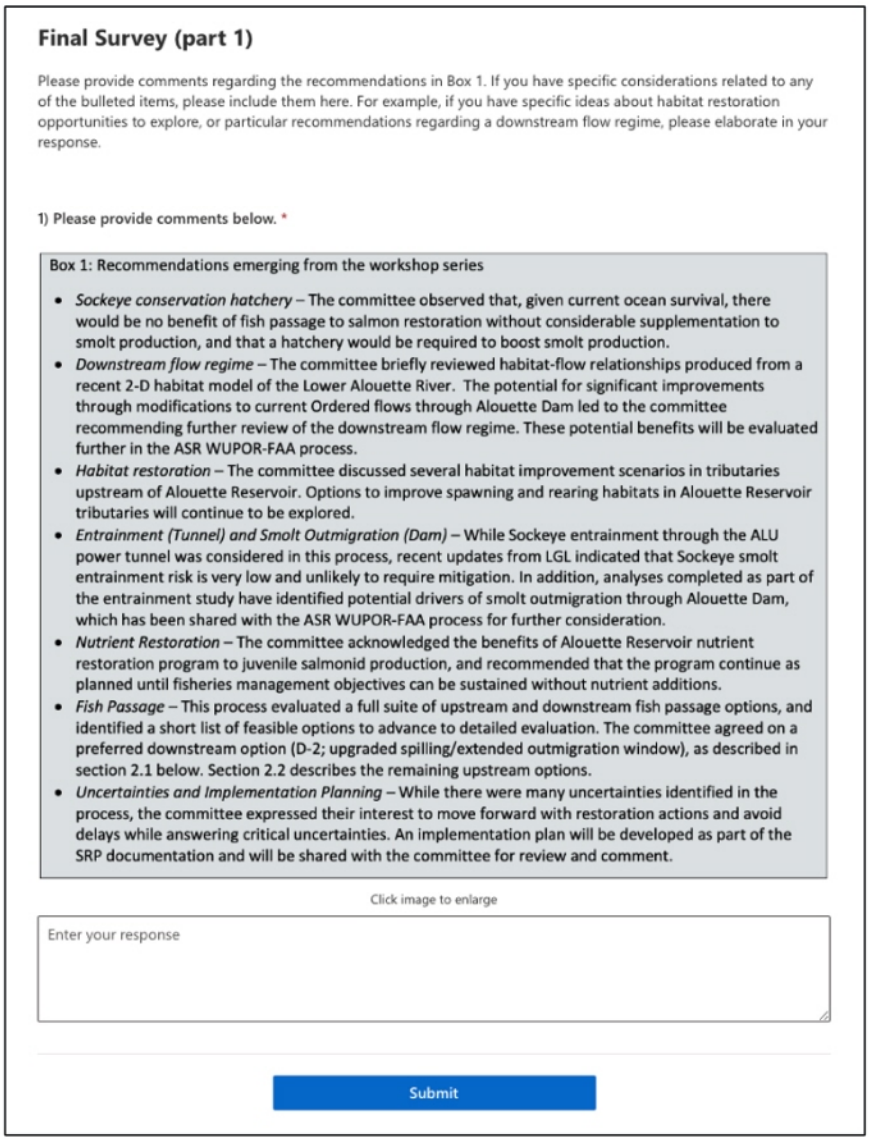
Preference Survey

Note that our final preference survey aims to solicit each organization's support for all salmon restoration activities discussed in this memo, including their preferences for upstream and downstream improvement options. Therefore, there are two parts – and two links – for this final preference survey:

- Final Survey Part 1: to capture each organization's final comments on our salmon restoration actions recommended from the last two workshops
- Final Survey Part 2: to capture each organization's final preferences for upstream fish passage improvements

Instructions for Part 1 of the Final Survey:

First, use the following link to provide any comments or considerations regarding the recommendations summarized in Box 1 above: https://bit.ly/42TNy8C. This survey will help us refine the documentation of committee preferences in the Alouette SRP.



Final Survey (part 1)

Please provide comments regarding the recommendations in Box 1. If you have specific considerations related to any of the bulleted items, please include them here. For example, if you have specific ideas about habitat restoration opportunities to explore, or particular recommendations regarding a downstream flow regime, please elaborate in your response.

1) Please provide comments below. *

Box 1: Recommendations emerging from the workshop series

- *Sockeye conservation hatchery* – The committee observed that, given current ocean survival, there would be no benefit of fish passage to salmon restoration without considerable supplementation to smolt production, and that a hatchery would be required to boost smolt production.
- *Downstream flow regime* – The committee briefly reviewed habitat-flow relationships produced from a recent 2-D habitat model of the Lower Alouette River. The potential for significant improvements through modifications to current Ordered flows through Alouette Dam led to the committee recommending further review of the downstream flow regime. These potential benefits will be evaluated further in the ASR WUPOR-FAA process.
- *Habitat restoration* – The committee discussed several habitat improvement scenarios in tributaries upstream of Alouette Reservoir. Options to improve spawning and rearing habitats in Alouette Reservoir tributaries will continue to be explored.
- *Entrainment (Tunnel) and Smolt Outmigration (Dam)* – While Sockeye entrainment through the ALU power tunnel was considered in this process, recent updates from LGL indicated that Sockeye smolt entrainment risk is very low and unlikely to require mitigation. In addition, analyses completed as part of the entrainment study have identified potential drivers of smolt outmigration through Alouette Dam, which has been shared with the ASR WUPOR-FAA process for further consideration.
- *Nutrient Restoration* – The committee acknowledged the benefits of Alouette Reservoir nutrient restoration program to juvenile salmonid production, and recommended that the program continue as planned until fisheries management objectives can be sustained without nutrient additions.
- *Fish Passage* – This process evaluated a full suite of upstream and downstream fish passage options, and identified a short list of feasible options to advance to detailed evaluation. The committee agreed on a preferred downstream option (D-2; upgraded spilling/extended outmigration window), as described in section 2.1 below. Section 2.2 describes the remaining upstream options.
- *Uncertainties and Implementation Planning* – While there were many uncertainties identified in the process, the committee expressed their interest to move forward with restoration actions and avoid delays while answering critical uncertainties. An implementation plan will be developed as part of the SRP documentation and will be shared with the committee for review and comment.

Click image to enlarge

Enter your response

Submit

Instructions for Part 2 of the Final Survey:

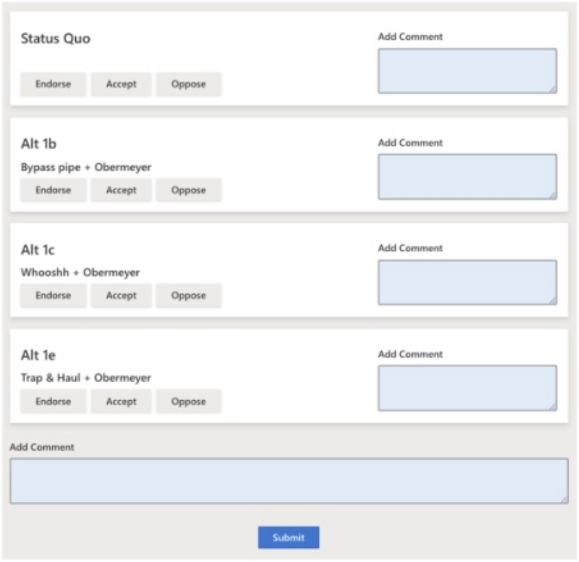
Second, use the following link to complete a final preference survey regarding upstream fish passage improvement: https://bit.ly/46hfBlb. The first component of this survey is a "Direct Rating" exercise, and the second is to "Endorse, Accept, or Oppose" each option. Please use the "Add Comment" features to provide rationale for your ratings.

Direct Rating instructions:

1. For your most preferred option, move the slider all the way to the right (Rating = 100).
2. Give each other option a rating that reflects your degree of preference relative to your first choice. For example, if you prefer your 2nd choice half as much as your 1st choice, give it a rating of 50.
3. Comments are encouraged – you can provide comments on each alternative, general comments, or both.

Endorse, Accept, or Oppose instructions:

1. For your each of the alternatives, use the buttons to either **Endorse**, **Accept**, or **Oppose** each option. The choices are defined as follows:
   - **Endorse** = I fully support this alternative
   - **Accept** = I can live with it; it may not be my first choice, but I will support it, here at the table and outside
   - **Oppose** = I can't support it
2. Use the "Add comment" boxes to include your rationale for each alternative.
3. When you are finished, click "submit"



From: Katie O'Donnell(kodonnell@compassrm.com)
To: Harris, Shannon WLRS:EX (Shannon.Harris@gov.bc.ca)
Subject: Re: ARSRP - final survey
Sent: 08/09/2023 16:49:31
Attachments: ARSRP_9Feb22 workshop notes_v1.0.docx, ARSRP_29Sept22 workshop notes_v0.2.docx, ARSRP_Dec2022 workshop notes_v0.2.docx, ARSRP_Mar2023 workshop notes_v0.1.docx, ARSRP_PostFinalWorkshopMemo_v1.0.docx

Hi Shannon,

We don't have a Sharepoint site set up, but I've attached the meeting minutes from the first 4 workshops here. The "Post-Workshop Memo" summarizes the key discussions from the fifth/final workshop. If there are any other presentations or reports that you'd find helpful, let me know and I'd be happy to send those along.

Thanks,
Katie

Katie O'Donnell, Ph.D. *(she/her)*
Associate // Ecologist / Decision Analyst
Compass Resource Management Ltd.
788 Beatty St. #302, Vancouver, BC V6B 2M1

From: Harris, Shannon WLRS:EX <Shannon.Harris@gov.bc.ca>
Sent: Wednesday, August 9, 2023 9:37 AM
To: Katie O'Donnell <kodonnell@compassrm.com>
Subject: RE: ARSRP - final survey

Hi Katie,
Can you remind me if we have a sharepoint site with minute meetings for this? I missed a number of meetings and therefore completion of the final survey is difficult.

Thank you.
Shannon

From: Katie O'Donnell <kodonnell@compassrm.com>
Sent: Friday, June 23, 2023 11:05 AM
To: Bob Bocking <bbocking@lgl.com>; Ducharme, Scott <Scott.Ducharme@dfo-mpo.gc.ca>; Elmar Plate <eplate@lgl.com>; Gonzalez, Julian <julian.gonzalez@bchydro.com>; Greta Borick-Cunningham <arms@alouetteriver.org>; Hollick-Kenyon, Sandra <Sandra.Hollick-Kenyon@dfo-mpo.gc.ca>; justin@leqamel.ca; s.22 ; Megan Mathews <mmathews@lgl.com>; murray.manson@dfo-mpo.gc.ca; Harris, Shannon WLRS:EX <Shannon.Harris@gov.bc.ca>; Sophie Sparrow <sophie@alouetteriver.org>; Wendell Challenger <wchallenger@lgl.com>
Cc: Dan Ohlson <dohlson@compassrm.com>; Leake, Alf <alf.leake@bchydro.com>; jacqueline.chapman@bchydro.com
Subject: ARSRP - final survey

Hi everyone,

As discussed at the May ARSRP workshop, we are sending a final survey to allow each organization to submit their comments/preferences. Your feedback will help us document the committee's recommendations within the Alouette Salmon Restoration Plan (SRP). The attached memo includes a recap of key discussions from the last 2 workshops, and instructions for completing the two-part survey.

We ask that each organization submit one (1) response to each part of the survey. Instructions and survey links are in the attached memo, and links are also included below.

- Final Survey Part 1: to capture each organization's final comments on our salmon restoration actions recommended from the last two workshops
- Final Survey Part 2: to capture each organization's final preferences for upstream fish passage improvements

We would appreciate responses by **Friday, July 7** (2 weeks from today). Please let me know if you'll need additional time.

As always, let us know if you have any questions about this request.

Thanks,
Katie

Katie O'Donnell, Ph.D. *(she/her)*
Associate // Ecologist / Decision Analyst
Compass Resource Management Ltd.
788 Beatty St. #302, Vancouver, BC V6B 2M1

From: s.22
To: Harris, Shannon WLRS:EX (Shannon.Harris@gov.bc.ca)
Subject: arsrpc
Sent: 08/16/2023 20:39:15

I followed your link and it appears to have only let me in to the first part of the survey.
I am going to place ARMS's response to the survey here and could you check why I didn't get to part Two?

Final Survey part 1

- Support Sockeye Hatchery also other Salmon Species may also need Hatchery enhancement.
- ARSRPC should continue with Down Stream Flow work to assist WUPOR committee with recommendations
- A fixed fund should be established for habitat restoration with ARSRPC to direct annual work
- Entrainment studies should continue as other Salmon species are added and the Lake population increases
- Nutrient Restoration to continue as long as necessary
- Fish Passage recommendation to be finalized by ARSRPC
- Adaptive management **approach** be adopted for **the watershed for** all future **environmental management and** restoration actions.

Fish passage
ARMS first choice based on the information provided;

- For downstream out migration Obermeyer with dam gate modifications
- For upstream passage: the Trap and Haul with vertical slot ladder with option of Whoosh over top portion of dam or Truck haul around top portion of Dam. This option give the most flexibility and options for future improvements. To be clear this is truck and trap at the Dam fishway and is *not* to be confused with truck and trap from the ALLCO Hatchery
- Note ARMS still would like to see an independent engineering report on a vertical slot through the south east perimeter of the Dam

compass

Alouette Salmon Restoration Planning Post-Workshop Memo

On 25–26 May 2023, the ARSRP committee held the fifth and final of a series of workshops to develop a salmon restoration plan (SRP) for the Alouette River watershed. The workshop series followed a structured decision making (SDM) framework, which evaluated potential alternatives (i.e., management actions) against a set of objectives determined by the committee. The scope involved deciding on the best set of actions to promote the restoration of all salmonid species and life stages in the Alouette watershed.

This memo is intended to support ARSRP committee members having further discussions within their respective organizations, to support the completion of a final survey of each organization's support for the restoration options discussed in the previous workshops. The response to the survey will inform the summary of the committee's preferences in the report being prepared summarizing the workshop outcomes.

Materials that follow include:

- Recap of key discussions from workshops #4 and #5
- Summary of evaluations of fish passage improvement options
- Instructions for completing the final preference surveys

1 Recap of Key Discussions from Workshops #4 and #5

During the development of the Alouette SRP, the ARSRP committee reviewed several unique combinations of restoration activities, including:

- different upstream and downstream fish passage improvement options;
- the operation of a sockeye conservation hatchery and the expansion of other hatchery operations;
- improvements to Lower Alouette River flows; and
- improvements to Alouette Reservoir tributary habitats.

The box below summarizes the emerging recommendations across the full spectrum of salmon restoration activities, which were reviewed and discussed in the workshop series. In survey #1, you will be asked to provide any comments or key considerations regarding these emerging recommendations. This feedback will help the project team with documenting the committee's preferences in the Alouette SRP, which is currently being drafted.

