Meeting #5

Regular Update

Study 9.11

Fish Passage Feasibility at Watana Dam

December 3, 2014

Welcome and Overview of the Meeting

- Introductions
- Agenda Review
- Purpose

- Meeting Handouts
  - Agenda
  - This presentation
  - Evaluation criteria description and example matrix
  - Biological Performance Tool description
  - Meeting attendance list

Purpose of the Meeting #5

- Regular check in, working meeting
- This meeting and the January meeting have been moved from our original plan to accommodate the ISR meeting obligations for all parties. No decisions will be made at this meeting and the goal is to prepare for Workshop #3 in March.
- R2/MWH work since the Workshop #2 meeting has been focused on:
    - Organizing concepts from brainstorm session to prepare for the March Workshop #3.
    - Development of draft evaluation criteria
    - Preparation of a draft evaluation matrix
    - Development of BPT specific to address alternatives

Review of Previous Meeting Notes And Action Items

- **September 18-19, 2013 Meeting #4 Site Tour Notes**
- **September 9-11, 2014 Workshop #2 Brainstorm Notes**
- **Summarize remaining action items**

Brainstorm Concept Organization

Tally of Ideas

Brainstorming Results
Tally of Upstream Components from Brainstorm Workshop #2

Result of Brainstorm Workshop Components	Priority 1	Priority 2	Deferred	Total 1,2, Deferred	Supplemental/ Features	
					S	F
Collection Location	8	4	6	18	0	0
Collector Entrance	10	2	1	13	1	0
Attraction Flow Source	9	3	5	17	2	0
Attraction Flow Volume	3	0	0	3	0	0
Attraction	0	0	0	0	2	0
Barrier Types	2	1	6	9	5	0
Sampling/Sorting	0	0	0	0	0	12
Upstream Passage	9	5	7	21	2	0
Strategy/Criteria	2	0	0	2	0	0
Exit Structure	8	0	1	9	3	0

Brainstorming Results
Tally of Downstream Components from Brainstorm Workshop #2

Brainstorming Results Workshop Components	Priority 1	Priority 2	Deferred	Total 1, 2, Deferred	Supplemental/ Features	
					S	F
Collection Site	8	0	0	8	0	0
Downstream Collection	21	2	4	27	9	0
Downstream Conveyance	1	1	1	3	2	6
Attraction	1	0	0	1	0	0

Upstream Passage

ACTIONS:

- Priority 1 & 2 Components – Develop for Workshop #3 (March 2015)
- Deferred Components

Proposed Grouping

Brainstorming Results – Upstream Passage

Proposed Grouping – Upstream Collection, Upstream Passage, Exit Structure

Subcategory Components	Priority 1	Priority 2	Deferred	Total 1,2, Deferred	Supplemental/ Features	
					S	F
Upstream Collection	**34**	10	18	62	10	12
Collection Location	8	4	6	18	0	0
Collection Entrance	10	2	1	13	1	0
Barrier Types	2	1	6	9	5	0
Sampling/Sorting	0	0	0	0	0	12
Attraction	0	0	0	0	2	0
Flow Source	9	3	5	17	2	0
Flow Volume	3	0	0	3	0	0
Strategy/Criteria	2	0	0	2	0	0
Upstream Conveyance	9	5	7	21	2	0
Upstream Exit (Exit Structure)	8	0	1	9	3	0

Grouping Detail

Brainstorming Concepts – Upstream Passage
Upstream Collection – Priority 1 & 2 - Collection Location (1 of 3)

Components	List #	Priority	Description
Collection Location			
Tsusena Creek (nature like entrance)	1	1	A high gradient stream not currently used by Spring Chinook. It is used by Grayling. Requires a barrier and attraction flow from mainstem, somewhere upstream. This creek is just below the dam. Example from Graham Hill, built side-channel ½ mile long. Example noted was mainly for coho, 80' head. Similar on Tualatin, bypass a water fall. Could be used as a phased component during construction.
Tsusena Creek (constructed fishway entrance)	2	1	A high gradient stream not currently used by Spring Chinook. It is used by Grayling. Simlar to #1, but with a constructed weir entrance. Could be used as a phased component during construction.
Fog Creek (nature like entrance)	3	1	See list #1. Could be used as a phased component during construction.
Fog Creek (constructed fishway entrance)	4	1	See list #2. Could be used as a phased component during construction.
At Powerhouse: Right, Left, collection channel	6	1	Conventional dam entrance.
At new barrier (where appropriate, at bridge?)	8	1	Goal of idea is more focused attraction flows to fishway entrance. Could be used as a phased component during construction.

Brainstorming Concepts – Upstream Passage
Upstream Collection – Priority 1 & 2 - Collection Location (2 of 3)

Components	List #	Priority	Description
Collection Location			
At new barrier (where appropriate, at bridge?)	8	1	Goal of idea is more focused attraction flows to fishway entrance. Could be used as a phased component during construction.
Sluice tunnel through dam. **Submerged lock, would need gates. Utilize dewatering tunnel.**	12	1	Duncan Dam, gated low leve l port used as a lock. Used for ~30 years. 500 to 1,000 bull trout over last 30 years. This idea was focused on collecting burbot. Could be a supplement to chinook goals. COULD RECLASIFY AS SUPPLEMENTAL ENTRANCE FOR DEEP MIGRATING SPECIES
Deep intake below turbine outfall	13	1	This idea was focused on collecting burbot. Could be a supplement to chinook goals. COULD RECLASIFY AS SUPPLEMENTAL ENTRANCE FOR DEEP MIGRATING SPECIES
Diversion bypass ~~channel~~ tunnel outlet	11	2	Use of diversion tunnel for location/entrance. Could be used as a phased component during construction.
Downstream of dam on bank (left, right)	14	2	This is possibly redundant with # 8. It could be possible to characterize with auxiliary entrances with #6. Intent is a conventional ladder entrance. Located at a location downstream. Could use if fish shown to accumulate downstream.

Brainstorming Concepts – Upstream Passage
Upstream Collection – Priority 1 & 2 - Collection Location (3 of 3)

Components	List #	Priority	Description
Collection Location			
Mobile feature (can be relocated)	15	2	This is a floating fish trap in tailrace with pumped attraction water at the entrance. It may function as an auxiliary entrance. Example is Cabinet Gorge, bull trout floating collector (it sunk). Movable or fixed.
Fishwheel	17	2	Could be a phased or temporary feature, or a feature used during construction.

Brainstorming Concepts – Upstream Passage
Upstream Collection – Defer – Collection Location

Components	List #	Priority	Comments
Collection Location			
Upstream of Portage Creek	5	Defer	Fatal Flaw: Lose existing Chinook salmon habitat. Potential to move unintended fish. Too far downstream.
At natural barrier: Impediment 1 or Impediment 3	7	Defer	Fatal Flaw: Lose existing Chinook salmon habitat. Potential to move unintended fish. Too far downstream.
At dam	9	Defer	Redundant with #6
Collection channel at dam	10	Defer	Redundant with #6
Boat & Anglers	16	Defer	Better options available, low efficiency, fish handling impacts, unknown success rate with chinook, not feeding.
Dip net fishery	18	Defer	Better options available, low efficiency, fish handling impacts. Site specific performance.

