DRAFT 24th July, 2014

Portland District U.S. Army Corps of Engineers
Willamette Valley Project BiOp Implementation Program
Standardization of Passage and Survival Metrics

PROJECT ACRONYMS

Dam	Acronym	Dam	Acronym
Hills Creek	HCR	Lookout Point	LOP
Dexter	DEX	Fall Creek	FCR
Cougar	CGR	Blue River	BLU
Green Peter	GPR	Foster	FOS
Detroit	DET	Big Cliff	BCL
Dorena	DOR	Cottage Grove	COT
Fern Ridge	FRN	Leaburg	LBG
Walterville	WVL	Lebanon	LEB
Upper Bennett	UBN	Lower Bennett	LBN

METRIC BOUNDARIES

- **Forebay:** The segment of river immediately upstream of a dam where operations at the dam are the primary contributing factor to velocity and direction of water flow. The upstream boundary of the forebay is defined as the upstream limit where a significant alteration in water flow allocation through operational changes affects water velocity and/or direction. The downstream boundary is defined as the upstream face of the dam.

- **Tailrace:** The segment of river immediately downstream of a dam where project operations are the primary contributing factor to velocity and direction of water flow (i.e., where the majority of flow from a given route is "mixed" with flow from other routes). The upstream boundary of the tailrace is defined as the downstream face of the dam and the downstream boundary is defined as the downstream limit where project operational changes effect water flow direction.

- **Maximum Conservation Pool:** This is the highest operating elevation for WVP dams during the conservation season. If pool elevations exceed this regulators will release more water to stay below the rule curve. The upstream boundary is the furthest extent upstream where the water surface elevation is the same as at the face of the dam; the downstream boundary is the upstream boundary of the forebay. This location will change as the reservoir levels fluctuate.

- **Minimum Conservation Pool:**

Comment [GRIFF1]: FPT should consider changing this from the Columbia. The zone of influence for the WVP dams will be very small. Suggest group uses geographical features that make sense (i.e. the log boom). Project specific boundary definitions (including any figures or maps) should be added to this document.

Comment [GRIFF2]: Same comment as above. Suggest the group considers geographical references or the first hydraulic drop below the dam.

Comment [GRIFF3]: Project specific boundaries should be included at important reservoir elevations (i.e. maximum conservation pool, minimum power pool, etc…).

- **Spill:** This refers to the passage of water through the spillway.

- **Regulating Outlet (RO) Spill**: This refers to the passage of water through the RO.

- **Surface Outlet:** This refers to a surface flow outlet (i.e. the Foster spill weir, the Dalles ice & trash sluiceway, etc.) or surface collector (i.e. Baker FSC), where fish are passed or collected through a route or device that has free surface flow (weir flow).

PASSAGE METRICS

- **Dam Passage Efficiency (DPE):** The number of fish that pass the dam divided by the total number of fish entering into the forebay.

DPE = (dam passage / forebay entrance)

- **Spillway Passage Efficiency (SPE):** The number of fish passing a dam through the spillway divided by the total number of fish passing the dam through all available routes.

SPE = (Spill passage / total project passage)

- **Spill Passage Effectiveness (SPS):** The ratio of the proportion of fish (SPE) passing through the spillway to the proportion of total project water discharge being spilled.

SPS = (SPE / [spill discharge / total project discharge)

- **Regulating Outlet Passage Efficiency (ROPE):** The number of fish passing a dam through the regulating outlet divided by the total number of fish passing the dam through all available routes.

ROPE = (RO passage / total project passage)

- **Regulating Outlet Passage Effectiveness (ROPS):** The ratio of the proportion of fish passing through the regulating outlet (ROPE) to the proportion of total project water discharge being passed through the regulating outlets.

ROPS = (ROPE / RO discharge / total project discharge)

- **Fish Passage Efficiency (FPE):** The number of fish passing a dam through any non-turbine route divided by the total number of fish passing the dam through all available routes.

  FPE = (non-turbine passage / total project passage)

- **Fish Collection Efficiency (FCE):** The number of fish passing a dam through a collection structure divided by the total number of fish passing the dam through all available routes.