Box 1: Recommendations emerging from the workshop series

- *Sockeye conservation hatchery* – The committee observed that, given current ocean survival, there would be no benefit of fish passage to salmon restoration without considerable supplementation to smolt production, and that a hatchery would be required to boost smolt production.
- *Downstream flow regime* – The committee briefly reviewed habitat-flow relationships produced from a recent 2-D habitat model of the Lower Alouette River. The potential for significant improvements through modifications to current Ordered flows through Alouette Dam led to the committee recommending further review of the downstream flow regime. These potential benefits will be evaluated further in the ASR WUPOR-FAA process.
- *Habitat restoration* – The committee discussed several habitat improvement scenarios in tributaries upstream of Alouette Reservoir. Options to improve spawning and rearing habitats in Alouette Reservoir tributaries will continue to be explored.
- *Entrainment (Tunnel) and Smolt Outmigration (Dam)* – While Sockeye entrainment through the ALU power tunnel was considered in this process, recent updates from LGL indicated that Sockeye smolt entrainment risk is very low and unlikely to require mitigation. In addition, analyses completed as part of the entrainment study have identified potential drivers of smolt outmigration through Alouette Dam, which has been shared with the ASR WUPOR-FAA process for further consideration.

- *Nutrient Restoration* – The committee acknowledged the benefits of Alouette Reservoir nutrient restoration program to juvenile salmonid production, and recommended that the program continue as planned until fisheries management objectives can be sustained without nutrient additions.
- *Fish Passage* – This process evaluated a full suite of upstream and downstream fish passage options, and identified a short list of feasible options to advance to detailed evaluation. The committee agreed on a preferred downstream option (D-2; upgraded spilling/extended outmigration window), as described in section 2.1 below. Section 2.2 describes the remaining upstream options.
- *Uncertainties and Implementation Planning* – While there were many uncertainties identified in the process, the committee expressed their interest to move forward with restoration actions and avoid delays while answering critical uncertainties. An implementation plan will be developed as part of the SRP documentation and will be shared with the committee for review and comment.

2 Fish Passage Improvement Alternatives

At workshop #4 (March 2023), the committee reviewed the initial suite of alternatives, including conceptual designs of the short-listed fish passage options. These options included:

Downstream Options

- **D-1**: Floating surface collector (FSC) with guidance nets
- **D-2**: Upgraded spilling (Obermeyer Gate) and extended outmigration window

Upstream Options

- **U-1A**: Vertical Slot Ladder (h = 300 mm) around left bank with exit pools
- **U-1B**: Vertical Slot Ladder (h = 230 mm) with bypass pipe
- **U-2**: Fully Upgraded Trap and Haul Facility with vertical slot ladder entrance
- **U-3**: Pneumatic Fish Transport Tube (Whooshh)

Alternatives 1A, 1B, 1C, 1D, and 1E each included a unique combination of upstream and downstream passage options, as summarized in the table here.

	Status Quo	Alt 1A	Alt 1B	Alt 1C	Alt 1D	Alt 1E
Upstream	SQ	U-1A	U-1B	U-3	U-2	U-2
Downstream	SQ	D-2	D-2	D-2	D-1	D-2

2.1 Comparing downstream passage improvement alternatives

The group first compared alternatives 1D vs. 1E. Both alternatives included the same upstream option (U-2), but different downstream options. Alt 1D included the FSC (D-1), while Alt 1E included the upgraded spilling option (D-2). Alt 1E outperformed 1D on most fish objectives, and the costs associated with 1E were much lower (Figure 1). The committee also expressed other concerns with the FSC that were not yet captured in the consequence table (e.g., aesthetics, public safety).

Following workshop #4, the project team developed an additional performance measure to represent these interests (see detailed PM Info Sheet for Public Use: Safety/Vandalism/Aesthetics). At workshop #5, the committee confirmed that Alt 1D was dominated by Alt 1E, and Alt 1D, and thus the floating surface collector for downstream passage, was eliminated from further consideration (Figure 1).

Objective		Unit	Alt 1d Trap & Haul + Surface Collector	Alt 1e Trap & Haul + Obermeyer
Fish				
Sockeye (anadromous) Capacity	median	# spawners	30,710	36,040
Chinook Capacity	median	# spawners	250	257
Coho Capacity	median	# spawners	808	824
Steelhead Capacity	median	# spawners	693	714
Chum Capacity	median	# spawners	317,698	328,616
Fish passage				
Fish Passage "volitionality"		1 to 7	3.2	4.4
Future adaptability (climate change)		1 to 3	2	3
Proven success		1 to 3	2.5	3
Cultural Resources & Heritage Protection				
Alouette Cultural Heritage Protection	Median	d/yr	152.2	156.3
Flood Risk				
Alouette Dam Releases	Median	days	0	0
Public Use				
Alouette Reservoir User Days	median	d/yr	106	106.2
Safety/Vandalism/Aesthetics		1 to 7	2.7	4.0
Cost				
Construction	median + 100%	$K	297,757	25,423
Operations & Maintenance		$K/yr	1126	712

Figure 1. Head-to-head comparison of alternatives 1D and 1E, which differ only in terms of their downstream fish passage component. Alternative 1D is selected (highlighted in blue); under Alternative 1E, cells in green indicate better performance, while those in white indicate similar performance. At workshop #5, the ARSRP committee confirmed that Alternative 1D should be eliminated from consideration.

2.2 Comparing upstream passage improvement alternatives

The group then compared the 4 alternatives with different upstream passage options: Alternatives 1A, 1B, 1C, and 1E. All 4 alternatives included the same downstream option (D-2 – upgraded spilling with Obermeyer gate).

Following workshop #4, BC Hydro's Dam Safety team highlighted significant seismic and feasibility concerns for option U-1A due to the need to trench through the earth fill portion of the dam. This option would potentially destabilize the dam structure during construction and seismic event(s). Consequently, it was recommended that U-1A be removed from consideration (a technical memo from Dam Safety was requested by the committee to document this outcome).

At workshop #5, the group compared the remaining alternatives with different upstream passage options, which are briefly described below.

- **Status Quo**: Includes the current trap-and-truck operation for upstream fish passage, and the current spilling operations for downstream fish passage.
- **Alternative 1B:** This alternative includes upstream fish passage option U-1B, which is a vertical slot fish ladder with a hydraulic drop of 230 mm per pool, a false weir, and a bypass pipe to transfer fish into the reservoir.
- **Alternative 1C**: This alternative includes upstream fish passage option U-3, which is a pneumatic fish transport tube system (Whooshh). This option was initially designed with a steeppass fish ladder, but the committee expressed concerns with this component. At workshop #5, the committee evaluated this alternative with the stipulation that the entrance ladder would be the same as in Alt 1E (i.e., a vertical slot ladder).

- **Alternative 1E**: This alternative includes upstream fish passage option U-2, which is a fully upgraded trap-and-haul facility, including a vertical slot ladder leading to a trapping pool, and water-to-water transfer of fish into a transport truck.

The committee used the consequence table below (Figure 2) as a basis for comparing options. The fish life cycle modeling results also showed that the range of predicted fish population outcomes (i.e., low and high estimates) for Alternatives 1B, 1C, and 1E were all overlapping. In other words, the analysis did not result in a clear "winner" according to model's fish capacity predictions.

After the resulting discussions, ARSRP committee members completed an initial survey to indicate their preferred upstream fish passage improvement option(s). This memo provides the reference material to support each organization's final preference for upstream fish passage.

Objective	Less Preferred → More Preferred		Unit	Status Quo	Alt 1b Bypass pipe + Obermeyer	Alt 1c Whooshh + Obermeyer	Alt 1e Trap & Haul + Obermeyer
Fish							
Sockeye (anadromous) Capacity	median		# spawners	0	38,933	47,600	36,040
Chinook Capacity	median		# spawners	203	260	275	257
Coho Capacity	median		# spawners	684	833	870	824
Steelhead Capacity	median		# spawners	613	715	758	714
Chum Capacity	median		# spawners	271,017	327,127	337,658	328,616
Fish passage							
Fish Passage "volitionality"			1 to 7	4.0	4.7	4.6	4.4
Future adaptability (climate change)			1 to 3	3	2.5	3	3
Proven success			1 to 3	3	3	2.5	3
Cultural Resources & Heritage Protection							
Alouette Cultural Heritage Protection	Median		d/yr	152.2	154.9	156.3	156.3
Flood Risk							
Alouette Dam Releases	Median		days	0	0	0	0
Public Use							
Alouette Reservoir User Days	median		d/yr	106	104.1	106.2	106.2
Safety/Vandalism/Aesthetics			1 to 7	4.0	3.4	3.2	4.0
Cost							
Construction	median + 100%		$K	0	69,653	21,752	25,423
Operations & Maintenance			$K/yr	90	486	294	712

Figure 2. Consequence table comparing the remaining alternatives with different upstream fish passage options, which ARSRP committee members used to determine preferred alternatives.

Note 1: The estimate of Sockeye capacity under Status Quo (capacity = 0) reflects the modeling result that, under current conditions (i.e., marine survival) and operations (i.e., current trap-and-truck, no Sockeye hatchery), establishing a self-sustaining population of anadromous Sockeye is unlikely. The Sockeye capacity estimates for 1B, 1C, and 1E assume improved marine survival.

Note 2: The O&M cost for Status Quo is an estimated annual cost of current trap-and-truck operations.

Note 3: The Construction cost for Alt 1C is based on the initial design (i.e., steeppass ladder). Revising the design to include a vertical slot ladder would increase the cost (likely similar to the cost of Alt 1E), but exact estimates were not available at the time of the workshop.

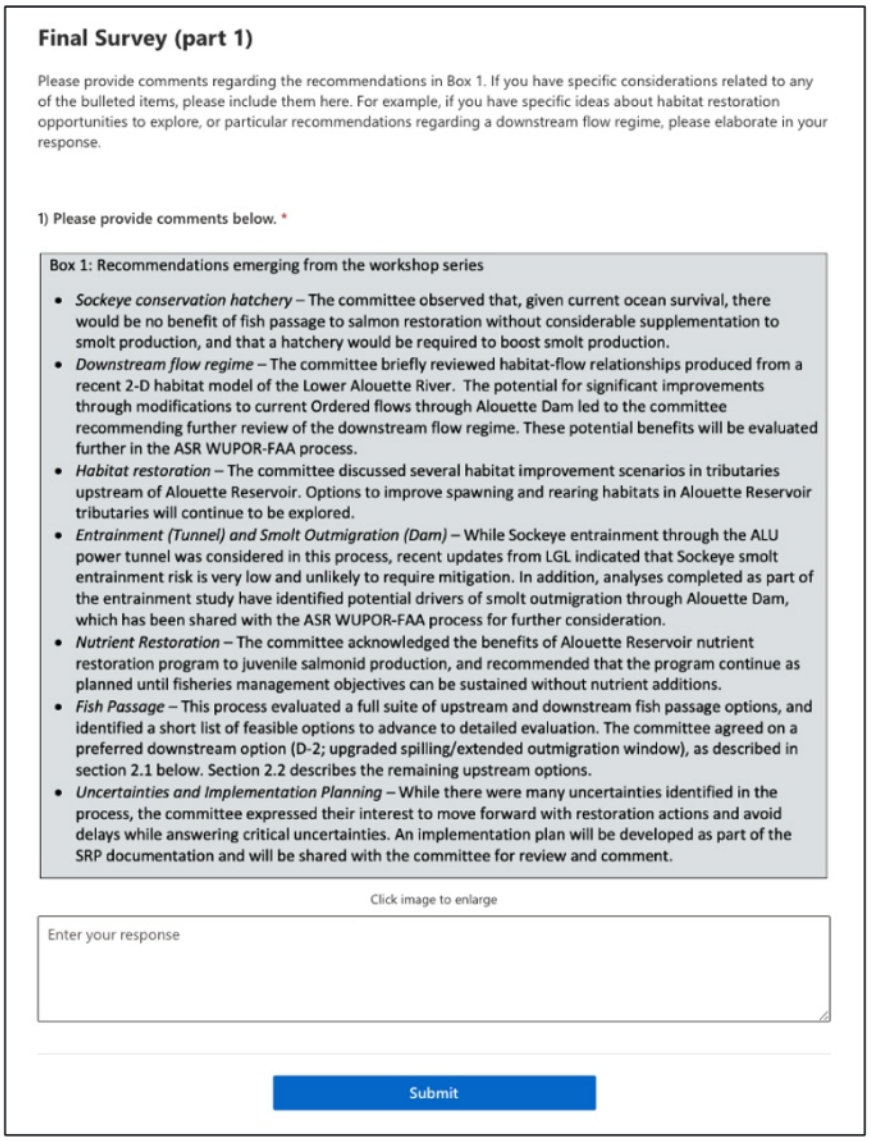
Preference Survey

Note that our final preference survey aims to solicit each organization's support for all salmon restoration activities discussed in this memo, including their preferences for upstream and downstream improvement options. Therefore, there are two parts – and two links – for this final preference survey:

- Final Survey Part 1: to capture each organization's final comments on our salmon restoration actions recommended from the last two workshops
- Final Survey Part 2: to capture each organization's final preferences for upstream fish passage improvements

Instructions for Part 1 of the Final Survey:

First, use the following link to provide any comments or considerations regarding the recommendations summarized in Box 1 above: https://bit.ly/42TNy8C. This survey will help us refine the documentation of committee preferences in the Alouette SRP.



Final Survey (part 1)

Please provide comments regarding the recommendations in Box 1. If you have specific considerations related to any of the bulleted items, please include them here. For example, if you have specific ideas about habitat restoration opportunities to explore, or particular recommendations regarding a downstream flow regime, please elaborate in your response.

1) Please provide comments below. *

Box 1: Recommendations emerging from the workshop series

- *Sockeye conservation hatchery* – The committee observed that, given current ocean survival, there would be no benefit of fish passage to salmon restoration without considerable supplementation to smolt production, and that a hatchery would be required to boost smolt production.
- *Downstream flow regime* – The committee briefly reviewed habitat-flow relationships produced from a recent 2-D habitat model of the Lower Alouette River. The potential for significant improvements through modifications to current Ordered flows through Alouette Dam led to the committee recommending further review of the downstream flow regime. These potential benefits will be evaluated further in the ASR WUPOR-FAA process.
- *Habitat restoration* – The committee discussed several habitat improvement scenarios in tributaries upstream of Alouette Reservoir. Options to improve spawning and rearing habitats in Alouette Reservoir tributaries will continue to be explored.
- *Entrainment (Tunnel) and Smolt Outmigration (Dam)* – While Sockeye entrainment through the ALU power tunnel was considered in this process, recent updates from LGL indicated that Sockeye smolt entrainment risk is very low and unlikely to require mitigation. In addition, analyses completed as part of the entrainment study have identified potential drivers of smolt outmigration through Alouette Dam, which has been shared with the ASR WUPOR-FAA process for further consideration.
- *Nutrient Restoration* – The committee acknowledged the benefits of Alouette Reservoir nutrient restoration program to juvenile salmonid production, and recommended that the program continue as planned until fisheries management objectives can be sustained without nutrient additions.
- *Fish Passage* – This process evaluated a full suite of upstream and downstream fish passage options, and identified a short list of feasible options to advance to detailed evaluation. The committee agreed on a preferred downstream option (D-2; upgraded spilling/extended outmigration window), as described in section 2.1 below. Section 2.2 describes the remaining upstream options.
- *Uncertainties and Implementation Planning* – While there were many uncertainties identified in the process, the committee expressed their interest to move forward with restoration actions and avoid delays while answering critical uncertainties. An implementation plan will be developed as part of the SRP documentation and will be shared with the committee for review and comment.