Brainstorming Results – Upstream Passage

Upstream Collection– Priority 1 & 2 – Collector Entrance (1 of 2)

Components	List #	Priority	Description
Collector Entrance			
Creek	20	1	It is Co-located with a tributary. Can be a water source option. Limited to existing creeks.
Deep portal	21	1	Goal for deep oriented fish (burbot).
Orifice	22	1	
Vertical slot, submerged weir	23	1	
Natural bedrock – nature-like entrance shape	24	1	Shape, texture, and flow conditions affect location of this component.
Hourglass entrance	25	1	This is an advanced version of a vertical slot entrance.
Multi-level entrance	26	1	
Adjustable gate to track water surface	27	1	An adjustable gate with a floating mechanism; it is typically used in collection channels.
Draft tube entrance	29	1	Using draft tube with cycling with unit to attract deep oriented fish. Manual or automated salvage operation at a specified frequency. Include idea of emulating draft tube, from experience with turbines sitting idle for a period of time.

Brainstorming Results – Upstream Passage

Upstream Collection– Priority 1 & 2 – Collector Entrance (2 of 2)

Components	List #	Priority	Description
Collector Entrance			
Tailrace barrier	30	1	MOVE TO SUPPLEMENT/FEATURE, NOT STAND ALONE FISH COLLECTION DEVICE
Shallow weir	19	2	Could be used as an exclusion means for pike, non-jumping species.
Scoop (fishwheel)	28	2	

Brainstorming Results – Upstream Passage
Upstream Collection – Defer – Collector Entrance

Components	List #	Priority	Comments
Collector Entrance			
Volitional fish intake	32	Deleted (Moved to Defer)	This is not a unique entrance type, and it will be addressed with other components.

Brainstorming Results – Upstream Passage
Upstream Collection – Supplement – Collector Entrance

Components	List #	Priority	Comments
Collector Entrance			
Lamprey friendly features	31	Supplement	Lamprey have not been observed in Upper River to date. Confirm won't impact other species (it likely won't based on today's knowledge). I.e., rounded corners, no wall-to-wall diffusers, no slot guides, etc.

Brainstorming Results – Upstream Passage
Upstream Collection – Priority 1 & 2 - Collection Entrance (Barrier Types)

Components	List #	Priority	Description
Barrier Types			
Another dam: fixed, rubber	57	1	This would be a separate barrier dam located downstream from the Watana Dam.
Watana Dam	56	1	
Picket weir	58	2	Operation of a picket weir would be limited to open-water (ice-free) flow period in river. Includes fixed or floating type weirs. FEATURE TO CONSIDER DURING CONSTRUCTION.

Brainstorming Results – Upstream Passage
Upstream Collection – Defer – Collection Entrance (Barrier Types)

Components	List #	Priority	Comments
Barrier Types			
Existing impediment/velocity barrier	68	Defer	This will result in loss of existing Chinook salmon habitat. Or movement of unintended fish into other habitats. Too far downstream.
porous weir/embankment	67	Defer	This component not feasible in a river of this scale.
louvers	66	Defer	Maintenance, scale, debris, and ice are concerns for this component. It is not reliably an exclusionary screening facility. Defined as a picket lead. Idea is captured with use of diffusers for AWS, or attraction water.
rotating screen	65	Defer	This component would be difficult to implement due to the size/flow of the river.
behavioral (strobe/lights/bubble curtain/scents/acoustic)	60	Defer	This is not proven to be reliable as a primary barrier, or enhancement. It is not predictable. Could be revisited as a retrofit type supplemental.
electrical	59	Defer	This technology is classified as experimental by NMFS. There are wildlife impact concerns, a power source to the tributaries is problematic, and a concern for reliability. Could be revisited as a retrofit type supplemental.

Brainstorming Results – Upstream Passage

Upstream Collection – Supplemental – Collection Entrance (Barrier Types)

Components	List #	Priority	Comments
Barrier Types			
draft tube stop logs	92	Supplemental	
floating picket	64	Supplemental	Could be considered during construction
draft tube barrier	63	Supplemental	
submerged directional features	62	Supplemental	Cofferdam remnants, directed flow, rocks, etc. Includes guidance characteristics of hydraulic features, such as barrier dams to guide, end wall of stilling basin, etc. Faraday example, berms to pinch river, help guide fish. Hanford reach constructed gravel spur dikes to guide fish, historical. East coast native fisheries, more typical to shallow river.
submerged guide wall for burbot	61	Supplemental	Engineered wall

Brainstorming Results – Upstream Alternatives

Upstream Collection – Consideration/Feature – Collection Location (Sampling Sorting)

Components	List #	Priority	Comments
Sampling/Sorting			
Batch vs continuous	107	Consideration/ Feature	
Count windows	108	Feature	
Performance tracking	109	Feature	
Monitoring trap	110	Feature	
Species sorting	111	Feature	
Monitoring facility	112	Feature	
Video monitoring facility	113	Feature	
Size grading	114	Feature	
Electronic sorting	115	Feature	
Predator separator	116	Feature	
Phased implementation	117	Feature	
Sorted fish fate & transport	118	Feature	

Brainstorming Results – Upstream Alternatives
Upstream Collection – Priority 1 – Attraction

Components	List #	Priority	Comments
Attraction			
Coffer dam remnant used Upstream	93	1	Collaborate on design for construction dewatering and fish passage. Could guide towards entrance. Coffer Dam ~100ft. Has been problematic in Columbia.

Brainstorming Results – Upstream Alternatives
Upstream Collection – Supplemental – Attraction

Components	List #	Priority	Comments
Attraction			
Directed flow	33	Supplemental	Use of flow, not a source. Turbulence or circulation. Possible from many potential sources. Mixer pumps may create flow. Low head pump used to create flow, flygt pump. Ex: Thompson Falls (jet augmentation).

Brainstorming Results – Upstream Alternatives

Upstream Collection – Priority 1 & 2 –Attraction Flow Source (1 of 2)

Components	List #	Priority	Description
Attraction Flow Source			
Turbine discharge	34	1	Direct from draft tubes. Temperature will be dependent on turbine intake design.
Outlet valve discharge	35	1	Tap off the tube, easier than use of cone valve. Cone valve sprays above water surface. Depending on configuration. Will pass temperature of water based on inlet elevation.
Low-head, electric Pumps	36	1	Will be used for supply of auxiliary water. Low head pumps in tailrace. Temp is same as tailrace.
Spillway flow	40	1	Will maintain this idea for use with other components, not a primary use as operational scenarios don't spill.
Fish turbine, **dedicated fish attraction flow**	41	1	This would be a power producing turbine, specific for fish passage, or a fish attraction flow source.
Gravity flow	42	1	Simple design, could be incorporated into any alt. Also as use for backup water. Energy dissipation must be considered.
Turbine pumps	43	1	A small amount of water is utilized to power a pump. Can use drive water for AWS water.
Susitna Upper River water	50	1	Upstream water is important source for homing fish. Key requirement of all upstream passage system.
Dewatering flow from other components	51	1	This source is potentially available from downstream passage components.

Brainstorming Results – Upstream Alternatives

Upstream Collection – Priority 1 & 2 –Attraction Flow Source (2 of 2)

Components	List #	Priority	Description
Attraction Flow Source			
Tributary flows	38	2	The location is from a specific source. Potentially use spawning stream water as attraction flow.
Bypass tunnel	39	2	It would be co-located with the dam spillway. Secondary priority due to more practical alts. MAY BE OPTION DURING CONSTRUCTION.
Natural attraction	45	2	No auxiliary flow associated with this component. MOVE TO DEFERRED. WON'T MEET NMFS CRITERIA, WON'T FUNCTION WELL. UNCLEAR DEFINITION, IDEA FROM BRAINSTORM.

Brainstorming Results – Upstream Alternatives
Upstream Collection – Defer

Components	List #	Priority	Comments
Attraction Flow Source			
Groundwater	48	Defer	Not known to be a potential water source at the component project locations.
Drainage galleries	49	Defer	Construction may limit the availability of flow. This may be good for lamprey. Gravel/silt/etc. contamination is a risk.
~~Mixer pumps~~	37	Deleted (Moved to Defer)	Redundant with #33
~~Gravity flow from forebay~~	44	Deleted (Moved to Defer)	Covered by #42
~~Deep pit with flow – for burbot~~	52	Deleted (Moved to Defer)	Not a source

Brainstorming Results – Upstream Alternatives
Upstream Collection – Supplemental – Attraction Flow Source

Components	List #	Priority	Comments
Attraction Flow Source			
Chemical attraction	46	Supplemental	Experimental.
Temperature attraction	47	Supplemental	Could be a feature. No real need to pursue unless different water source from river.

Brainstorming Results – Upstream Alternatives
Upstream Collection – Priority 1 – Attraction Flow Volume

Components	List #	Priority	Description
***NEAR FIELD* Attraction Flow Volume**			
5-10 percent of fish design flow (near-field)	~~54~~ 53	1	Typical NMFS fish passage criteria/guidelines. Bonneville Dam 3 to 5% as a reference. May not be required for all species, site specific need to discuss more.
Flow shaping/configuration ~~(far-field)~~	~~55~~ 54	1	Shaping discharge to provide attraction to the fish entrance facility, or avoid hydraulic occlusion.
Variable flows that mimic natural conditions (far field operational concept)	~~56~~ 55	1	OPERATIONAL CONSIDERATION OF PROJECT. ADDRESSED WITH OPERATION GROUP. Natural hydrograph idea. Could peak within a band of natural hydrograph. Effect would be limited at this project due to volume. No precedent. Note AWS system must compete with what is happening at dam.

Brainstorming Results – Upstream Alternatives
Upstream Collection – Priority 1 – Strategy/Criteria

Components	List #	Priority	Description
Strategy/Criteria			
Prototype phasing options	86	1	This is a strategy that would phase installation of facilities. GLOBAL TO ALL FACILITIES. CONSIDER OPTIONS DURING CONSTRUCTION PERIOD.
Ability to retrofit	New today	1	See criteria document.

Brainstorming Results – Upstream Alternatives
Upstream Conveyance – Priority 1

Components	List #	Priority	Description
Upstream Passage			
Structural Fishway	69	1	Utilizes slope of 1/10-1/16 with resting pools due to structure height (~600 vertical). Normally has a short segment with a trap to deal with tailrace water surface variations.
Nature-like Fishway	70	1	Utilizes 1-3 percent slope with flows ranging from 20-50 cfs. Short segments also used with a trap to deal with tailrace water surface variations. Generally most applicable to low head projects.
Haul: truck, boat/barge, hydrofoil, tram, helicopter, float plane, ~~Sherpa, mules~~, drones, snow machine	72	1	Generally a fish transport container with life support and transportation included.
Fish Lock	73	1	Could be used in association with a bypass tunnel over the sluiceway. It would consist of a dedicated tower and abutment.
Fish Lift	74	1	
Helical ladder	78	1	Fishway alignment would weave up tower. This is a feature of structural fishway.
Tunnel	80	1	Potential component for shorter section of passage system or as a means to route a structural fishway. Could potentially be located in north abutment.
Lamprey passage system: LAPS @ Bonneville	81	1	Closed duct.
Lamp ramp @ Willamette Falls	82	1	Open flume

Brainstorming Results – Upstream Alternatives
Upstream Conveyance– Priority 2

Components	List #	Priority	Description
Upstream Passage			
Modified tributary (Fog or Tsusena)	71	2	Use of this existing tributary for a passage route as far upstream as possible, then transition to transport channel/structural fishway/tunnel for remaining distance. Potentially suitable for downstream passage as well. Tsusena Creek preferable due to proximity to the dam and reduced impact to existing Chinook use. Fog Creek has a lower gradient, and also has existing Chinook salmon use.
Pescalator	75	2	The design is based on an archimedes screw principle. It is a potential component of a larger system.
Rock ramp	79	2	This is a potential component of a system, used generally for shorter sections at 3-6 percent slope.
Series of steep pass/Denil	88	2	This could be a component of a larger system, or a second entrance, or part of a temporary facility.
Bypass tunnel/diversion tunnel	89	2	This would repurpose tunnel used for construction of the dam.

Brainstorming Results – Upstream Alternatives
Upstream Conveyance – Defer

Components	List #	Priority	Comments
Upstream Passage			
Fish cannon (Whooshh)	76	Defer	This is an experimental system with long-term health concerns. Project scale is too big for this idea.
Catapult	77	Defer	There are better options available. This idea was presented to illustrate value of brainstorming.
Fish pump & pipe	83	Defer	System is not feasible for adults, doesn't meet NMFS criteria.
Pneumatic pump & pipe	84	Defer	System is not feasible for adults, doesn't meet NMFS criteria.
Jet pump and pipe	85	Defer	System is not feasible for adults, doesn't meet NMFS criteria.
Challenge section	87	Defer	Potential to use as faunal filter. Potential volitional sorting system.
Pipe to end of reservoir	94	Defer	Too long (42 mi. +/-), no precedent.

Brainstorming Results – Upstream Alternatives
Upstream Conveyance– Supplemental

Components	List #	Priority	Comments
Upstream Passage			
Slow turbine start-up	90	Supplemental	
Pressurized draft tube	91	Supplemental	

Brainstorming Results – Upstream Alternatives
Upstream Exit – Priority 1

Components	List #	Priority	Description
Upstream Exit (type/location)			
Fish Slide	95	1	Feature for ladder or haul release.
Multi-port	96	1	Feature for ladder or haul release. Multi-level, deep to shallow.
Truck ramp	97	1	Location near the quarry on south abutment.
Multiple release locations	98	1	Most compatible with boat, float plane, helicopter hauling options.
Release at dam	101	1	
Head of reservoir release	102	1	
Release lock	103	1	Could be tied into a ladder, or other feature. Could be duplicated to reduce hold time.
Floating exit	104	1	This used in combination with a variable slope to accommodate pool fluctuation.