Click image to enlarge

Enter your response

Submit

Instructions for Part 2 of the Final Survey:

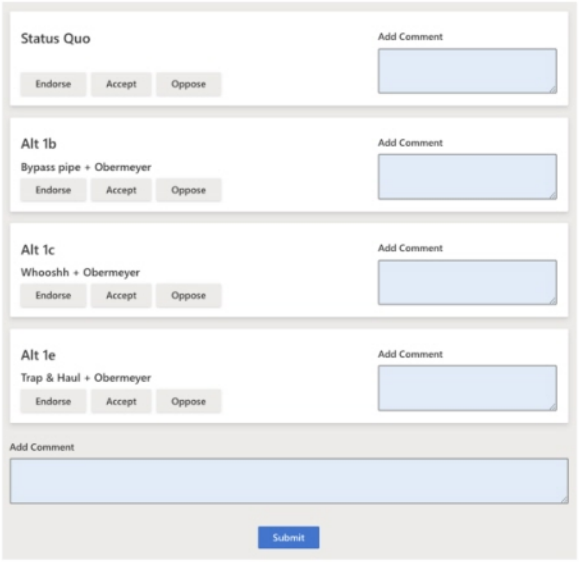
Second, use the following link to complete a final preference survey regarding upstream fish passage improvement: https://bit.ly/46hfBlb. The first component of this survey is a "Direct Rating" exercise, and the second is to "Endorse, Accept, or Oppose" each option. Please use the "Add Comment" features to provide rationale for your ratings.

Direct Rating instructions:

1. For your most preferred option, move the slider all the way to the right (Rating = 100).
2. Give each other option a rating that reflects your degree of preference relative to your first choice. For example, if you prefer your 2nd choice half as much as your 1st choice, give it a rating of 50.
3. Comments are encouraged – you can provide comments on each alternative, general comments, or both.

Endorse, Accept, or Oppose instructions:

1. For your each of the alternatives, use the buttons to either **Endorse**, **Accept**, or **Oppose** each option. The choices are defined as follows:
   - **Endorse** = I fully support this alternative
   - **Accept** = I can live with it; it may not be my first choice, but I will support it, here at the table and outside
   - **Oppose** = I can't support it
2. Use the "Add comment" boxes to include your rationale for each alternative.
3. When you are finished, click "submit"



From:	Harris, Shannon WLRS:EX(Shannon.Harris@gov.bc.ca)
To:	Kerr-Upal, Manjit WLRS:EX (Manjit.Kerr-Upal@gov.bc.ca); Beck, Martina WLRS:EX (Martina.Beck@gov.bc.ca)
Subject:	FW: Agenda for Alouette Reservoir Salmon Restoration Program May 15-16
Sent:	05/08/2023 20:42:56
Attachments:	ARSRP_Agenda_May2023_Draft v0.1.docx, TM 004 - Climate Change Adaptability - Rev 1.docx, TM 005 - Success of Similar Systems Rev 1.docx

Hi there,
This is one of the committees (fish passage) that I mentioned during our meeting I am supporting. We have two full days of meetings.

Shannon

From: Katie O'Donnell <kodonnell@compassrm.com>
Sent: Monday, May 8, 2023 1:33 PM
To: Bob Bocking <bbocking@lgl.com>; Ducharme, Scott <Scott.Ducharme@dfo-mpo.gc.ca>; Elmar Plate <eplate@lgl.com>; Gonzalez, Julian <julian.gonzalez@bchydro.com>; Greta Borick-Cunningham <arms@alouetteriver.org>; Hollick-Kenyon, Sandra <Sandra.Hollick-Kenyon@dfo-mpo.gc.ca>; justin@leqamel.ca; s.22 >; Megan Mathews <mmathews@lgl.com>; murray.manson@dfo-mpo.gc.ca; Harris, Shannon WLRS:EX <Shannon.Harris@gov.bc.ca>; Sophie Sparrow <sophie@alouetteriver.org>; Wendell Challenger <wchallenger@lgl.com>; Brian Ma <bma@essa.com>; mbayly@essa.com; Autier, Vincent <Autier@mcmillencorp.com>; Kevin Ganshorn <kganshorn@ecofishresearch.com>; cam.hiebert@bchydro.com; Thwaites, Emily <emily.thwaites@bchydro.com>
Cc: Dan Ohlson <dohlson@compassrm.com>; Leake, Alf <alf.leake@bchydro.com>; jacqueline.chapman@bchydro.com
Subject: Agenda for ARSRP May 15-16

Hi everyone,

A few updates as we prepare for next week's ARSRP workshop--

- **Agenda**: A draft agenda for the workshop is attached. We've secured a nice conference room at the BC Hydro building in Burnaby (Edmonds), and, like the last workshop (in March), *we strongly encourage folks to attend in person*. While the exact agenda may change during the workshop, we know the meeting will be heavily discussion-based.
- **RSVP**: Please take 30 seconds to respond here (**by Thursday**) to help us plan for logistics: https://forms.office.com/r/dh0KEJRTX8
- **Pre-reading**: There are 2 technical memos (TMs) attached here, which Vincent (McMillen) compiled to address some of the issues raised at the March workshop. The project team is preparing another pre-read memo, which will be sent later this week.

As always, let us know if you have any questions or concerns going into the workshop. Looking forward to seeing everyone next Monday and Tuesday!

Thanks,
Katie

Katie O'Donnell, Ph.D. *(she/her)*

Associate // Ecologist / Decision Analyst

Compass Resource Management Ltd.

788 Beatty St. #302, Vancouver, BC V6B 2M1

Technical Memorandum No. 004			
To:	Jacqueline Chapman, Ph.D. Alf Leake	Project:	Alouette Reservoir – Fish Passage Options Evaluation
From:	Vincent Autier, P. Eng. McMillen	cc:	File
Date:	03/25/2023	Job No:	22-109
Subject:	Improving Resilience of Fish Passage Facilities to Climate Change		

Revision Log

Revision No.	Date	Revision Description
0	03/23/2023	Draft Submittal
1	03/25/2023	Final Draft Submittal

1.0 Purpose and Objective

The purpose of this technical memorandum (TM) is to present some high-level concepts to improve resilience of fish passage facilities to climate change and evaluate the recently developed conceptual fish passage options for Alouette (ALU) Dam to determine their adaptability to changing conditions.

The objective of this TM is to present additional information to the Alouette River Salmonid Restoration Program (ARSRP) committee following Workshop No. 4 held on March 8 and 9, 2023. This additional information will further complete the fish passage evaluation at ALU Dam.

2.0 Project Background

The ARSRP is developing an overall salmonid restoration plan for the Alouette watershed that incorporates an assessment of all life cycle requirements for all species of interest. To advance this effort, the ARSRP requires technical support to evaluate upstream and downstream fish passage options at Alouette Dam for a range of species. With the goal to restore and enhance fish species historically native to the Alouette Watershed, the fish passage options should consider the following species: Sockeye Salmon (*Oncorhynchus nerka*), Chinook Salmon (*O.*

tshawytscha), Coho Salmon (*O. kisutch*), steelhead (*O. mykiss*), Chum Salmon (*O. keta*), Pink Salmon (*O. gorbuscha*), Cutthroat Trout (*O. clarki*), Bull Trout (*Salvelinus confluentus*), other resident species, and invasive species.

The intent of this work is to identify and describe technically feasible options that support ARSRP biological objectives using technologies and operations that are proven within the specific context of the Alouette Dam.

The project has advanced to conceptual design level of some preferred alternatives for upstream and downstream fish passage. These alternatives have been presented to the ARSRP for review and comment. Following the latest workshop, the team determined that it may be of value to evaluate the alternatives for their adaptability to climate change.

Climate change means that we need to consider variability in order to develop facilities which are resilient to environmental conditions that are likely to change over time (e.g., water temperature, streamflow, sea level height, prevalence of invasive species, etc.). The environmental conditions can affect key design criteria, such as fish passage design flows, peak flows, bank full flows, water temperature, geomorphology, sediment transport, need to sort, etc.

3.0 Evaluation

In order to further evaluate the previously developed alternatives, which are presented in McMillen 2023, McMillen reviewed the *NOAA Fisheries WCR Guidance to Improve the Resilience of Fish Passage Facilities to Climate Change, 2022*, document (NMFS, 2022).

The first step, as defined by NMFS, is to identify the Project Element Lifespan. For this project, it is assumed that the lifespan is a Long Life Expectancy (i.e., more than 10-years) and that the project has a high importance factor due to the project goal to restore and enhance fish species historically native to the Alouette Watershed.

Preliminary items to increase resilience to climate change are presented below:

- Complete maintenance activity earlier to ensure fishways are operational during earlier runoff and migration.
- Additional debris removal and maintenance.
- Wildfires and sediment and debris plan for mitigation and/or cleanup process.
- May need to transport fish if cold water flows cannot be provided.
- May need to transport fish if decreasing minimum flow.

- Design entrances to accommodate future low tailrace river stages and potentially need to increase attraction flow.
- Consider installing exit openings at multiple elevations in the forebay.
- Provide sufficient freeboard in fishway pools to ensure pools are not flooded during extreme high flows.
- Install weirs that are adjustable to account for uncertainty of future water surface elevations.
- Modify pool design to operate safely at lower flow rates.
- Increase screen surface area.

Table 3-1 presents a high-level evaluation of each fish passage options against some key factors such as water temperature, fish passage design flow, invasive species management, entrance and exit conditions, ability to transport fish, ladder hydraulics, and expandability.

Table 3-1. Adaptability to Climate Change

Alt	Description	Water Temperature	Fish Passage Design Flow	Invasive Species Management	Entrance Condition	Exit Condition	Ability to Transport	Ladder Hydraulics	Expandability
U-1A	Vertical slot fishway 300 mm drop around left bank	Surface water. Limited to no adjustability in water temperature.	Flow rate cannot easily be adjusted. Adding AWS cannot easily be done.	Cannot manage invasive species without design modifications, beyond just adjusting entrance gate position.	The fishway entrance can be designed to adapt to variable water depth.	The exit structure has multiple exits, but the bandwidth is limited. Adding additional exits would render this option unfeasible (due to dam safety).	As currently conceived, the fishway does not have the ability to easily collect fish for transport. This would require an off-channel trap.	For lower flow rates, temporary sills in the vertical slots could be added as long as the slots are equipped with guide slots.	Operation bandwidth is limited. Expanding operation could be done by pumping fishway flow when the water level drops below a low forebay minimum operation level.
U-1B	Vertical slot fishway 230 mm drop w/ bypass pipe	The water will be pumped from the forebay. Water temperature could be adjusted by pumping at different depths.	Due to the hydraulic drop per pool being lesser than U-1A, flow rate could be increased to some extent if the pools were initially oversized. The flow is pumped. The pump station would have a duty and back up pump, therefore both pumps could be turned on and adjusted with a VFD. However, if we want to keep the temperature adjustability, we would need to oversize the screen.	Switch gates could be installed just downstream of the false weir to remove invasive species out of the system. This could be automated using a scanning system, or done manually by an attending biologist.	The fishway entrance can be designed to adapt to variable water depth.	This option already provides this flexibility. The bypass would be equipped with an open flume to allow fish to exit at different levels of submergence.	Fish will be trapped in the holding pool and could be collected and transported without much modification.	Same as U-1A	Expandability is not required as the ladder would be full height already.
U-2	Upgraded trap and haul	The water would be pumped from the tailrace. The tailrace is currently supplied by the LLO (i.e., already cooler temperature).	Similar to U-1A.	The trap and haul as proposed does not include sorting, however sorting could be added. It increases the complexity of the design and the need for O&M staff. While it is possible to add sorting facilities later, it would be best to incorporate these potential future changes in the initial design.	The fishway entrance can be designed to adapt to variable water depth.	The exit would be from the back of a truck into receiving water. If condition changes, so will the transport program to ensure fish safety.	Already a transporting option.	Same as U-1A	If design incorporate this feature, the fishway entrance to the trap and truck holding pool could later be expanded into a full height fishway.
U-3	Pneumatic tube (Whooshh)	The water would be pumped from the tailrace. The tailrace is currently supplied by the LLO (i.e., already cooler temperature).	A steeppass flowrate is capped, therefore adding significant amount of flow would be problematic through the steeppass section. Instead, additional sections in parallel would need to be added.	The Whooshh system comes with the ability to sort invasive species.	If using a steeppass, the steeppass section is limited in length and the whole system would need to be relocated according to the variation in tailwater.	The exit tubes will be on a floating platform and will adjust to variable forebay water level.	Fish can easily be transported under this option if necessary.	With lower flow, the water depth in the steeppass will decrease which would make it less safe to fish.	Additional units could be added, or additional tubes on the same scanner could be added.
D-1	Floating Surface Collector	The pumped water recirculates in the forebay so does not contribute to water input to the river. Therefore, water temperature cannot be adjusted.	The system would have two vee-screens, the screen and the pump system could be increased by about 10 to 20% to give additional margin. This would however result in a significant cost increase; again, this would not supplement river flow.	Invasive species are typically sorted during upstream movement, however for downstream movement, fish will be collected in a holding pool and could be sorted to remove invasive species.	NA	NA	Fish will be collected in a holding pool and then brought to shore, once on shore they can be transported for downstream release.	NA	Due to the size and cost, these facility types do not get expanded, instead operation can be adjusted to some limits.
D-2	Upgraded spilling	Water being released would be in the spring when water would be expected to already be cooler. The water being released would be from the surface with no adjustability.	Gate position can easily be adjusted to release more flow in the river.	Sorting invasive species will not be feasible.	NA	NA	Cannot collect and transport fish.	NA	The gate crest can be adjusted to allow more flow to be released.

4.0 Conclusion

Following the ARSRP Workshop No. 4, McMillen further evaluated the alternatives for adaptability to climate change. While the evaluation is a high-level review, it provides interesting information as to the potential adaptability of the conceptual design as currently defined and the possibility to further develop the conceptual design in order to provide the desired adaptability. For example, regarding the need to provide the ability to transport fish when the water temperature is too high or when the water level is too low, U-2 Upgraded Trap and Haul provides the ability to transport. It is incidental to the alternative. However, for U-1A on off-channel would need to be designed in order to provide this feature, which would further increase capital and operational cost, as well as adding complexity to the design. Taking water temperature as another example, U-1A utilizes surface water with no adjustability to water temperature (and no adjustability that can later be added), while U-1B would have a pump station with intakes at different depth within the reservoir which would allow adjustability of the water temperature.

Each alternative has its pros and cons, and each will require additional development during the design phase to either include the adjustability in the structure up front or provide the ability to add at a later time when the need arises. In any case, this will require additional coordination to determine the climate change risks specific to ALU dam and the necessity to include the adjustability in the design. It is recommended to use the NMFS 2022 process flowchart for long-term projects to navigate the development of solutions to render the fishway facilities more resilient to climate change.

5.0 References

McMillen, 2023. Alouette Reservoir Fish Passage Options Evaluation – Conceptual Design Report Rev No. B. February 28, 2023.