Brainstorming Results – Upstream Alternatives
Upstream Exit – Defer

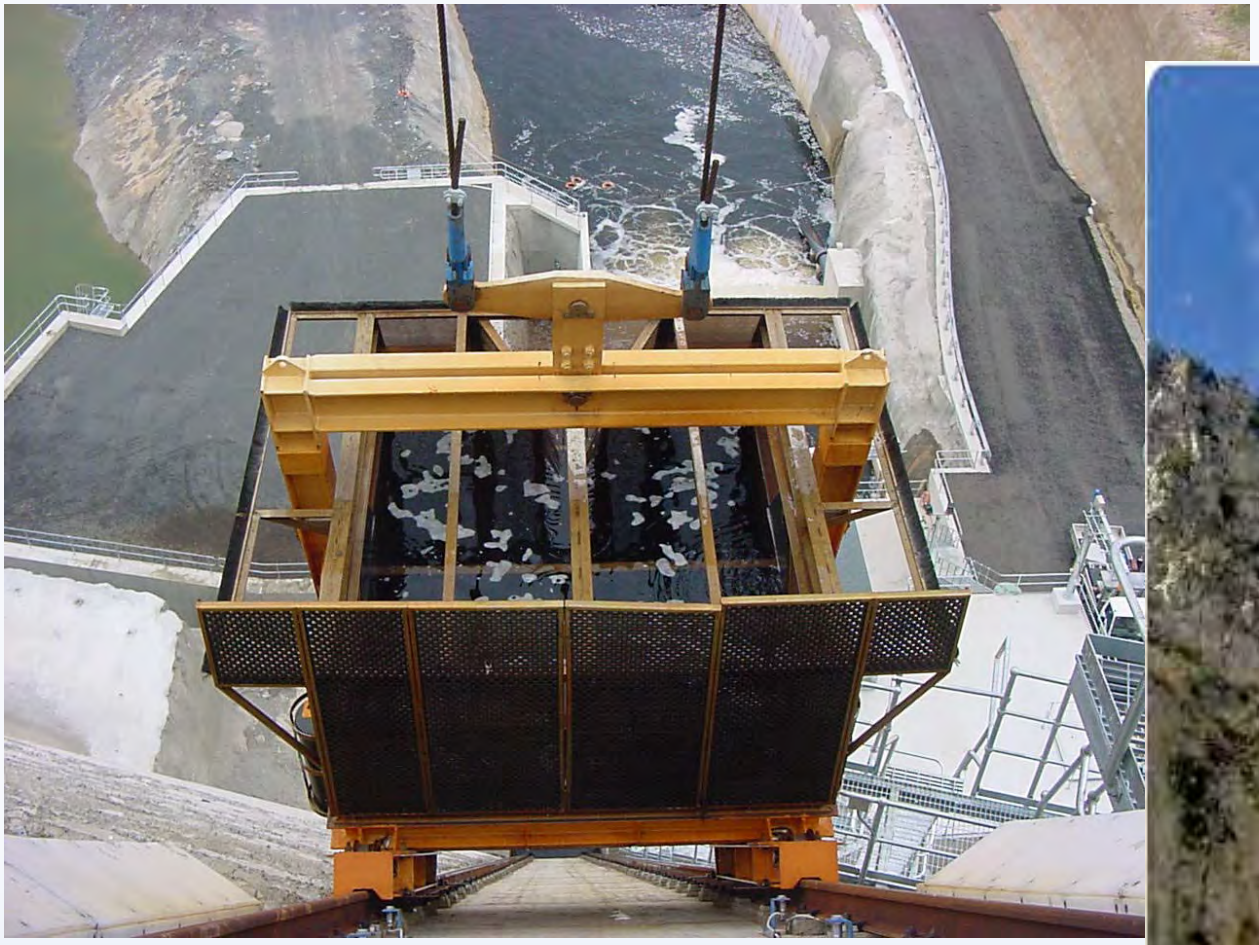
Components	List #	Priority	Comments
Upstream Exit			
~~Cycling lock exit~~	106	(Moved to Defer)	Repeat of #103

Brainstorming Results – Upstream Alternatives
Upstream Exit– Supplemental

Components	List #	Priority	Comments
Upstream Exit			
Stress release ponds	100	Supplemental	Includes acclimation goals, temperature, fallback, etc. More amenable to transport options, not likely needed with volitional alts.
Submerged exit	105	Supplemental	
Hose Release	***99***	***Supplemental***	***Design detail***

Upstream Passage Alternative Examples

Fish Lift



Hopper Tram on Rails

Aerial Tramway

Fish Lift

Components:

- Entrance
- Collection Pool with AWS
- Loading facility and tram with hopper
- Landing and release facility

Pros

- Tram operation can be frequent with short distance to travel.
- Easily adjusts to forebay water level fluctuations

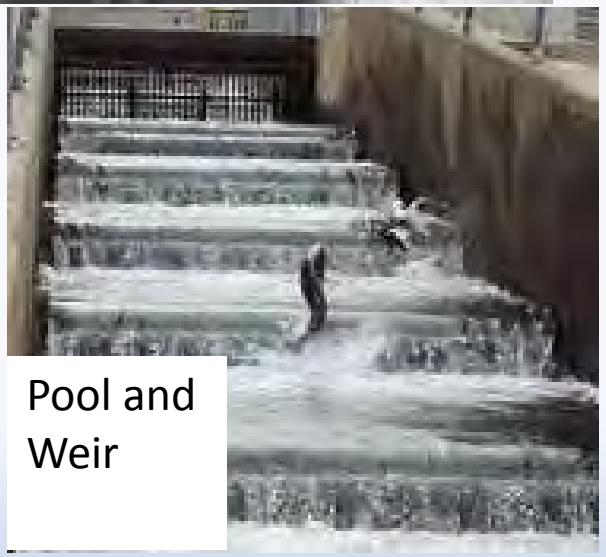
Cons

- Limited hopper capacity
- Tram maintenance, many moving parts
- Delay while holding fish
- Operators required at both ends.
- Difficult operation in ice conditions

Structural Fishway (ladder)

Ice Harbor

Vertical Slot



Pool and Weir

Structural Fishway

Components:

- Entrance
- Collection Pool with AWS
- Multi-pool transitions structures at upstream and downstream end to accommodate forebay and tailwater fluctuations.
- Vertical Slot, Ice-Harbor, Pool and Weir, baffled Fishway approximately 1,000-3,200 m long

- Pros
- Fully volitional
- Proven passage technology

- Cons
- Complicated operations due to forebay and tailwater fluctuation
- No precedence at this scale
- Predation in ladder
- Uncertainty of successful forebay passage upstream

Trap and Truck Transport

Barrier Dam

Fish hauling truck

Trap and Truck Transport

- Components
  - *Barrier dam, fish ladder to trap, auxiliary water supply (AWS)*
  - *Loading facility and truck*
  - *Release location*
- Pros
  - *Configurable barrier dam and trap optimized to location and attraction*
  - *Flexible release location depending on conditions*
  - *Proven with salmon/steelhead species*
  - *Scalable up for trap size and number of trucks if lots of fish*
  - *Common technology and operation*
- Cons
  - *Complications of holding/transporting fish (delay, potential injury)*
  - *Truck breakdowns/operator error*

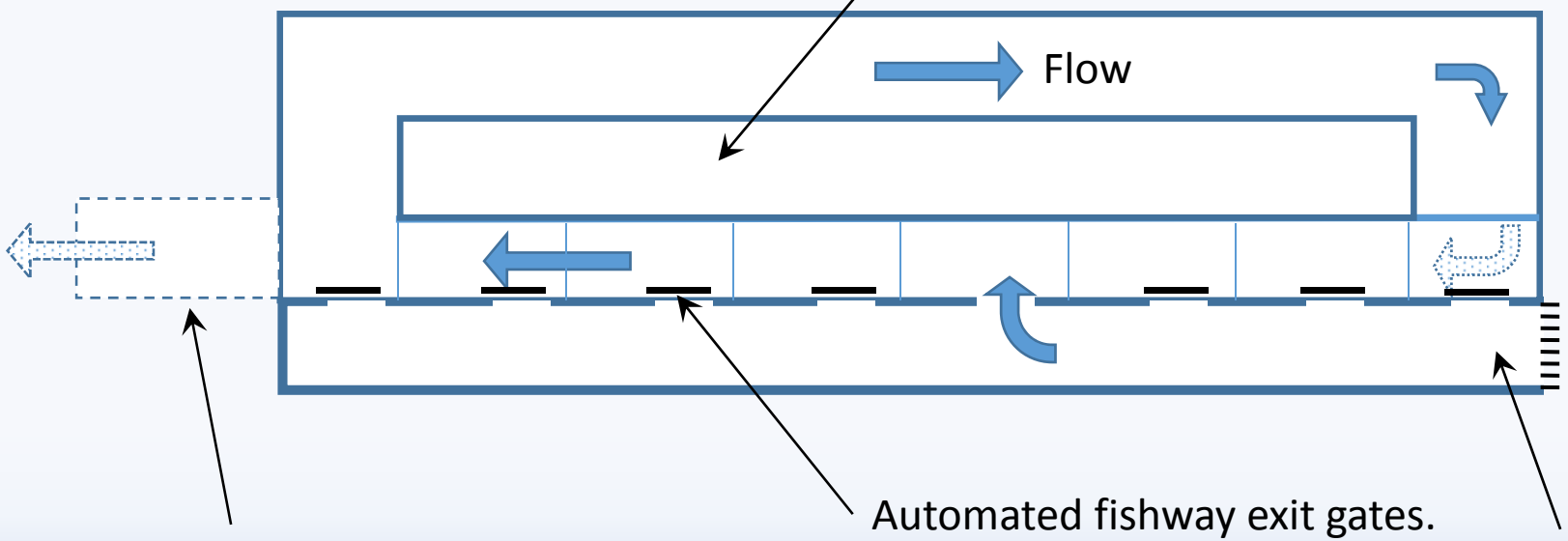
Volitional Fishway

Possibly modified and combined with downstream passage volitional bypass

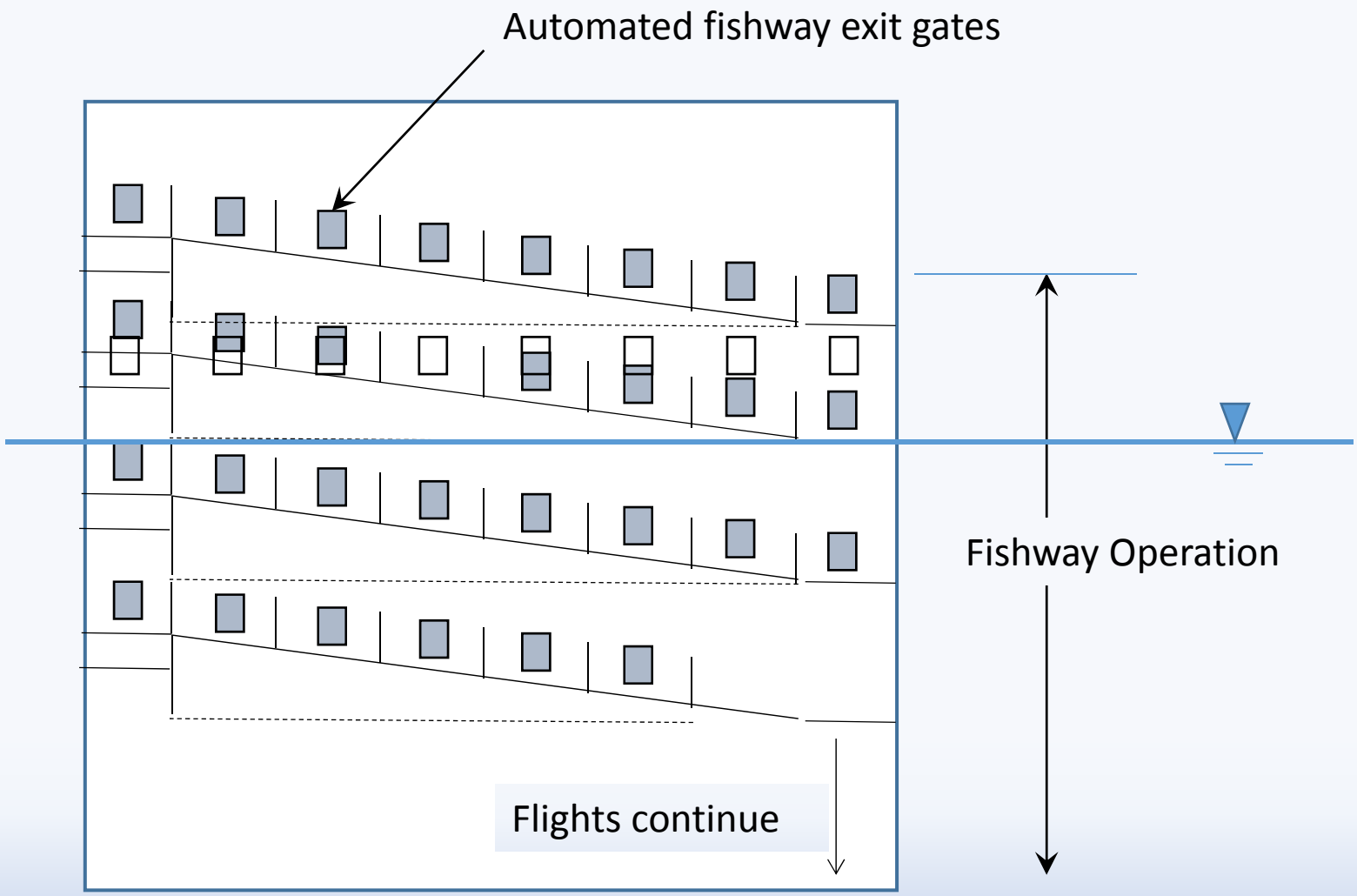
Stationary Helical Fishway Tower

10 flights (single flight shown)

7 - 4'x6' pools each flight



Volitional Fishway



Downstream Passage

Grouping Detail

Brainstorming Results – Downstream Alternatives
Proposed Grouping – Downstream Collection, Downstream Conveyance

Subcategory Components	Total 1,2, Deferred	Priority 1 Alternatives	Priority 2 Alternatives	Deferred Alternatives	Supplemental/ Enhancements
Downstream Collection	37	32	1	4	9
Collection Site	8	8	0	0	0
Attraction	1	1	0	0	0
Downstream Collection	28	23	1	4	9
Downstream Conveyance	2	0	1	1	8

Proposed Grouping

Brainstorming Results – Downstream Passage
Downstream Collection – Priority 1 – Collection Site

Components	List #	Priority	Description
Collection Site			
Tributaries	119	1	Kosina & Oshetna
Dam	120	1	Could include right bank, left bank, over turbines, near spillway
Head of reservoir: above high pool upstream of Oshetna	121	1	~PRM 235.3
Head of reservoir: above high pool downstream of Oshetna	122	1	~PRM 234
Tributaries and Upper Mainstem Susitna	123	1	Combination of #119 and #121
Head of reservoir: below low pool	124	1	~PRM 222. As far upstream as possible.
Reservoir below Kosina/ mid-reservoir	125	1	
Moveable in reservoir	126	1	For placement anywhere in reservoir

Brainstorming Results – Downstream Alternatives
Downstream Collection – Priority 1 - Attraction

Components	List #	Priority	Comments
Attraction/location			
Coffer dam remnant use	156	1	Coffer dam utilized as a potential base of a structure. Used for burbot, upstream cofferdam.

Brainstorming Results – Downstream Alternatives
Downstream Collection – Priority 1 (1 of 2)

Components	List #	Priority	Description
Downstream Collection			
Temporary portable trap Screw trap/inclined plane/ fyke	127	1	For tributary locations, component of larger system and guidance elements to increase efficiency. CONSIDER FOR USE DURING CONSTRUTION.
Merwin-type trap in reservoir	128	1	Net pen with guide nets, floating deck, reservoir/low-velocity locations. CONSIDER FOR USE DURING CONSTRUTION.
Picket rack	129	1	In channel, with upstream and downstream collection boxes. Suitable for smaller streams. CONSIDER FOR USE DURING CONSTRUTION.
Off-channel with weir/rubber dam	130	1	Exclusionary and directs fish and flow to bypass screen. Tributary collection style/type.
Screened facility	132	1	Screens in river, assuming exclusionary screening. Tributary. Ice, debris concerns.
Louvers	133	1	In tributaries, could be combined with other facility. Off channel use. Use at dam. More guidance than exclusionary. Doesn't meet NMFS criteria. Mayfield Dam, holyoke MA, Seton Dam, trib of Frazier River BC (~10 yrs ago), Skinner & Tracy in CA.
Collection tower, in Reservoir near tribs	136	1	Fixed concrete tower, requires power, multiple fixed ports or movable screens.
Movable Screen inside tower	137	1	Traditional screen inside tower near dam, movable screens to track water surface.
Floating surface collector	138	1	FSC – often has guide nets in reservoir to assist in directing fish to collector.
Partial screen collector	139	1	Columbia River SBS, STS, etc.