NMFS (National Marine Fisheries Service), 2022. NOAA Fisheries West Coast Region Guidance to Improve the Resilience of Fish Passage Facilities to Climate Change – 2022. September 2022.

Alouette River Salmon Restoration Program

Agenda – 2023 – Workshop #5

DATE:	15 & 16 May 2023, 9 am–4 pm In-person @ BC Hydro – Edmonds (Conference Room #4 [The Longhouse]) Teams (online, if needed)
OBJECTIVES:	• Review consequence table of final suite of alternatives • Confirm preferred restoration option(s) and priorities for near-term actions • Discuss approach for adaptive SRP and implementation plan
ATTENDEES:	ARSRP Committee members; consultants from McMillen Jacobs and ESSA; facilitators from Compass Resource Management

Day 1 (May 15)

#	Time	Details	Pre-reading	Lead
1	9–9:30	**Kick-off** • Introductions, review agenda • Recap of SDM process to date	Compass pre-read memo	All / Compass
2	9:30–10	**Fish Passage Options – Updates** • Climate change adaptability • Success in similar systems	TM004 TM005	McMillen Jacobs
3	10–10:30	**Consequence Table – Updates** • Review additional objectives & PMs • Discussion/questions	Compass pre-read memo	Compass
	10:30	*Break*		
4	10:45–12	**Fish Life-cycle Modeling – Updated results** • Review updates to model, evaluations of each restoration option • Discussion/questions	–	ESSA
	12–1	*Lunch break – approximate time*		
5	1–4 (*incl. 15-min break*)	**Consequence Table – Discussion & Preferences** • Review evaluation of alternatives • Preference assessment • Discussion/questions	Compass pre-read memo	Compass / All
	4:00	*Adjourn*		

Day 2 (May 16)

#	Time	Details	Pre-reading	Lead
1	9–9:15	**Kick-off:** Day 1 Recap and agenda review		All
2	9:15–12 (*incl. 10-min break*)	**Facilitated Discussion** • Seek committee agreement on recommendations • Discuss outline of Salmon Restoration Plan	Compass re-read memo	Compass / All
	12–1	Lunch break – approximate time		
3	1–3:30	**Facilitated Discussion (cont.)**		Compass
4	3:30–4	**Wrap-up:** Discuss next steps		
	4:00	Adjourn		

Technical Memorandum No. 005			
To:	Jacqueline Chapman, Ph.D. Alf Leake, P. Eng.	Project:	Alouette Reservoir – Fish Passage Options Evaluation
From:	Vincent Autier, P. Eng. McMillen	cc:	File
Date:	05/05/2023	Job No:	22-109
Subject:	Success of Similar Systems		

Revision Log

Revision No.	Date	Revision Description
0	04/11/2023	Draft Submittal
1	05/05/2023	Final Draft Submittal

1.0 Purpose and Objective

The purpose of this technical memorandum (TM) is to present information on the success of systems similar to those presented in the Alouette Reservoir – Fish Passage Options Evaluation Conceptual Design Report (McMillen 2023).

The objective of this TM is to present additional information to the Alouette River Salmonid Restoration Program (ARSRP) committee following Workshop No. 4 held on March 8 and 9, 2023. This additional information will further complete the fish passage evaluation at Alouette (ALU) Dam.

2.0 Project Background

The ARSRP is developing an overall salmonid restoration plan for the Alouette watershed that incorporates an assessment of all life cycle requirements for all species of interest. To advance this effort, the ARSRP requires technical support to evaluate upstream and downstream fish passage options at Alouette Dam for a range of species. With the goal to restore and enhance fish species historically native to the Alouette Watershed, the fish passage options should consider the following species: Sockeye Salmon (*Oncorhynchus nerka*), Chinook Salmon (*O. tshawytscha*), Coho Salmon (*O. kisutch*), steelhead (*O. mykiss*), Chum Salmon (*O. keta*), Pink Salmon (*O. gorbuscha*), Cutthroat Trout (*O. clarki*), Bull Trout (*Salvelinus confluentus*), other resident species, and invasive species.

The intent of this work is to identify and describe technically feasible options that support ARSRP biological objectives using technologies and operations that are proven within the specific context of the Alouette Dam.

The project has advanced to conceptual design level of some preferred alternatives for upstream and downstream fish passage. These alternatives have been presented to the ARSRP for review and comment. Following the latest workshop, the team determined that it would be valuable to know how successful those technologies may be.

3.0 Alternatives Development

At the completion of the initial screening held during the December 2022 workshop, the ARSRP Committee confirmed the following options for fish passage.

3.1 Upstream Fish Passage Options

The following upstream fish passage options are technically feasible at Alouette Dam and have been further developed to the conceptual design level.

- Alternative U-1 (ID No. 05): Pool Types – Vertical Slot.
  - U-1A: This Alternative is a vertical slot ladder with exit pools and reduced operation level of 5 metres, hydraulic drop per pool (h) of 300 millimetres and located around the left bank.
  - U-1B: This Alternative is a vertical slot ladder with h = 230 millimetres to the top of the dam. It would make use of a bypass pipe to release fish into the reservoir.
- Alternative U-2 (ID No. 10): Proposed Trap and Haul. This alternative is a full upgrade of the exiting trap and haul facility. It would have a vertical slot ladder that leads to a trapping pool where fish would be held and then crowded and passed to a fish transport truck with a hopper for water-to-water transfer.
- Alternative U-3 (ID No. 14): Pneumatic Fish Transport Tube Systems. This alternative is a Whooshh Innovations (Whooshh) based option. It would utilize a steeppass. Fish would ascend the steeppass equipped with a false weir downstream of where the pneumatic fish transport tube systems would be installed.

3.2 Downstream Fish Passage Options

The following downstream fish passage options are technically feasible at Alouette Dam and have been further developed to the conceptual design level.

- Alternative D-1: This alternative is a floating surface collector with guidance nets and a bypass pipe.
- Alternative D-2: This alternative is a spilling alternative, similar to the status quo, with the difference that the spillway gate would be modified to support passage of surface-oriented fish and the operation of the spillway may be modified to better align with the out-migration window.

4.0 Case Study and Assessment

This section presents some case studies to evaluate the success of similar systems. The alternatives have some unique features and are a combination of different elements. In other words, each facility is unique and there are no two identical facilities. Each has unique environmental, physical, and regulatory constraints. Therefore, success is a hard term to define. In the conceptual design report, "fish passage efficiency" was defined and estimated for each alternative. This section will document other facilities with similar features to enumerate similar systems. This evaluation is not meant to be a complete metadata review and will only present fish passage efficiency or success when those are readily available online. The facility enumeration will provide background on the popularity of a system, with the idea that if a system is widely used it must be successful. On the other hand, a feature rarely used might mean one of three things: 1) new technology not yet widely applied, 2) pour results and thus not widely used, or 3) produces good results but is overly complicated, expensive to operate, or limited application.

Prior to evaluating "similar systems", this section presents the "unique" feature of the fish passage solutions, in order to identify and query the internet for that particular feature.

- U-1A: The fishway itself, a vertical slot ladder, is not unique and is one of the most popular technical fishway used for upstream fish passage. However, its unique feature is the exit structure with ~17 exit pools to address the forebay water surface fluctuation.
- U-1B: This alternative also has a vertical slot fishway. Its unique feature is the false weir and fish transfer pipe to release fish in the forebay.
- U-2: Proposed Trap and Haul. The trap and haul system is a common way to pass fish around dams. One of its possible unique features would be the direct transfer of fish through a water-to-water transfer, without sorting.
- U-3: Pneumatic Fish Transport Tube Systems. This alternative is a Whooshh based option. Its unique feature is the use of the Whooshh system as a new technology.
- D-1: This alternative is a floating surface collector with guidance nets and a bypass pipe. The FSC is a unique feature.

- D-2: This alternative is a spilling alternative with a modified adjustable weir crest gate equipped with a down ramp.

4.1 Upstream Passage Exit Structure

A gated exit structure is a series of exit pools each equipped with a gated exit in order to address the fluctuation in the reservoir. Each gate is operated individually within a bandwidth, and closing the gate and opening the adjacent gate when the water level fluctuates out of that gate bandwidth. Figure 4-1 presents an example of gated exit pools.

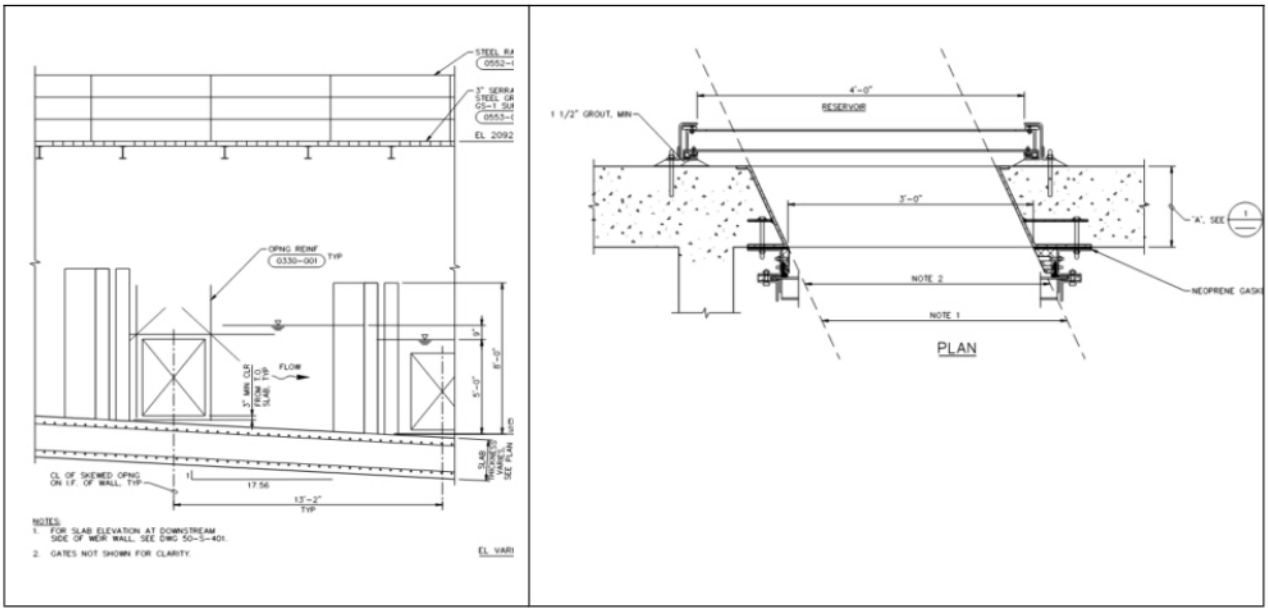


Figure 4-1. Example of Gated Exit Pools. On the left is a section of the gated exit pool, on the right is a gate and thimble detail (including an isolation gate).

Table 4-1 presents fishways with gated exit pools to address the forebay fluctuation. As can be seen in the table, very few fishways have been built with this feature. There are a few known facilities which were designed to include gated exit pools but were not built or a different solution was found. A few examples of that are:

- Trail Bridge fish ladder was designed to a 90% design level. The fishway was a vertical slot ladder including 16 gated exit pools to address the reservoir fluctuation. This design was abandoned. Eugene Water Electric Board (EWEB) is currently investigating a trap-and-haul facility at the Trail Bridge Powerhouse instead.

- The Opal Spring fish ladder was designed with five gated exit pools, but instead Deschutes Valley Water District (DVWD) limited the forebay operation and built the ladder with only one exit pool.

- The Scott Dam Fish Ladder was advanced to a preliminary design and included 31 exit pools. It would have become the largest fishway exit structure and would have accommodated up to 9.3 m of forebay fluctuation. However, this option is no longer on the table and there are talks about removing Scott Dam.

Table 4-1. Gated Exit Structure

ID No.	Project Name	Location	Owner	River	Number of Exit Pools	Water Fluctuation (m)	Species Transported
Built and in Operation							
01	Clackamas River North Fork Dam Fishway	Oregon, USA	Portland General Electric	Clackamas River	20	6 (h=0.30m)	ST, CK, CO, BT
02	Soda Springs Fish Passage	Oregon, USA	PacifiCorp	North Umpqua River	14	4.25 (h=0.30m)	CK, CO, ST, RT, LP
03	River Mill Dam Fish Ladder	Oregon, USA	Portland General Electric	Clackamas River	5	1.83 (h~0.30m)	ST, CK, CO, BT, LP
Modified or Moved to a Different Solution							
04	Scott Dam Fish Ladder	California, USA	Pacific Gas and Electric	Eel River	31	9.3 (h=0.30m)	ST, CK, CO, LP
05	Trail Bridge Fish Ladder	Oregon, USA	Eugene Water Electric Board	McKenzie River	16	3.68 (h=0.23m)	BT, ST, CK, CT, RT, LP
06	Opal Springs: Volitional Fish Passage	Oregon, USA	Deschutes Valley Water District	Crooked River	1 - 5	1.14	ST, CK, LP

ST steelhead, *SO* Sockeye salmon, *CO* Coho salmon, *CK* Chinook salmon, *PS* pink salmon, *CS* chum salmon, *CT* cutthroat trout, *RT* rainbow trout, *BT* bull trout, *LP* Lamprey

The team contacted Portland General Electric (PGE) to be interviewed on the Clackamas River North Fork Dam Fishway. The team was able to get in touch with Nick Ackerman – Senior Scientist. Nick Ackerman informed us that the functionality of accommodating various reservoir elevations has not been used in approximately 30 years as the reservoir is no longer operated as a peaking hydro project. PGE noted that there is no quantitative information on the effectiveness of the fishway exit from the era in which this variable exit strategy was employed, however there was rumor of sustainable returns.

The team contacted PacificCorp and discussed the Soda Springs Fish Passage project with Rich Grost – Senior Aquatic Scientist. He informed the team that the upstream fishway at Soda Springs is a volitional half Ice-Harbor Design similar to the River Mill Ladder, with fourteen gated exit pools and a hydraulic drop per pool of 0.30 m. While there was no measurement for upstream passage efficiency the

fishway seems to work very well, based on video count. Rich Grost stated that very few fish rejected passage past the counting station (i.e., viewing window with video counting capabilities). The exit structure seemed to be working effectively. He did note that a lesson learned was to keep the gates maintained and operating properly.

4.2 False Weir

A false weir is a piece of equipment that adds flow into a pool to entice fish to believe that it is another weir to be used for upstream movement. As soon as the fish engages itself over the false weir, it passes over an apex with no opportunity to return. The false weir is used often in trap and haul facilities to have fish exiting a holding pool in the place of a fish lock, hopper, or pescalator. Figure 4-2 presents an isometric section of a false weir. Table 4-2 presents facilities where a false weir is currently used.

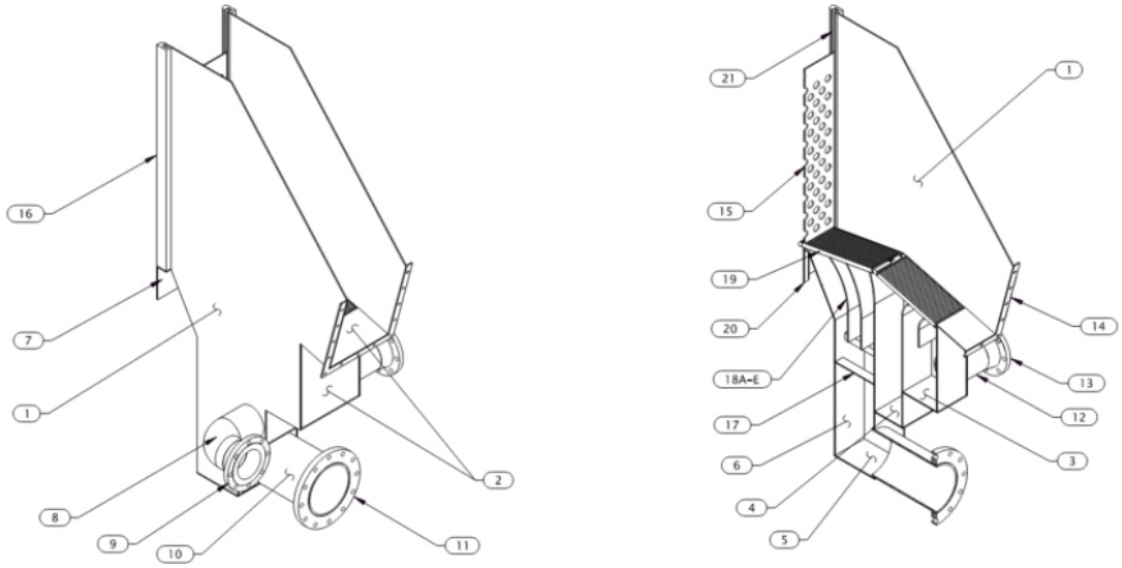


Figure 4-2. Example of False Weir Isometric and Isometric Section

Table 4-2. False Weir Examples

ID No.	Project Name	Location	Owner	River	Species Transported
01	Foster Fish Collection Facility	Oregon, USA	U.S. Army Corps of Engineers	South Santiam River	ST, CO, SO, CK, CT, PS, CH, BT
02	Cougar Dam Adult Fish Collection Facility	Oregon, USA	U.S. Army Corps of Engineers	South Fork of McKenzie River	CK, BT
03	Minto Fish Collection Facility	Oregon, USA	U.S. Army Corps of Engineers	North Santiam River	CK
04	Fall Creek Adult Fish Collection Facility	Oregon, USA	U.S. Army Corps of Engineers	Fall Creek	CK

05	Clackamas River Adult Collection Facility	Oregon, USA	Portland General Electric	Clackamas River	ST, CK, CO, BT
06	Roza Dam	Washington, USA	Bureau of Reclamation	South Fork McKenzie River	RT, CK, ST. CO, SO
07	Tumwater Dam	Washington, USA	Chelan County P.U.D.	Wenatchee River	CK, SO, CO, BT

4.3 Water-to-Water Transfer

Kock, 2020, reviewed trap and haul facility programs regarding Pacific Salmon. As part of that review Kock created a table summarizing the trap and haul facility locations, program type, fish species, and transport distance. McMillen supplemented the table developed by Kock to 1) identify those trap and haul facilities having a water-to-water transfer, and 2) adding information to cover other facilities.

Water-to-water transfer is a safe and fish friendly way to pass fish from a hopper to a fish transport truck. When fish are crowded toward the end of the pool, a removable screen would be lifted and fish would be moved into the hopper, which would be partially recessed in the floor of the holding pool. When full, the hopper would be lifted with a hoist system and would be moved by a trolley crane above a fish transport truck where the hopper would be lowered to match its bottom opening to the truck tank fitting. The fish transport truck would be pre-filled with water using a water supply system to ensure that when the gate is open, the hopper volume hydraulically connects with the water truck volume. A valve on the truck would then be opened and the water allowed to exit the truck through a screen allowing the hopper volume to gently be transferred into the truck. Figure 4-3 presents the valve and controls allowing the water-to-water transfer to happen.

Figure 4-3. Example of Valve Allowing the Water-to-Water transfer (e.g., Clackamas Adult Collection Facility)

Table 4-3. Trap and Haul Facilities

ID No.	Project Name	Location	Owner	River	Species Transported
Includes a Water-to-Water Transfer					
01	Clackamas Adult Collection Facility	Oregon, USA	Portland General Electric	Clackamas River	ST, CK, CO, BT
02	Cougar Dam Adult Fish Collection Facility	Oregon, USA	U.S. Army Corps of Engineers	South Fork of McKenzie River	CK, BT
03	Minto Fish Collection Facility	Oregon, USA	U.S. Army Corps of Engineers	North Santiam River	CK
04	Foster Fish Collection Facility	Oregon, USA	U.S. Army Corps of Engineers	South Santiam River	ST, CO, SO, CK, CT, PS, CH, BT
05	Fall Creek Adult Fish Collection Facility	Oregon, USA	U.S. Army Corps of Engineers	Fall Creek	CK
06	Trail Bridge Dam Trap and Haul Facility	Oregon, USA	Eugene Water Electric Board	McKenzie River	CK, BT, RT, CT, WF
07	Lewis River Adult Collection Facility	Washington, USA	PacifiCorp	Lewis River	CH, ST
08	Lower Baker Trap and Haul	Washington, USA	Puget Sound Energy	Baker River	SO, CO, CT
09	Cowlitz Salmon Hatchery	Washington, USA	Tacoma Public Utilities	Cowlitz River	ST, CK, CO, CT
10	Mud Mountain Dam Fish Passage Facility Project	Washington, USA	U.S. Army Corps of Engineers	White River	CK, ST, CO, PS, BT, CH
11	Green River Collection Facility (Below Howard Hanson Dam)	Washington, USA	U.S. Army Corps of Engineers	Green River	CH, ST, CO
Does Not Include a Water-to-Water Transfer					

12	Pelton Trap	Oregon, USA	Pacific Gas and Electric	Deschutes River	SO, CK, ST, BT
13	Dexter Adult Fish Facility	Oregon, USA	U.S. Army Corps of Engineers	Middle Fork Willamette River	CK
14	Three Mile Falls Dam	Oregon, USA	The Confederated Tribes of the Umatilla Indian Reservation and by the Oregon Department of Fish and Wildlife	Umatilla River	ST, CO, CK, BT
15	Lostine Adult Collection Facility	Oregon, USA	Nez Perce Tribe	Lostine River	ST, CK, BT
16	Merwin Upstream Collection and Transport Facility	Washington, USA	PacifiCorp	Lewis River	ST, CK, CO, CT
17	North Fork Powerhouse and Upstream Fish Passage Cushman No. 2	Washington, USA	Tacoma Power Utilities	North Fork Skokomish River	SO, CO
18	Wynoochee Trap and Haul	Washington, USA	Tacoma Power Utilities	Wynoochee River	ST, CO, CK
19	Lower Granite Dam adult trap	Washington, USA	Idaho Fish and game	Snake River	CK
20	Sunset Falls	Washington, USA	Snohomish PUD	South Fork Skykomish River	SO
21	Toutle River Fish Collection Facility	Washington, USA	Washington Department of Fish and Wildlife	Toutle River	ST, CO, CT
22	Cle Elum Dam	Washington, USA	Bureau of Reclamation	Yakima River	SO
23	Elwha River Weir	Washington, USA	Washington Department of Fish and Wildlife	Elwha River	CO
24	Box Canyon Dam Upstream Fish Passage Facility	Washington, USA	Pend Oreille PUD	Pend Oreille River	BT

ST steelhead, *SO* Sockeye salmon, *CO* Coho salmon, *CK* Chinook salmon, *PS* pink salmon, *CS* chum salmon, *CT* cutthroat trout, *RT* rainbow trout, *BT* bull trout

4.4 Whooshh Technology

McMillen contacted Steve Dearden at Whooshh Innovations to provide a list of projects that used the Whooshh system. Steve provided a list of 37 projects and included their purpose/application, species, disposition and provided additional comments. Several of these projects are in the planning/permitting phase for deployment in the next two years in both the US and Europe. At BC Hydro's request, only permanent applications are documented in this TM..

Table 4-4. Whooshh Innovations Example Projects

ID No.	Project Name	Location	Install Year	Owner/Partners	Species	Purpose/ Application	Type	Disposition	Comment
Volitional Passage Projects [fish volitionally swim into system from river, passage through Whooshh tubes to destination. May include optional workup steps]									
01	Roza Dam	Yakima River, WA	2014	USBR/Yakama Tribe	Spring Chinook	Broodstock collection	Permanent	Lease --> Purchase	Restoration hatchery program. Survival and Fecundity superior for Whooshh fish over fish handling - both groups subsequently truck transported to Cle Elum Hatchery and held for up to 3 months to spawn
Upcoming volitional passage installations									
02	Chief Joseph (River Left)	Columbia River	2023	USACE/US Dept of Energy	Chinook	Passage portal land-based long route at high head dam	2 year minimum	Lease --> Purchase	Full range of sizes, volitional passage. Reintroduction (Chinook).
03	Ice Harbor	Snake River	2023	USACE/US Dept of Energy	Sockeye, Chinook	Retrofit integration and transformation of established fish ladder to selective passage and American Shad removal	2 year minimum	Lease --> Purchase	Selective fish passage, monitoring, removal of American Shad
04	Tremont	Wareham, MA	2023	City of Wareham / US Dept of Energy	American Shad, river herring	Fishway chamber bi-directional multispecies fish passage system	2 + years	Purchase	Passage reintroduction
05	Dayton Dam Project	Fox River, IL	2023	U of IL / Illinois DNR / US Dept of Energy	various	Floating Guardian system: Invasive carp removal	2 + years	Purchase	Invasive carp removal, and fish monitoring
06	Boardman River Project	Traverse City, MI	2024	GLFC	Various	Integrated Selective passage system with selective sorting for invasive species removal	Dependent on funding, 10-year project	Purchase	Combined with other fish passage elements to provide selective fish passage with sorting, restoring fish passage
Volitional entry systems [Fish swim in volitionally, data gathering or sorting only]									

ID No.	Project Name	Location	Install Year	Owner/Partners	Species	Purpose/ Application	Type	Disposition	Comment
07	Emiquon Preserve	Illinois USA	2023	U of ILL and ILL DNR	Various	Invasive species attraction and entry and FishL™ Recognition imaging: floating system	Study/ Permanent	Lease --> Purchase	Installation in progress. Floating system will address river height fluctuation issues
Fish Handling systems [Fish swim in volitionally to river trap or similar, manual load to Whooshh system for direct transfer to trucks or facilities]									
08	Washougal	Columbia River	2014	WA Dept F&W	Chinook	Broodstock collection Fall Tule Chinook	Permanent	Purchase	In service since 2014. Appx 135,000 cumulative. Avg ~15,000 Chinook/year. Made the "Salmon Cannon" technology a household name.
09	Forshaga	Sweden	2019	Fortum	Atlantic Salmon	Wild Atlantic salmon, sorting facility to Trap and Haul	Permanent	Purchase	Hatchery Program
10	Milton Freewater	Milton Freewater OR	2020	Umatilla Tribe	Spring Chinook	Broodstock collection	Permanent	Purchase	Reintroduction Program
11	Okanagan Weir	Okangan River. WA	2016	Colville Tribe	Summer Chinook	Broodstock collection	Permanent	Lease --> Purchase	Hatchery Program
12	Trinity River	California	2022	Hoopa Valley Tribe	Chinook, Steelhead, Coho	Broodstock collection	Permanent	Purchase	Harvest Program
13	Grieg	Norway	2018	Grieg	Atlantic Salmon	Broodstock collection	Permanent	Lease --> Purchase	Aquaculture
14	Austevoll	Norway	2014	Austevoll	Atlantic Salmon	Seafood processing application.	Permanent	Purchase	Aquaculture
15	Conowingo Shad	Susquehanna River	2022	Exelon/ Constellation	American Shad	Distance fish transport surrogate study with gizzard then modified for American Shad*	Study/ Permanent	Purchase	Passage. Custom T123 275 m long distance active transport system of sensitive species
Elver (juvenile eel) passage systems									
16	Viggeby	Sweden	2022	Tekniska Verken	eel	Juvenile eel system	Permanent	Purchase	Passage
17	Mid Calder	Scotland	2021	Forth Rivers Trust	eel	Juvenile eel system	Permanent	Purchase	Passage
18	Lila Edet	Sweden	2018	Vattenfall	eel	Juvenile eel system	Permanent	Purchase	Passage

ID No.	Project Name	Location	Install Year	Owner/Partners	Species	Purpose/ Application	Type	Disposition	Comment
19	Vessigebro	Sweden	2017	Vessigebro Power Station	eel	Juvenile eel system	Permanent	Purchase	Passage

4.5 Floating Surface Collector

Floating surface collectors (FSCs) take advantage of the surface-oriented out-migrant fish. FSCs are increasingly being implemented to provide juvenile fish passage at hydroelectric projects with large storage reservoirs in the Pacific Northwest. FSCs have been installed in strategic locations in the forebays of a hydropower project where juvenile fish have been known to congregate, or where guide nets help guide the fish into the collection system. Typically, FSCs use simple fixed screens and a vee-configuration as a single vee or double vee. Attraction flow is pumped by large submersible horizontal propeller pumps that typically range between 28.3 and 56.6 m^3/s. FSCs work by collecting juvenile fish using attraction flow, then dewatering into a holding area, where fish have access to a bypass channel or are transported by truck to a safe release point downstream of the project.

If the vertical water level fluctuation in the reservoir is low, a fish screen structure (FSS) similar in configuration as an FSC but it is fixed (i.e., not floating) can be used. In that case, fish may be directly transferred to a bypass pipe. However, when the fluctuation is too great, fish are collected into a holding tank and the tank is transferred to a transport truck, or to the dam crest where fish are then transferred into a bypass pipe. Figure 4-4 provides an image of the FSC used in the Clackamas River (OR). Table 4-4 presents a list of FSCs and FSSs in the Pacific Northwest.

Figure 4-4 Floating Surface Collector at North Fork on the Clackamas River, PGE

Table 4-5. Floating Surface Collector Facilities in the Pacific Northwest

ID No.	Name	Owner	Location	Reservoir Fluctuation (m)	Screen Type	Fish Transport	Flow (m^3/s)
01	North Fork	PGE	Clackamas River, WA	3.0	FSC	Bypass Conduit	17/28.3
02	Lower Baker	PSE	Baker River, WA	9.1	FSC	Trap and Transport	14.16/28.3
03	Upper Baker	PSE	Baker River, WA	9.1	FSC	Trap and Transport	14.16/28.3
04	Cougar (in design)	USACE	S. Fork McKenzie River, OR	55.0	FSC	Trap and Transport	28.3
05	Cougar	USACE	S. Fork McKenzie River, OR	55.0	PFFC	Trap and Transport	2.83
06	Swift FSC	PacifiCorp	Lewis River, WA	30.5	FSC	Trap and Transport	17/22.68
07	Cushman	Tacoma Power	Skokomish River, WA	6.1	FSC	Trap and Transport	7.08
08	Trail Bridge (design only)	EWEB	McKenzie River, OR	NA	FSS	Bypass Conduit	56.63
09	Round Butte	PGE	Deschutes River, OR	0.3 to 2.75	FSS	Trap and Transport	170
10	River Mill	PGE	Clackamas River, WA	0.6 to 1.83	FSS	Bypass Conduit	14.16/19.82
11	Soda Springs Fish Passage	PacifiCorp	North Umpqua River	4.25	FSS	Bypass Conduit	53.00

FSC Floating Surface Collector; *FSS* Fish Screen Structure; *PFFC* Portable Floating Fish Collector

4.6 Modified Weir Crest Adjustable Gate with Down Ramp

A weir crest adjustable gate is an overflow weir gate used to control water level and amount of water released. They can be designed with an inflatable bladder such as the pneumatically actuated gates from Obermeyer Hydro, Inc. or they can be actuated using a drum and wire ropes to adjust the weir elevation. In either case, the modified gate is the addition of a plate hinged at the gate crest, providing a down ramp for fish. The down ramp is on rollers or slider pads. When the gate is fully lowered, the gate panel (which is hinged at the base) is flat (i.e., horizontal) and the down ramp is in line with the gate panel.