Brainstorming Results – Downstream Alternatives
Downstream Collection – Priority 1 (2 of 2)

Components	List #	Priority	Description
Downstream Collection			
High velocity screens	141	1	Do not comply with NMFS criteria for fish screens.
Conventional screen	143	1	Low velocity, NOAA criteria screens

Brainstorming Results – Downstream Alternatives
Downstream Collection – Priority 1 (1 of 2)

Components	List #	Priority	Description
Downstream Collection			
Turbine passage	144	1	High head so likely very low survival. Baseline if nothing else is done.
Modification of existing spillway	147	1	This will requires a safe route downstream and needs to accommodate a fluctuating pool. Notched feature.
Dedicated spillway feature	148	1	This will requires a safe route downstream and needs to accommodate a fluctuating pool. Design will consist of a 30 percent slope down face of dam with multiple intake ports in pool. No screening involved.
Surface flow outlet/Corner collector	149	1	Could be full flow unscreened source or fully screened. Fixed height.
Turbine intake screen collection	150	1	similar to #141 and 139.
Cycling lock (low level pressurization chamber)	151	1	Conduit under dam with gates at both ends for benthic species. Not standalone for salmon species.
Simulated Wells intakes	153	1	Location above turbine, can be combined with many elements. Uses bulk flow towards intake (turbines near intake). Entrance type for collection system. Form of Surface Flow Outlet (SFO). Vertical slot collection device.
Floating ice/trash sluiceway	154	1	Could be positioned over intake or spillway. Higher flows, surface water, dewatering screens or not.

Brainstorming Results – Downstream Alternatives
Downstream Collection – Priority 1 (2 of 2)

Components	List #	Priority	Description
Downstream Collection			
Rearrange intake location	158	1	Slide intakes towards left bank with diagonal penstocks to current powerhouse location. Move spillway near turbine outlets to maximize bulk flow. Example of #148. put intakes in corner.
Two-vessel trawl in reservoir	172	1	

Brainstorming Results – Downstream Alternatives
Downstream Collection – Priority 2

Components	List #	Priority	Description
Downstream Collection			
Off-channel with weir/rubber dam with FCA screen/Coanda	131	2	Exclusionary which directs fish and flow to a FCA or coanda screen.
MIS/Eicher screen	142	2	Passage flow is pressurized in a conduit.

Brainstorming Results – Downstream Alternatives
Downstream Collection – Defer

Components	List #	Priority	Comments
Downstream Collection			
Fish friendly turbines	140	Defer	High head of this dam is a fatal flaw
Spillway passage	146	Defer	Fatal flaw is that the spillway not used regularly.
Decompression raceway	152	Defer	Experimental technology, not tested, concern for debris, difficult access if something goes wrong.
Rearrange dam axis	157	Defer	Fatal flaw is that it is structurally challenging for foundation needs. Outside scope of study. Other means may accomplish same goal, such as guidance devices.

Brainstorming Results – Downstream Alternatives
Downstream Collection – Supplemental

Components	List #	Priority	Comments
Downstream Collection			
Guide nets/Barrier nets	134	Supplemental	
Behavioral guidance (strobe, noise, bubbles, turbulence)	135	Supplemental	
Modified operations for passage – pool level modification	145	Supplemental	
Floating Guide walls/curtains in forebay	155	Supplemental	
Shoreline alteration to shape flow	159	Supplemental	
Guidance circulation	160	Supplemental	Induced flow, B2 powerhouse corner collector, turbulence signature.
~~Guide nets~~	161	Supplemental	Duplicate to 134
Simulated lake outlet	162	Supplemental	Baker FSC, RSW's in columbia. Velocity, shape, acceleration, substrate/texture.
Modified valves or dedicated fish turbine	163	Supplemental	Use cone valve discharge to drive collector. Function of frequency, need flow conveyance. Consider use of valve for collector, dedicated or supplement for flow when flow being bypassed anyway.

Brainstorming Results – Downstream Alternatives
Downstream Conveyance – Priority 2

Components	List #	Priority	Description
Downstream Conveyance			
Nature-like channel	168	2	

Brainstorming Results – Downstream Alternatives
Downstream Conveyance – Defer

Components	List #	Priority	Comments
Downstream Conveyance			
Tributary channel	169	Defer	Release into a tributary downstream, and allow them to move volitionally. Could imprint on non-natal tributary.
~~Traveling or fixed bar screens~~	170	Deleted (Mover to Defer)	Redundant with other features

Brainstorming Results – Downstream Alternatives
Downstream Conveyance – Supplemental

Components	List #	Priority	Comments
Downstream Conveyance			
Associated sampling/sorting facilities	174	Supplemental	

Brainstorming Results – Downstream Alternatives
Downstream Conveyance – Feature

Components	List #	Priority	Comments
Downstream Conveyance			
full flow vs partial flow (screening)	164	Feature	Feature. Removable Spillway Weir (RSW) on Columbia vs. STS/SBS (partial). Using full collection flow to convey fish to tailrace vs dewatering.
Continuous vs ~~discrete~~ batch	165	Feature	Bypass running all the time, vs. haul (lock/tram/helicopter/truck, etc.). Two categories.
Truck/boat/float plane/tram/heli	166	Feature	Conveyance means.
Channel/pipe or trough around dam	167	Feature	Continuous, what you put it in. Clackamas pipeline, Green Peter, B2 Corner collector, bypass at many dams.
~~Small turbine-like shallow intake~~ Surface collector to attract and pass	171	Feature	Cowlitz Falls North Shore Collector. Multi port collector, CleElum concept by USBR.
Sluice tunnel through dam	173	Feature	Conveyance piece of burbot passage. Could be standalone for deep species.