Figure 4-5 presents an example of a modified weir crest adjustable gate (a.k.a. tilting weir gate) with down ramp used at the Derby Dam Downstream Fish Passage Project, in Nevada.

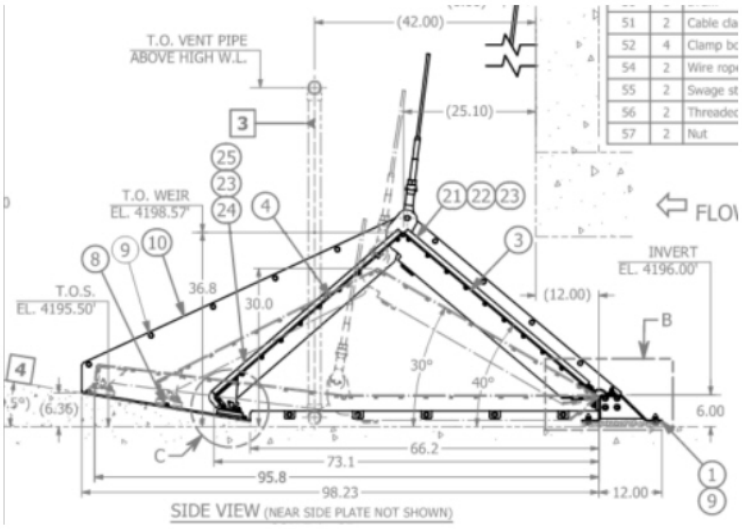


Figure 4-5. Example of a Tilting Weir Gate

While the modified gate with a down ramp is novel and has few known installations to date, the results are positive as out-migrant are gently passed downstream of the gate crest instead of falling on the concrete below and risking to getting injured.

5.0 Conclusion

The objective of this TM was to present additional information to the ARSRP committee following Workshop No. 4 held on March 8 and 9, 2023. This TM presented some case studies in a series of tables to evaluate the success of similar systems, or component of a system. While information was not readily available on the success of similar system, the TM strives to demonstrate that the different components are widely used in upstream or downstream fish passage facilities. The limited information on gated exit structure does not seem to reflect the system working poorly. We understand from discussion with PacifiCorp and PGE that the exit structures function as intended but the owner needs to stay ahead of maintenance schedule on the regulating gates. At a minimum, through the enumeration of the different systems, BC Hydro and ARSRP could further interview those systems owners to gather additional valuable information that may inform the alternative selection and/or design through lesson learned.

6.0 References

Grost R, 2016. Restoring the North Umpqua River. Fish Passage Improvements at Soda Springs Dam. Hydro Review (HR) Volume 35 Issue 4. January 5, 2016.

Kock T. 2020. Review of Trap-and-haul for maintaining Pacific salmonids (Oncorhynchus spp.) in impounded river systems. November 2020.

McMillen, 2023. Alouette Reservoir Fish Passage Options Evaluation – Conceptual Design Report Rev No. B. February 28, 2023.

From:	Philip Halteman(phalteman@compassrm.com)
To:	Drew Atkins (drew@kwantlenlands.ca); Justin Laslo (justin@leqamel.ca); Stephen McGlenn (stephen@leqamel.ca); Cindy Collins (cynthia.collins@matsqui.com); Alice McKay (alice.mckay@matsqui.com); Sneep, Daniel (daniel.sneep@dfo-mpo.gc.ca); Sotiropoulos, Maria (maria.sotiropoulos@dfo-mpo.gc.ca); Harris, Shannon WLRS:EX (Shannon.Harris@gov.bc.ca); Leanne Todd (leanne.todd2@bchydro.com); Gonzalez, Julian (julian.gonzalez@bchydro.com); Stoddard, Erin (erin.stoddard@bchydro.com); Whitehouse, Ryan (Ryan.Whitehouse@bchydro.com); Joanna Glawdel (Joanna.Glawdel@bchydro.com); Sarah Bowie (sbowie@ausenco.com); David Harper (harper@plandynamics.ca); Thwaites, Emily (emily.thwaites@bchydro.com)
To:	Katie O'Donnell (kodonnell@compassrm.com)
Subject:	Alouette-Stave-Ruskin WUPOR-FAA: October Workshop Pre-read
Sent:	09/22/2023 23:24:52
Attachments:	1_ASR_WUPORFAA_ORAC_Oct2023_PreReadMemo.pdf, 2_ASR_WUPORFAA_ORAC_Oct2023_Agenda.pdf, 3_ASR_WUPORFAA_TermsofReference_Draft.pdf, 4_ASR_WUPORFAA_PriorityIssuesMemo_Draft.pdf

Hi all,

Attached, please find the pre-read for our upcoming workshop on October 4 (afternoon) and 5 (full day). The workshop will be held at the BC Hydro Edmonds office in Burnaby. Please make time to work through these four documents before the workshop.

You'll note that the pre-read memo references PM Infosheets – these will come next week, and are not required reading for the October workshop.

Please don't hesitate to let me know if you have any questions or concerns.

Have a good weekend!

Philip Halteman, Ph.D. *(he/him)*
Senior Associate | Ecologist / Decision Analyst
Compass Resource Management Ltd.
302-788 Beatty St., Vancouver, BC V6B 2M1

Phone: 778-772-9897
www.compassrm.com

Order Review Advisory Committee Workshop Agenda – DRAFT

Alouette-Stave-Ruskin Water Use Plan Order Review & Fisheries Act Authorization Process

Two Sessions: **October 4, 2023, 1:00 to 4:30**
October 5, 2023, 9:00 to 4:30

BC Hydro Edmonds, 6911 Southpoint Drive, Burnaby

Workshop Objectives:

- Confirm agreement on a Terms of Reference for the ORAC
- Confirm agreement on the Priority Issues for the Alouette-Stave-Ruskin WUPOR-FAA process
- Review first-round draft operational alternatives and Performance Measures
- Discuss and confirm workplan

Session 1: 4 October 2023.

Hybrid Meeting Info (in person attendance strongly recommended):

Microsoft Teams link: Click here to join the meeting

Dial-in Option: +1 437-703-5263,,501063799# (Meeting ID 501 063 799#)

Time	Item	Lead
1:00	**Tier 1 (Nations-only) discussions**	First Nations
1:45	**Welcome, Meeting Opening, Agenda Review**	Compass
2:00	**Terms of Reference** • Review context for this process • Seek agreement on the TOR as guidance for this process	BCH Compass
2:45	***Break***	
3:00	**Priority Issues** • Review development of the Priority Issues Memo • Confirm that no critical issues are missing, and that Paths are correct	Compass, All
4:15	**Wrap Up & Next Steps** • Review outcomes, implications for Day 2 Agenda	Compass, All
4:30	***Close***	

Session 2: 5 October 2023.

Hybrid Meeting Info (in person attendance strongly recommended):

Microsoft Teams Link: Click here to join the meeting

Dial-in option: +1 437-703-5263,,591017970# (Meeting ID 591 017 970#)

Time	Item	Lead
9:00	**Welcome, Meeting Opening, Agenda Review, Day 1 Recap**	First Nations
9:30	**Decision Process Overview** • Review proposed process for evaluating potential changes to operations	Compass
10:45	***Break***	
11:00	**Developing Possible Solutions** • Outline process for developing first round of alternatives • Discuss draft operational changes to address Path 1 issues	Compass BCH
12:00	***Lunch***	
1:00	**Evaluating bookend alternatives** • Review draft Performance Measures (PMs) • Discuss approach to reviewing and revising PMs	Compass, All
2:30	***Break***	
2:45	**Evaluating bookend alternatives (continued)** • Review draft Performance Measures (PMs) • Discuss approach to reviewing and revising PMs	Compass, All
3:00	**Wrap up, Next Steps** • Seek approval of Terms of Reference, Priority Issues Memo • Discuss revised workplan and outline next steps	Compass
3:45	**Tier 1 (Nations-only) discussions**	First Nations
4:30	***Close***	

Alouette-Stave-Ruskin WUPOR-FAA

Issues Identification Outcomes – DRAFT FOR DISCUSSION PURPOSES

As described in the WUPOR-FAA ORAC Terms of Reference, the first step in the ORAC process is to review the implementation of the WUP Orders, identify any operation related issues that have arisen and identify any new operation related issues not considered during the original WUP. An issues list was developed which incorporated operational and non-operational items. The issue list was then further refined into a priority issues list of operational items which the ORAC will seek to resolve during the WUPOR-FAA process. This document describes the issues discussed to date by the ORAC participants and presents the outcomes of early discussions to develop the priority issues list.

Pathways to Issue Resolution

Issues identified by the ORAC Participants to date have been sorted into one of the following pathways:

- **Path 1.** [Priority Issue] The issue is within scope of the WUPOR-FAA and may be resolved through this process.
- **Path 2.** It is unclear if the issue is in scope or out of scope of the WUPOR-FAA. These issues may require further discussion to identify the most appropriate venue or approach for resolution.
- **Path 3.** The issue is outside of the scope of the WUPOR-FAA process.

Path 1 (Priority) issues will be the focus of the work of the ORAC and inform the development of alternatives (i.e., that include operational adjustments, other mitigations, and offsetting). Each alternative will be analyzed against a common set of evaluation criteria that reflect the core interests of ORAC participants and are in line with the WUP Objectives. These evaluation criteria (currently in draft) are provided in Table 1 below and will be discussed and further refined in the next ORAC meeting.

Table 1. Draft evaluation criteria for use in comparing alternatives.

Evaluation Criteria	Relevant Location(s)
Fish and Fish Habitat	
Availability of spawning and rearing habitats	South Alouette River, Lower Stave River
Alouette Sockeye Outmigration Success	Alouette Lake Reservoir
Stranding Risk	South Alouette River, Lower Stave River
Total Dissolved Gas (TDG) Risks	Lower Stave River
Entrainment	Alouette Tunnel
Flood Risk	South Alouette River
Protection of Cultural Heritage Resources	Alouette Lake Reservoir, Stave Lake Reservoir
Financial (including lost power generation and cost of monitoring programs, mitigation, off setting, etc.)	All locations
Aquatic Ecosystem Productivity	Stave Lake Reservoir
Recreation Access and Use	Alouette Lake Reservoir, Stave Lake Reservoir
Operational Flexibility	All Locations

Path 1 (Priority) Issues

- **Salmon, Steelhead and Trout spawning and rearing habitat availability (South Alouette River):** Salmon, Steelhead and trout habitat (both rearing and spawning habitats) is a core consideration for the mitigation of impacts to fish and fish habitat and for the Application for Authorization.

Operations that affect salmon, Steelhead and trout habitats include minimum flows on the South Alouette River through the Low Level Outlet and Spillway Operating Gate.[1] Flow-habitat studies on the South Alouette River will provide additional information to inform any recommendations for potential operational changes.

- **Salmon, Steelhead and Trout spawning and rearing habitat availability (Lower Stave River):** Salmon, Steelhead and trout habitat (both rearing and spawning habitats) is a core consideration for the mitigation of impacts to fish and fish habitat and for the Application for Authorization. Key concern is to minimize impacts to fish and fish habitat in the Lower Stave River during low inflow periods when it is challenging to meet Ordered Tailwater elevations at Ruskin Dam. Flow-habitat studies on the lower Stave River will provide additional information to inform any recommendations for potential operational changes.
- **Sockeye Outmigration (Alouette Lake Reservoir):** Sockeye smolt outmigration from Alouette Lake Reservoir occurs through the Spillway Operating Gate during the spring outmigration window (April to June) and is the only opportunity for Sockeye smolts to exit the reservoir to the South Alouette River. Reliably meeting this window is a priority issue for Indigenous Nations and stakeholders involved in this Order Review. Initial results from ongoing studies indicate that specific reservoir operations may contribute to the relative success of smolt outmigration.
- **Protection of Reservoir Cultural Heritage Resources (Alouette Lake Reservoir, Stave Lake Reservoir):** Concerns have been expressed by Indigenous Nations about impacts to cultural heritage resources in the Alouette and Stave Lake Reservoirs during periods of the year when reservoir elevations are low enough to enable access to, or cause erosion at, reservoir heritage sites. Maintaining higher reservoir elevations to protect cultural resources at times of the year when they are particularly vulnerable is an approach that will be considered during this process.
- **Reservoir Productivity (Stave Lake Reservoir):** Monitoring studies ordered for the Stave Lake and Hayward Reservoirs as part of the WUP indicated that opportunities may exist to improve littoral productivity (i.e., productivity along the reservoir's shallower edge) in Stave Lake Reservoir. While littoral productivity is important for reservoir fish populations, no effects were recorded in Stave Lake Reservoir as a result of changing reservoir elevations.
- **Fish entrainment through Alouette tunnel (Alouette Lake Reservoir):** The Alouette tunnel connects Alouette Lake and Stave Lake Reservoirs. BC Hydro passes water from Alouette Lake Reservoir to Stave Lake Reservoir to use for power purposes at Stave Falls Generating Station and Ruskin Generating Station. Passing this water also allows for more flexibility in controlling Alouette Lake Reservoir levels for recreation and downstream flooding mitigation purposes. Fish (e.g., Sockeye smolts), however, become entrained in the tunnel when it is used. Ongoing studies may provide some early insights into the extent and seasonality of the fish entrainment.
- **Security of Stave Lake cabin properties (Stave Lake Reservoir)**: Stave Lake cabin owners have voiced concern about periods of the year when reservoir elevations are low enough to enable mud bogging, which is disruptive (noise, garbage, large fires, damage to the land, etc.) and poses an increased security risk to owners' properties.

Path 2 Issues

- **Robustness of operations to changing weather patterns:** Over the past decade, inflow patterns in the Alouette and Stave watersheds have been changing, characterized by more variability in

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[1] *Because the existing infrastructure cannot provide flows above the ordered minimum, any recommendations for higher flows through Alouette Dam cannot be included in recommended changes to the Alouette-Stave-Ruskin Order resulting from the current process. However, BC Hydro is currently undertaking the Alouette Environmental Flow Discharge Upgrade Capital Project, which will replace the low-level outlet in the Alouette dam. The ARSRP recommended examining increased baseflows to support salmon restoration, so to support the capital project and due to the strong interest in salmon restoration in the Alouette, the ORAC will consider this priority issue.*

precipitation, with more extended or altered wet periods with higher inflows and more extended or altered dry periods with drought conditions. These periods of wetter-than-normal or drier-than-normal weather (e.g., fall of 2022) can make it difficult for BC Hydro to meet all of the requirements of the Orders simultaneously. This process will consider the effects of climate change on hydrological variability and where possible incorporate reasonable flexibility to manage operations within the bounds of the Orders under increasing climate uncertainty. At this point, it is unclear whether operational adjustments or other means of providing flexibility (e.g., how the Order requirements are described) will provide for more robust and reliable operations.

- **Protection of River Cultural Heritage Resources (Lower Stave River):** In addition to concerns about heritage resources in the reservoirs, there are also concerns about impacts to cultural heritage resources along the banks of the Lower Stave River downstream of Ruskin Dam. The ability of operational changes to manage erosion downstream of Ruskin Dam is not yet clear, though increased spilling frequency may potentially impact these sites.
- **Current and future Indigenous use and protection of cultural knowledge:** Reservoir access to enable current and future use by Indigenous community members (e.g., for cultural knowledge maintenance and education) is a priority concern for the Nations and has many components. Boat access, parking for vehicles, and road access for difficult-to-reach parts of the reservoirs are all mechanisms to support use by Indigenous communities for a variety of cultural purposes. However, the degree to which changes to operations could better support these uses is likely limited, and so other means will need to be discussed.

Path 3 Issues

- **Upstream Fish Passage (Alouette Lake Reservoir):** Salmon were able to migrate into Alouette Lake prior to construction of the Alouette Dam. Though BC Hydro currently supports a trap and transfer program for upstream migrating Sockeye, upstream fish passage to enable Sockeye Salmon and other species returning to the South Alouette River access to Alouette Reservoir is an important issue for many ORAC participants. The ongoing Alouette River Salmon Restoration Program (ARSRP) evaluates salmon restoration potential and options including upstream fish passage technologies, and so discussion of fish passage options as well as other salmon restoration options will continue to occur through that program.
- **Water use for FNs economic benefit:** The Provincial government sets mandates for initiatives such as revenue sharing, and BC Hydro has not received any direction on such a mandate. Other forms of economic benefits (e.g., service or supply agreements) are outside the purview of the WUPOR-FAA process.
- **Decommissioning of Alouette Generating Station:** Integrated Resource Planning evaluates the role of BC Hydro's generating facilities around the province to meet provincial and western North America electricity demands. Discussions of facility decommissioning are outside of the scope of this WUPOR-FAA and are instead part of engagement on the Integrated Resource Plan.

Next Steps

Once these issues and their respective pathways are confirmed and agreed to by the core ORAC participants, a first set of alternatives will be developed that seek to fully address each identified priority issue. As described above, these initial alternatives will be evaluated against the evaluation criteria identified in the Table 1 above and following rounds of analysis will seek opportunities to balance the benefits and drawbacks of these alternatives.

MEMO

To: Alouette-Stave-Ruskin WUPOR-FAA ORAC participants

From: Philip Halteman and Katie O'Donnell, Compass Resource Management

Date: 22 September 2023

Re: Alouette Stave Ruskin WUPOR-FAA Pre-Reading Material

This memo contains materials to help you prepare for our upcoming meeting on 4–5 October. This document and the agenda provide an overview of the meeting objectives and the flow of the topics for the two days. In addition to this memo, please review the Terms of Reference (TOR) and the Priority Issues Memo, which are appended.

Recap of the process so far

The ORAC Indigenous Nations and Regulators (ORAC-INR) table first met in October 2021 to discuss the proposed decision process for working through the Order Review, including the process objectives, scope, and ways to design the process to be more collaborative. In January 2022, the ORAC-INR table met to hear from the Nations about their respective high-level goals for this process and any preliminary direction on specific issues to begin working on. These meetings resulted in an expanded workplan and major revisions to the structure and content of the Draft Terms of Reference.

In the spring of 2022, the group met several times to explore and better understand the context and need for the process. In April, the group met with representatives of the Comptroller for Water Rights (CWR) to better understand the intended scope of this process, and also met to discuss an initial list of priority issues to be addressed through the WUPOR-FAA process. In May and June 2022, the ORAC-INR table met several times for a series of information sharing meetings, including a site visit to the Alouette-Stave-Ruskin (ASR) facilities. As part of these meetings, BC Hydro presented an overview of current ASR operations, as well as a summary of monitoring outcomes that highlighted many of the key lessons from monitoring and studies conducted during implementation of the Water Use Plans. In addition, all participants shared their perspectives on the range of issues related to operations of BC Hydro's facilities.

In September 2022, Compass and BC Hydro held one-on-one meetings with representatives from Matsqui First Nation and Leq'a:mel First Nation regarding the priority issues that will be addressed in this process and drafted an initial Priority Issues Memo, which identified the set of issues discussed up to that point and proposed a set of pathways for seeking resolution of the range of issues.

In February 2023, the ORAC Key Stakeholder (ORAC-KS) table met for the first time. The group reviewed the draft TOR and Priority Issues Memo and provided input. Participants also discussed the scope and schedule for the process, reviewed current ASR operations and outcomes of ASR monitoring studies.

In preparation for the October ORAC-INR and ORAC-KS workshops, Compass and BC Hydro have held several one-on-one meetings to discuss the updated process and schedule with participants, and to inform updates to the draft TOR and Priority Issues Memo.

Topics and objectives for this workshop

Day 1

Terms of Reference

Over the last year, we have updated the Terms of Reference (TOR) for this process to address feedback from ORAC participants. The latest draft is included as essential pre-reading material for this meeting (Document #1). In the first session on 4 October, we will be seeking agreement in principle on the TOR for this process. Please come prepared to engage in this discussion, and to propose constructive solutions for any outstanding concerns you identify.

Priority Issues

As described in the TOR, the first step in the ORAC process is to review the implementation of the WUP Orders, to identify any operations related issues that have arisen, and to identify any new operations-related issues not considered in the WUP. The Priority Issues Memo describes the issues discussed to date by the ORAC participants and presents the outcomes of early discussions to identify the issues the process will focus on (i.e., the priority issues, Document #2). In the second session on 4 October, we will review the Priority Issues and ask the group to confirm that all critical issues have been identified. These issues will inform the next step of the process, as described below. Please be prepared to share your perspectives.

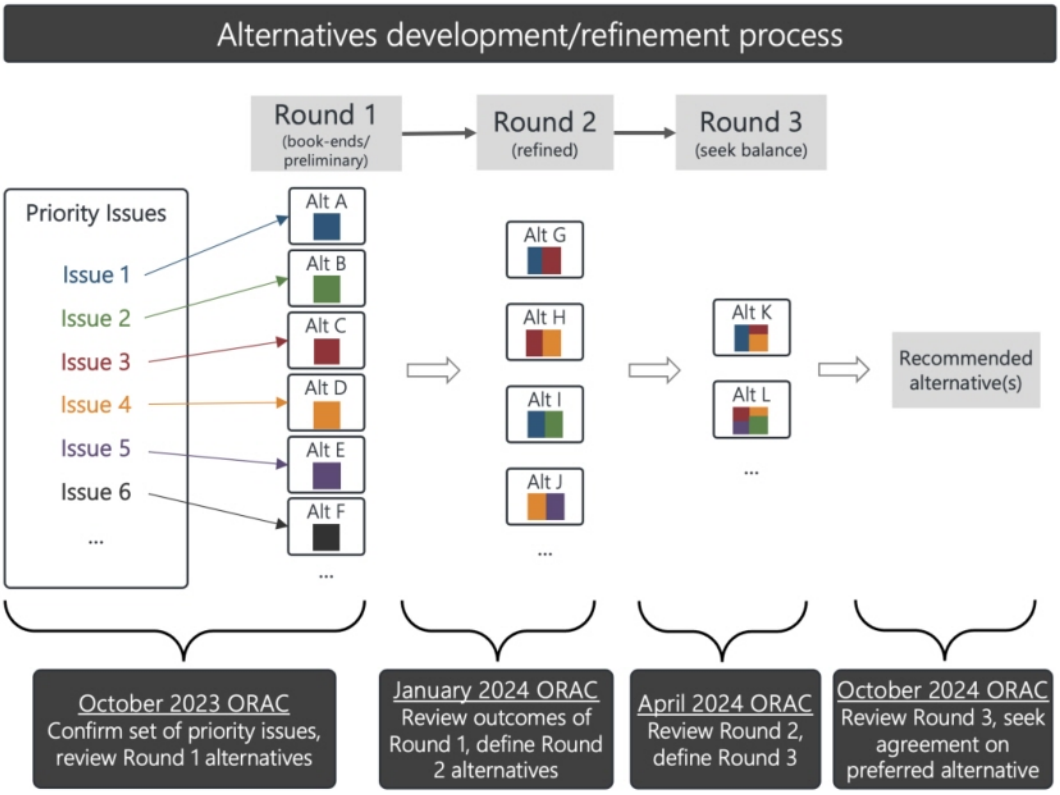
Day 2

Decision Process Overview

We will begin the second day by reviewing and walking through (in condensed form) the decision process described in the Terms of Reference. This review will cover the steps of the decision process and illustrate how the group will evaluate the different operational alternatives and consider their relative merits. To help prepare for this session, we have included a brief primer on Structured Decision Making (SDM, which this process is modelled on) with this pre-reading material (Document #3).

Developing Operating Alternatives from the Priority Issues

As discussed at previous meetings and described in the draft TOR, the core of this process is built around identifying potential operational changes to seek to resolve the priority issues identified. The intent of our October ORAC meeting is to describe the set of potential operational changes that will form the first round of alternatives we evaluate (see Alternatives development/refinement process diagram below). These first round "bookend" alternatives will do some things well and do some things very poorly (for example, one alternative may make improvements to reservoir productivity but cause extensive flooding impacts downstream). The intent of these alternatives is to learn how effectively operational changes can address the underlying issues, *not to propose that they are good solutions overall*. Over the next several ORAC meetings, we'll look at what those solutions do well and what they do poorly and begin to mix and match elements of each to find a better balance among the interests of the group.



Evaluating Bookend Alternatives

In the final session of the October meeting, we will review the draft Performance Measures (PMs), which are the metrics we will use to evaluate how well the alternatives address the interests of the group. The primary intent for this session is to identify (a) how well the draft Performance Measures capture the interests they are intended to represent, and (b) in what ways the PMs can be improved. Preliminary details about each draft PM have been documented in the Performance Measure Information Sheets (PM Info Sheets) included in the pre-reading material (Document #4). These will be revised with input from this group as necessary through a series of technical meetings in coming months to better tailor the PMs to the interests of the group.

Pre-Reading Summary

The pre-reading materials are designed to help participants come prepared to discuss the topics above. In addition to this memo, participants should review the following documents in order to be prepared to engage productively at the workshop:

1. **Draft Terms of Reference**, which outlines the context and scope for the WUPOR-FAA process and outlines a process for working toward agreement on the key decision facing the group.
2. **Draft Priority Issues Memo**, which describes the range of issues discussed by the group to date and identifies which issues the process will focus on.
3. **SDM Primer (optional reading)**, which describes in detail the structured decision making process on which the proposed decision process is modelled.
4. **Draft PM Info Sheets (optional reading)**, which detail the values and interests the Performance Measures are intended to capture, and how they are calculated.

Figure 1. Draft Process Schedule for Alouette-Stave-Ruskin WUPOR & FAA

Date	Anticipated key tasks	ORAC Meetings: First Nations	ORAC Meetings: Regulators	ORAC Meetings: Key Stakeholders	What we'd do in the meeting	What you'd need to do to prepare
Setup and Issues Identification - COMPLETE						
Jul-Sept 2022	*FN Priority Issues Identification*	Distribute Issues Workbook to FNs				
Sept 2022	*Identify priority issues*	Nations and Regulators Meeting (Priority Issues & TOR)			Confirm a set of priority issues (including what is in/out of scope), discuss the revised Terms of Reference, and discuss development of Alternatives	Complete the Priority Issues workbook and be prepared to discuss; Review the draft TOR and provide feedback to Compass regarding changes/edits that are needed in order to adopt the TOR.
Feb 2023 (1 day)	*Share issues*		Key Stakeholders Meeting (Priority Issues & TOR)		Meet with identified stakeholders to 1) explain process; 2) brief on status of issues identified to date, and 3) seek input on local stakeholder issues	Read the workshop pre-read sent by Compass that will describe the process and status of the issues. Optional attendence for Regulators and First Nations.
Alternatives Analysis - Specifics be developed collaboratively with First Nations						
Oct 2023 (1 day)	*Confirm Priority Issues Review Round 1 alternatives Confirm Workplan*	**Nations and Regulators Meeting** (Alternatives Analysis Rd 1)			Confirm Priority Issues for process. Review proposed Round 1 (bookend) alternatives and draft PMs. We will discuss as a group, confirm Round 1 alternatives, and agree to workplan.	Read the workshop pre-read sent by Compass that will describe the Priority Issues and the outcomes of Round 1 alternatives.
Oct 2023 (1 day)	*Confirm Priority Issues Review Round 1 alternatives Confirm Workplan*		**Key Stakeholders Meeting** (Alternatives Analysis Rd 1)		Provide further input on Priority Issues for process. Review proposed Round 1 (bookend) alternatives and draft PMs. We will discuss as a group, confirm Round 1 alternatives, and agree to workplan.	Read the workshop pre-read sent by Compass that will describe the Priority Issues and the outcomes of Round 1 alternatives.
Nov-Dec 2023 (half days)	*Refine PMs*	**Technical subgroup meetings**			We will hold 4 TSG meetings to further refine PMs: (1) Fish Habitat; (2) Cultural Heritage, Flooding, Recreation; (3) Other fish PMs; (4) Incorporating Climate Change	If you are participating on any TSGs, attend the relevant technical workshops.
Jan 2024 (2 days)	*Review Updated PMs & Rd 1 Alternatives Identify Round 2 alternatives*	**Nations and Regulators Meeting** (Alternatives Analysis Rd 1)			Discuss the outcomes of Round 1 and define alternatives to model in Round 2.	Read the workshop pre-read sent by Compass that will describe outcomes of Round 1 alternatives. Be ready to provide suggestions for alternatives to model in Round 2.
Feb 2024 (tbd)	*Refine PMs (if necessary)*	Technical subgroup meetings (as needed)			TSG meetings as needed to further refine PMs or to address other technical topics	If you are participating on any TSGs, attend the relevant technical workshops.
Apr 2024 (2 days)	*Review Rd 2 Alternatives Identify Round 3 alternatives*	**Nations and Regulators Meeting** (Alternatives Analysis Rd 2)			Discuss the outcomes of Round 2 and define alternatives to model in Round 3.	Read the workshop pre-read sent by Compass that will describe outcomes of Round 2 alternatives. Be ready to provide suggestions for alternatives to model in Round 3.
Apr 2024 (1 day)	*Review Rd 2 Alternatives Identify Round 3 alternatives*		**Key Stakeholders Meeting** (Alternatives Analysis Rd 2)		On a parallel track, second meeting with invited stakeholders to bring them up to date with developments and to seek further input.	Read the workshop pre-read sent by Compass that will describe outcomes of Round 2 alternatives. Be ready to provide suggestions for alternatives to model in Round 3. Optional attendence for Regulators and First Nations.
Jun 2024 (1 day)	*Discuss monitoring plans and offsetting approaches*	**Technical subgroup meeting**			Discuss monitoring plans, offsetting approaches, other physical works, and related topics.	If you are participating on any TSGs, attend the relevant technical workshops.
Oct 2024 (2 days)	*Review Round 3 alternatives and seek agreement on a preferred operational alternative*	**Nations and Regulators Meeting** (Alternatives Analysis Rd 3)			Discuss the outcomes of Round 3 alternatives; Compass will seek to identify a preferred alternative that all ORAC members can support.	Read the workshop pre-read sent by Compass that will describe outcomes of Round 3 alternatives. Seek input from your community as required, and be prepared to provide a formal level of support for the alternatives.
Dec 2024 (1 day)	*Finalize monitoring plans and offsetting approaches*	**Nations and Regulators Meeting** (Alternatives Analysis Rd 3)			Finalize monitoring plans, offsetting approaches, and other physical works.	Read the workshop pre-read sent by Compass that will describe outcomes of Round 3 alternatives. Seek input from your community as required, and be prepared to provide a formal level of support for the alternatives.
Recommendations						
Jan 2025 (1 day)	*Review and amend draft report*	**Nations and Regulators Meeting** Recommendation Review			Discuss feedback received on Compass's draft report - Resolve any outstanding issues.	Read the draft report and be prepared to discuss. Is the report fair, and does it adequately capture areas of agreement? Are any changes required? Provide written feedback on the draft report, if desired.
Jan 2025 (1 day)	*Review and amend draft report*		**Key Stakeholders Meeting** Recommendation Review		Discuss feedback received on Compass's draft report - Resolve any outstanding issues.	Read the draft report and be prepared to discuss. Is the report fair, and does it adequately capture areas of agreement? Are any changes required? Provide written feedback on the draft report, if desired. Optional attendence for Regulators and First Nations.
Mar 2025 (1 day)	*Review and seek endorsement of final report*	**Nations and Regulators Meeting** Recommendation Review			The group will meet a final time to review and discuss the final report. Assuming the final draft meets expectations, participants will be asked to formally endorse the report.	Read the final report, and seek input from your community as required. Participants will be asked to formally support the report at the September meeting.