Downstream Passage Alternative Examples

Floating Surface Collector

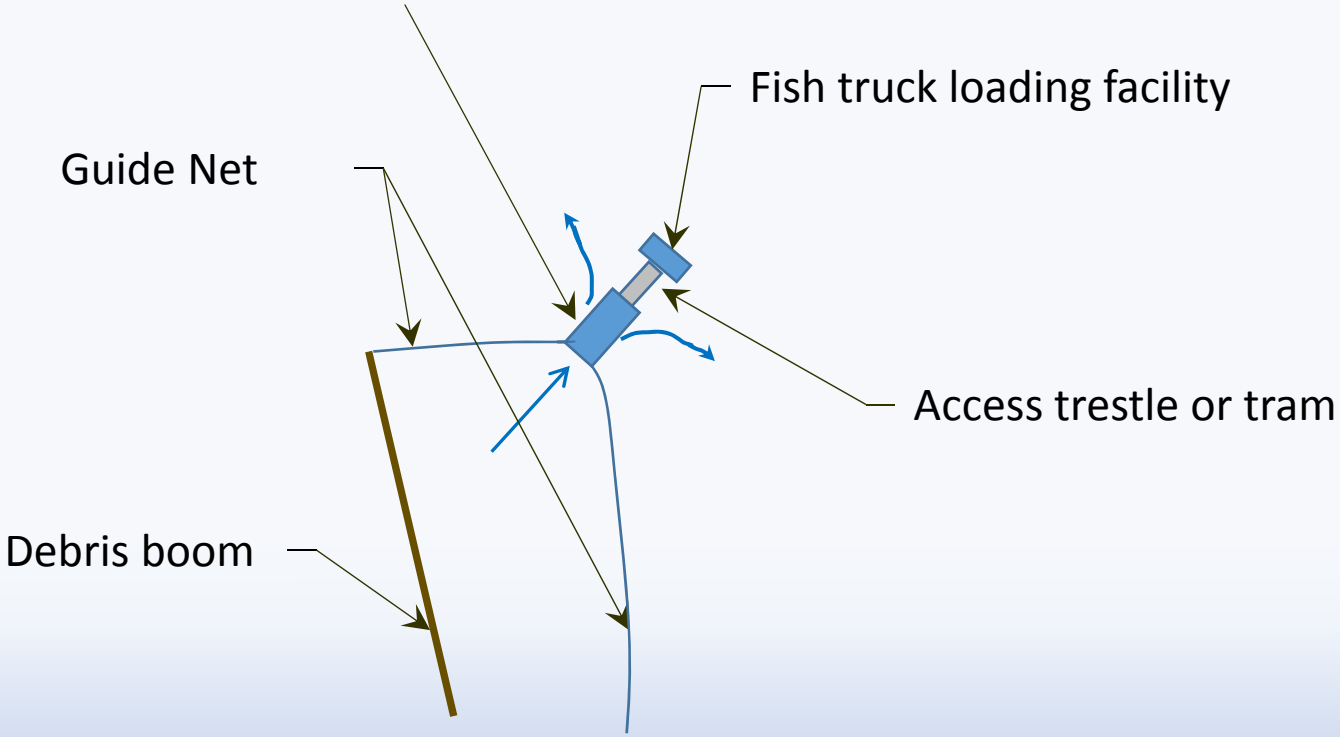
General Description (FSC)

- Floating barge with fish inlet, moored in a favorable location to attract fish
- Big funnel that draws in and accelerates water and fish to a bypass
- Sets up a flow pattern to simulates a natural lake outlet to a river/creek
- Pumped flow returned to reservoir
  - *Very low-head pumps, no loss of water or generation*
  - *Power required, operating cost*
- Fish transport back to creek downstream of dam via:
  - *Hopper*
  - *Floating pods or boats*
  - *Pressure pipe to open channel*
  - *Volitional (not practical for FSC options)*
- Assume no sorting on barge

Cushman FSC, WA

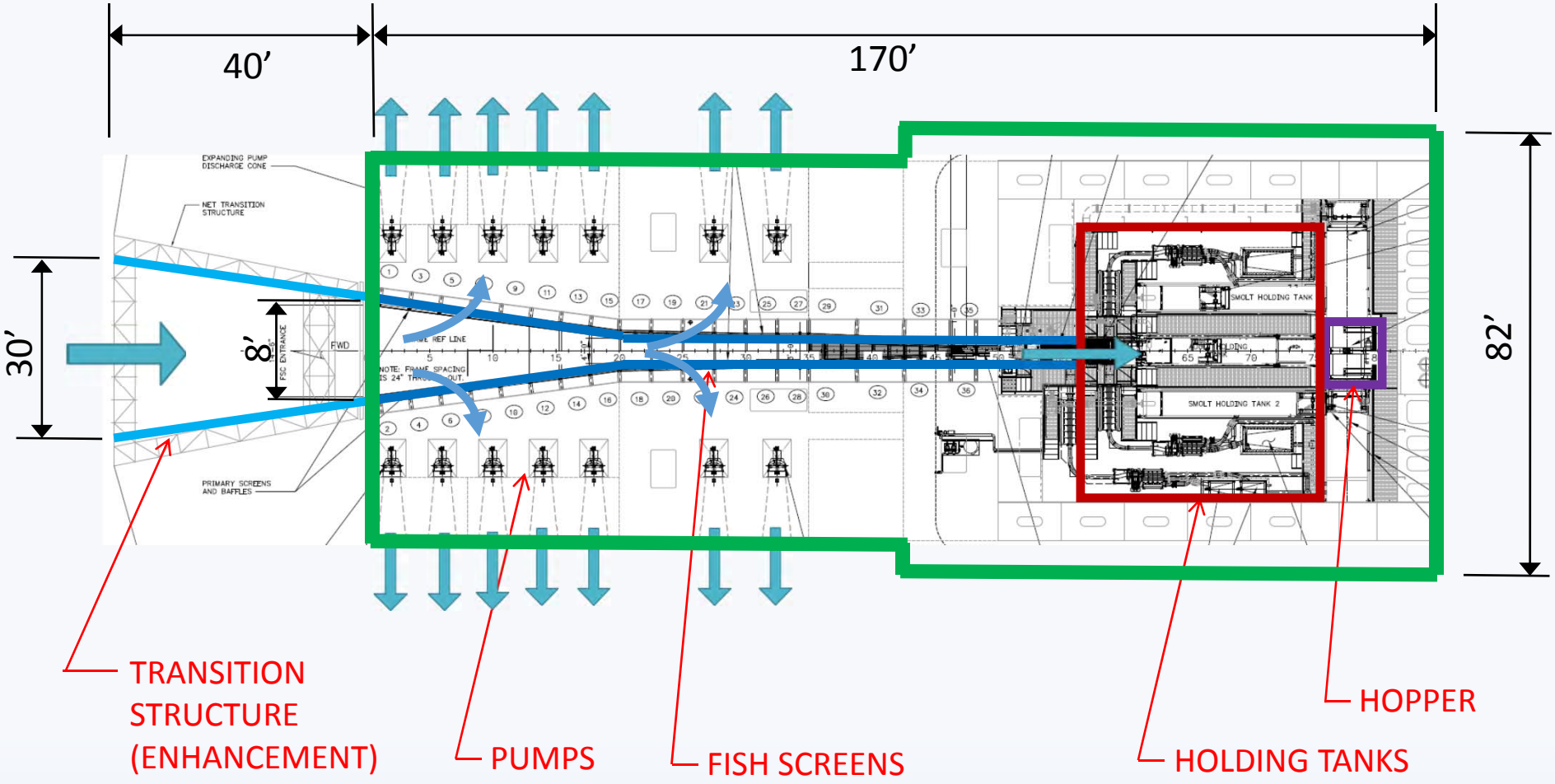
Floating Surface Collector

Floating Surface Collector
Located to accommodate barge depth at low pool



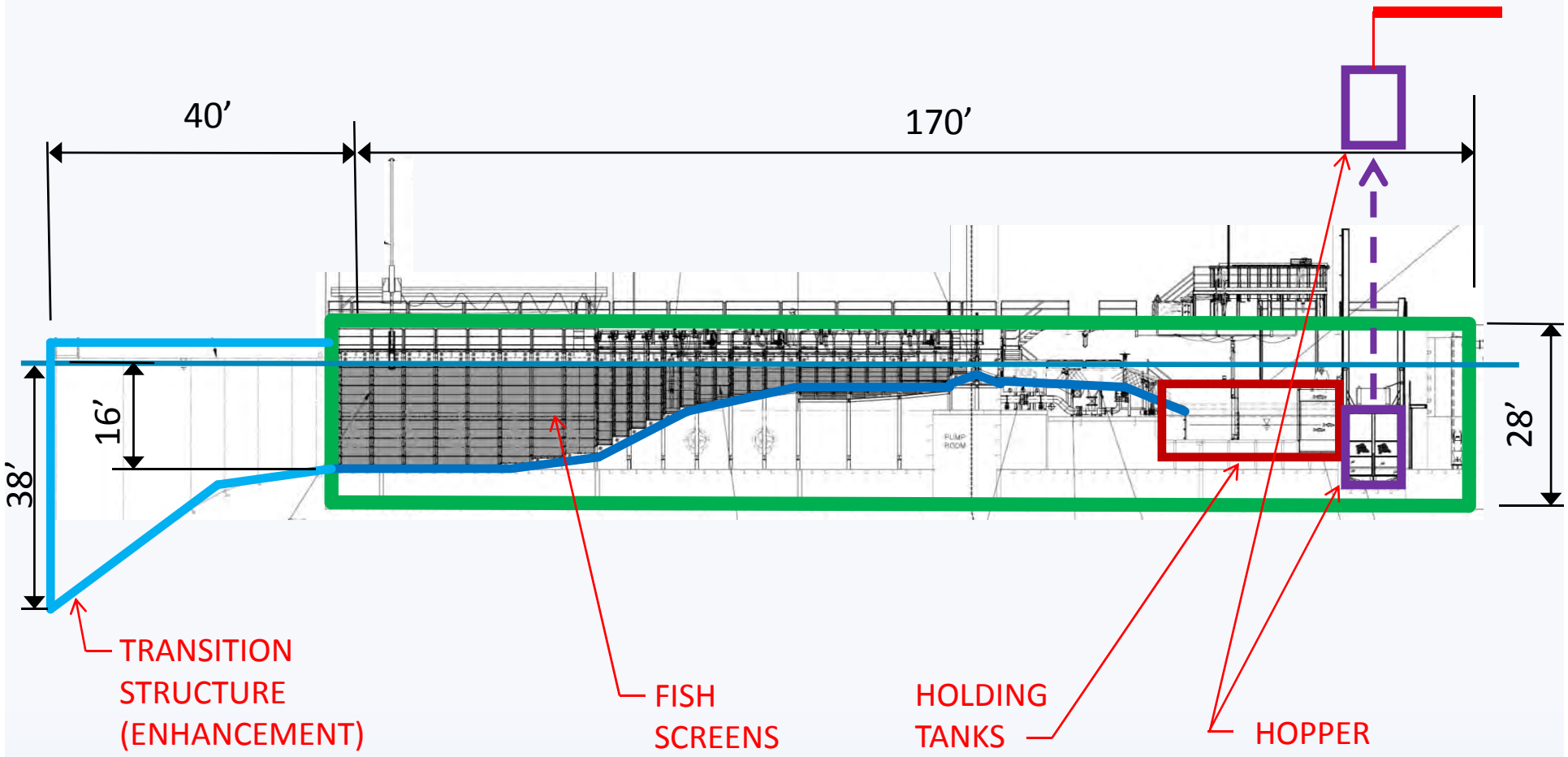
FSC Example Photos

FSC Plan View – Concept Description



Plan View and Component Definition (Swift FSC, 600 - 900 cfs)

FSC Elevation View – Concept Description



Elevation View and Component Definition (Swift FSC)

FSC

Components:

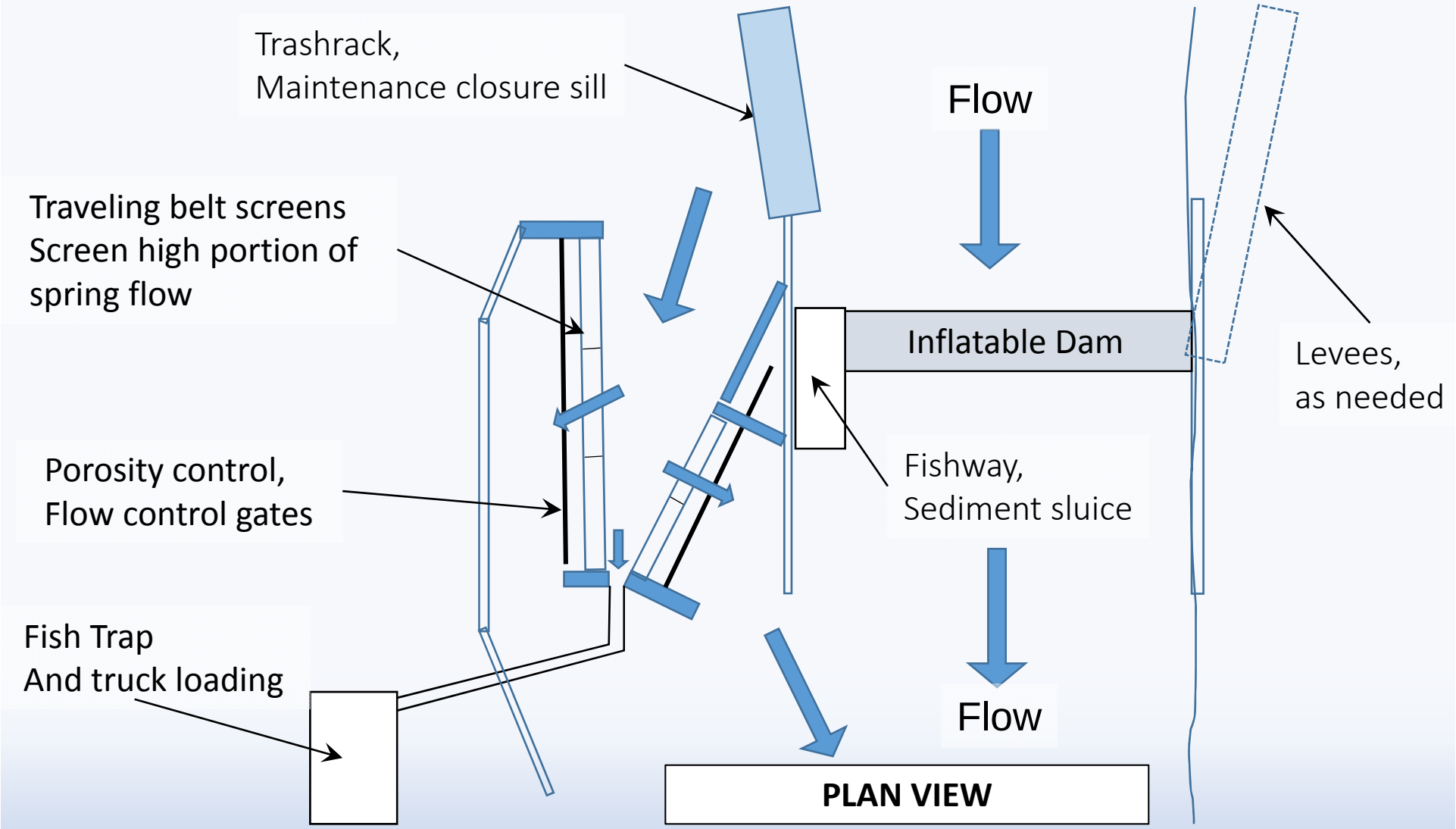
- Log boom, debris management system
- Entrance transition structure, guide nets
- Floating barge, screens, pumps, fish holding
- Mooring provisions
- Fish transport hopper and/or fish bypass pipeline
- Power

- Pros
  - Flexible Location
  - Full exclusionary screening
  - Adjusts to forebay water level fluctuations
  - Proven design

- Cons
  - Complicated operations
  - Partial collection – will miss some fish
  - Barge and guide nets difficult to hold during floods

Tributary Traps

Tributary Traps (example layout)



Tributary Traps

Components:

- Optional flow diversion (inflatable dam, flash boards etc.)
- Screens, pickets or nets to separate fish and flow
- Collection box with hoist
- Truck loading facility

- Pros
- Traps fish/larvae before entering the reservoir
- Flexible trap location (if temporary traps used)
- Multiple release locations with truck transport
- Increased survival from tributary to estuary

- Cons
- Difficult to deploy and maintain in channel, difficult access
- Debris handling/fish injury
- High personnel needs (especially for temporary traps)
- Not volitional – may move fish that do not want to move downstream