Terms of Reference – DRAFT

Order Review Advisory Committee
Alouette-Stave-Ruskin
Water Use Plan Order Review and Fisheries Act Authorization

Last Updated: September 21, 2023

Contents

Note to the reader:

This Terms of Reference is meant to be a living document that captures the current approach to collaborative planning for the Alouette-Stave-Ruskin Water Use Plan Order Review and Fisheries Act Authorization process. Because the process is evolving over time and its participants are learning and building capacity for this work, this TOR will be updated to reflect new lessons learned and recent developments.

Order Review Advisory Committee

An Order Review Advisory Committee (ORAC) with representatives from Indigenous Nations, regulators, local municipalities, environmental non-profits, objector status stakeholders, special interest stakeholders, and BC Hydro has been formed to support the Alouette, Stave, Ruskin Water Use Plan Order Review and application for *Fisheries Act* Authorization (WUPOR-FAA) Project. The ORAC consists of an Indigenous Nations and Regulators Table and a Key Stakeholder Table.

The objectives of the ORAC are to review the implementation the Alouette and Stave-Ruskin WUP Orders and FAAs, identify priority issues, and make recommendations for issues resolution. The ORAC will participate in a collaborative process facilitated by a third-party facilitator to work toward a set of agreed upon recommendations for the Alouette, Stave, Ruskin System.

How We Plan to Work Together

This Terms of Reference (TOR) will provide the ORAC with guidance for how to complete the work ahead. The TOR provides direction on three topics:

- **Scope of the work:** A description of the scope of the WUPOR-FAA process, what advice and recommendations the ORAC is being asked for, and how that advice is intended to be used.

- **Participation and responsibilities**: The groups (e.g., Nations, organizations, etc.) that will be involved, what form that involvement will take for each group, and what responsibilities come along with that involvement.

- **Process to work toward consensus:** What process the ORAC will use to work toward agreement, including what principles guide the group's approach; how the group will build common understanding of the issues, develop creative solutions for those issues, and seek consensus on which solution provides the best balance across what's important to the group; and what will happen if the group can't reach consensus.

Water Use Plan Order Review and Application for *Fisheries Act* Authorization: What is it, and why now?

At the direction of the Province, BC Hydro undertook Water Use Planning for its hydroelectric facilities across the province. Through a collaborative process, with input from Indigenous Nations, regulators, stakeholders, local government, and the public, twenty-three Water Use Plans were developed.

The Water Use Plans for the Alouette and Stave-Ruskin watersheds were developed in 1996 (updated in 2009) and 2003 respectively. These plans recommended operational changes and monitoring studies to achieve a better balance between competing water uses in those watersheds. The Water Use Plans were reviewed and accepted by the Comptroller of Water Rights and were implemented through *Water Act* (now *Water Sustainability Act*) Orders ("Orders"). These Orders imposed various changes to BC Hydro's operations as recommended in the WUPs and required BC Hydro to complete several monitoring studies to determine if the operational changes achieved the intended benefits.

Following this, *Fisheries Act* Authorizations (FAAs) were issued by Fisheries and Oceans Canada (DFO) for the Alouette and Stave-Ruskin facilities in 2010. The FAAs authorized impacts to fish and fish habitat resulting from project operations and maintenance, provided BC Hydro operated its facilities in accordance with the Orders. The FAAs were given expiry dates tied to the anticipated review of the Orders. The Alouette and Stave-Ruskin FAAs expire in 2028.

The next step in the Water Use Planning process is to conduct a review of the Orders for the Alouette and Stave-Ruskin watersheds. As requested by the Comptroller of Water Rights (CWR) and referenced in the Alouette WUP and the Stave-Ruskin Consultive Committee report, this Order Review will seek to combine the Alouette and Stave-Ruskin Orders into one integrated Order for the system.

As the FAAs point to the Ordered operations and are set to expire in 2028, BC Hydro plans to apply for a new, integrated FAA for the Alouette-Stave-Ruskin system. BC Hydro will develop and consult on their Application for Authorization (AfA) under the *Fisheries Act* concurrently with the WUPOR process.

WUPOR-FAA Process and Scope

The scope of the WUPOR-FAA process is shaped by the legislation that governs the Orders and the FAAs, which include the BC *Water Sustainability Act* and the federal *Fisheries Act* respectively. Through the WUPOR-FAA process, the ORAC will collaboratively develop a set of recommendations that will inform the development of BC Hydro's application to amend the Order and their Application for Authorization (AfA) under the *Fisheries Act*. This involves:

- Review Order implementation and associated monitoring study outcomes to determine if the intended WUP benefits were achieved,
- Identify priority issues related to Order implementation, outcomes of the monitoring studies, or any new operations-related issues that have arisen,
- Work through a collaborative process toward resolution of the identified priority issues, and
- Make recommendations based on the outcomes of the process.

As this process will work to combine the Alouette and Stave-Ruskin Orders, an application for an integrated Order for the system will be made to the Comptroller of Water Rights. This application may include additional recommended changes to operations (depending on the outcome of the process) for the Comptroller's review and consideration. The Comptroller will consult on BC Hydro's Order amendment application following submission.

Following submission of the Order amendment application to the CWR, an AfA for a new, integrated FAA for the Alouette-Stave-Ruskin system will be submitted by BC Hydro to DFO for review and consideration. DFO will conduct their own consultation on the application as per their fiduciary obligation to affected Indigenous groups.

Following this WUPOR-FAA process, should conditions change substantially on the system (for example, changes to infrastructure that affect Ordered operations, or new information is brought forward that trigger a review of an ordered operation), changes to operations will be reviewed and considered. This review may result in a recommendation for amendment to the existing Order and/or FAA for consideration and decision by the statutory decision maker. The process for considering operational changes and requesting amendments will be outlined by BC Hydro (in accordance with the governing acts) and will be reflective of the magnitude of the changes being contemplated.

ORAC Decision Scope

There are two core decisions to be made by the ORAC:

- The first is about whether adjustments to operations or operating priorities for the Alouette-Stave-Ruskin system (or minor physical works in lieu of operational changes) can be made to resolve identified priority issues.
- The second is about what other actions could be taken to monitor, mitigate, or offset impacts to fish and fish habitat related to the operation and maintenance of the Alouette, Stave, Ruskin facilities.

The outcomes of these decisions will result in a list of recommendations that will be provided to BC Hydro in an ORAC report for consideration. The recommendations may include proposed changes to operations, proposed minor physical works in lieu of operational changes, other mitigations to address impacts to fish and fish habitat, and/or monitoring studies to resolve outstanding questions or information gaps related to operations. The ORAC report will be appended to BC Hydro's application under the *Water Sustainability Act* to combine the Alouette and Stave Ruskin Orders. This application may make recommendations for changes to BC Hydro's Ordered operations for the system depending on the outcome of the process. The Comptroller of Water Rights is the statutory decision maker for this application.

Following the Order application submission to the Comptroller of Water Rights, BC Hydro will submit the AfA to DFO for review, consultation, and decision.

Who Will be Involved and How?

This process will have two ORAC tables where issues will be identified, potential solutions developed, and alternatives discussed (See Appendix 1 for list of participants).

The Indigenous Nations and Regulators Table will include representation from Indigenous Nations (Katzie [tentative], Kwantlen, Matsqui, and Leq'a:mel – participation from the Indigenous Nations will occur as they are willing and able), the Province (Ministry of Water, Land, and Resource Stewardship), Fisheries and Oceans Canada (DFO), and BC Hydro (See Appendix 1 for a detailed list of participants). This table will meet regularly and work through a fulsome assessment of issues and potential resolutions following the decision process outlined below. This table, together with local municipalities from the Key Stakeholder Table, will develop a set of recommendations that will be provided to BC Hydro for consideration.

In keeping with the mandates of BC Hydro and the provincial and federal governments to advance reconciliation with Indigenous peoples and support the principles of UNDRIP, working toward consensus recommendations from this process is a key component of seeking the Free, Prior, and Informed Consent of First Nation communities on a *Water Sustainability Act* Order and a new *Fisheries Act* Authorization.

It's important to acknowledge that participating Indigenous Nations have the responsibility to make decisions in the interests of their community members, and in accordance with Indigenous Nation-specific laws and governance customs (e.g., laws relating to land codes), as well as traditional laws.

The Key Stakeholder Table will include representation from local municipalities, local environmental non-profits, objector status stakeholders and special interest stakeholders. Input from this table will be sought at several critical points in the process, including (a) on a list of draft priority issues for the process, (b) on a short-list of refined alternatives, and (c) on a draft ORAC summary report prepared by the facilitator. Input from this table will be brought to and discussed by the Indigenous Nations and Regulators Table for incorporation into the process. Local municipalities will also participate in some additional meetings throughout the process and will participate in the development of recommendations.

Process for Working Toward Agreement

Principles

The following principles will guide the WUPOR-FAA process and the interactions of ORAC participants:

- Recognize and support the profound and distinct connections that Indigenous peoples have with the watersheds and the stewardship responsibilities that accompany those connections;
- Recognize and respect the interconnectedness of all beings (including waters, land, fish, and people);
- Maintain transparency and honesty in communication;
- Strive for consensus and work to find areas of agreement;
- Respect each others' mandates, decision-making authorities, and scope; and
- Respect existing legal and constitutional rights and responsibilities.

Decision Process

The work of the ORAC to develop its recommendations will focus in three main areas, and will be iterative (that is, the steps will be repeated as needed):

1. The group will **identify priority issues** of the groups at the table (i.e., what issues need to be resolved), and the underlying values that these concerns represent (i.e., why these issues are important to resolve). The group will discuss all of the priority issues and agree on which issues fall within and outside of the scope of the WUPOR-FAA process. For issues that the group agrees fall outside of the scope of this process, appropriate venues will be identified where these issues can be resolved.
2. The group will openly **explore, discuss, and propose creative alternatives** for operational adjustments, physical works or studies to address in-scope issues.
3. The group will talk directly about the relative merits of the options at hand and work to **find and build consensus around operations that strike an acceptable balance** across all the important values.
4. The group will work toward a set of **co-developed recommendations** to support BC Hydro's WUPOR and FAA applications.

If consensus cannot be reached in the ORAC process, the level of support for all remaining alternatives will be documented along with the specific areas of agreement and disagreement. BC Hydro will then decide on what recommendations to include in their submissions to the regulators.

Meeting Guidelines

The ORAC will meet every few months to work through the decision process described above. The following guidelines will provide structure for these meetings:

- When possible and practical, the ORAC will prioritize meeting in person and on the land.
- Time will be provided before and after ORAC meetings for Indigenous Nations to talk to each other without BC Hydro, regulators, and facilitators (unless specifically requested).
- Responsibilities of ORAC participants include:
    - bringing relevant concerns to the meeting,
    - representing interests of their respective community/organization,
    - coming prepared to engage in discussion items on the agenda,
    - actively seeking areas of agreement with other ORAC participants, and
    - holding each other accountable to this Terms of Reference and the spirit of the process.
- The facilitator is responsible for:
    - ensuring that the principles, decision process, and meeting guidelines as described in this document are adhered to,
    - providing structure to and otherwise supporting the group's efforts to find areas of agreement and work through areas of disagreement,
    - providing relevant material ahead of meetings in a timely fashion to ensure participants have time to prepare themselves for the meetings, and
    - documenting the process and its outcomes in a fair and neutral manner.

Appendix 1 – WUPOR-FAA Process Membership List

Indigenous Nations & Regulators Table

Organization	Representative(s)
BC Hydro	Leanne Todd
Fisheries and Oceans Canada	Daniel Sneep Maria Sotiropolous
Katzie First Nation (tentative)	Rick Bailey Kimberly Armour
Kwantlen First Nation	Drew Atkins
Leq'a:mel First Nation	Stephen McGlenn Justin Laslo
Matsqui First Nation	Chief Alice McKay Cindy Collins
BC Ministry of Water, Land, and Resource Stewardship	Shannon Harris

Key Stakeholder Table

Organization	Representative(s)
BC Hydro	Leanne Todd
City of Mission	Kyle D'Appolonia Tracey Pagenhardt
City of Pitt Meadows	Jackie Kloosterboer
City of Maple Ridge	Forrest Smith
BC Parks	Daris LaPointe
Alouette River Management Society (ARMS)	Greta Borick-Cunningham Ken Stewart John Kelly
Stave Lake Cabin Owners	Noreen Beauvais, Stephen Amsing, Tracy Kutny, Lynda Wallace
Stave Lake Boaters	Andy Sutcliffe

Process Observers and Technical Support (TBC)

Organization	Representative(s)
BC Hydro	Joanna Glawdel, Operations Engineer
BC Hydro	Julian Gonzalez, Indigenous Relations
BC Hydro	Emily Thwaites, Community Relations
BC Hydro	Ryan Whitehouse, Environment – Fish and Aquatics

Appendix 2 – Process Workplan