  FCE = (Collector passage / total project passage)

- **Reservoir Passage Efficiency (RPE):** Number of fish passing the forebay line divided by total number of fish entering the reservoir.

  RPE = (forebay entrance / reservoir entrance)

- **Surface Outlet Efficiency (SOE):** The number of fish passing through a surface flow outlet (i.e. Foster spill weir) divided by the total number of fish passing the dam.

  SOE = (SO passage / total project discharge)

- **Surface Outlet Effectiveness (SOS)**: The ratio of the proportion of fish passing through a surface flow outlet (SOE) to the proportion of total project water discharge passing through the SO. For spillway surface flow outlets, any training spill required for operation of the outlet shall be included as part of the "proportion of total project water discharge" for that route.

  SOS = (SOE / [SO discharge / total project discharge])

TIMING METRICS

- **Time of Passage:** The instantaneous time based on a set of detections that a fish passes a given route. These times are used for calculation of the above timing metrics.
  - **Spillway:** Last detection time on an underwater antenna or underwater detection array at the face of the spillway.
  - **Regulating Outlet:** Last detection time on an underwater antenna or detection array within or adjacent to a regulating outlet intake.
  - **Turbine:** Last detection time on an underwater antenna or detection array within or adjacent to a turbine intake.

- **Surface Outlet:** Last detection on an underwater antenna or underwater detection array at or near the crest of the surface flow outlet.

- **Reservoir Residence Time:** The elapsed time from first detection at the head or reservoir to the first detection at the upstream boundary of the forebay.
- **Forebay Residence Time:** The elapsed time from first detection at an array established at the upstream boundary of the forebay to the last detection time on a passage route receiver.

- **Tailrace Residence/Egress Time:** The elapsed time from passage from a given route to last detection on a line established at the downstream boundary of the tailrace.
  - Turbine fish: start time for this calculation should be the last detection on the turbine intake if draft tube detection is not in place.
  - Regulating outlet fish: start time for this calculation should be the last detection on the regulating outlet intake if detection is not in place in the outfall.
  - Spillway fish: start time for this calculation should be the last detection on underwater spillbay antennas.

- **Dam Passage Time:** The elapsed time from first detection at a forebay array to the last detection on a tailrace array. This time is equivalent to the sum of the forebay residence and tailrace egress times. NOTE: For fish collected in forebay this would be measured from forebay entrance to release in the tailrace.

SURVIVAL PARAMETERS

- **Absolute Survival**: Estimate of survival representing the actual proportion of fish surviving through a *zone of inference*[1].

- **Relative Survival**: The ratio of the absolute survival of two groups (i.e., S_1/S_2). For example, the ratio of survival estimates through two different passage routes at a dam.

- **Reservoir/Pool Survival**: The probability of survival from the upstream boundary of the reservoir of a dam to the upstream boundary of the forebay for that dam.

[1] A segment of river through which passage survival is estimated. This zone is defined as the reach between the fish release location(s) and location of the recapture site of a given study. For a single-release model, the zone is from the fish release location to the first detection array; for a paired-release design the zone is from the release location of the treatment group to the release location of the reference group.

- **Project Survival:** The probability of survival from the upstream boundary of the reservoir of a dam to the downstream boundary of the tailrace of the dam. Includes survival through the reservoir, forebay, dam, and tailrace of a given dam.

- **Dam Passage Survival:** The probability of survival from the upstream boundary of the forebay to the downstream boundary of the tailrace; it includes the forebay, all routes of passage, and the tailrace of a given dam (or dams for re-regulation projects). This can be expressed as:

  Dam Passage Survival = Dam Passage Efficency x Concrete Survival
  OR
  Dam Passage Survival = Tailrace Egress / Forebay Entrance

- **Concrete Survival:** The probability of survival from the upstream boundary of a dam to the downstream boundary of the tailrace; it includes all routes of passage, and the tailrace of a given dam. This parameter is calculated as the probability of survival through each route of passage weighted by the probability of passage through each route (i.e., $(S_{Spill} \times P_{Spill}) + (S_{RO} \times P_{RO}) + (S_{Bypass} \times P_{Bypass}) + (S_{Turbine} \times P_{Turbine})$) where "S" is the probability of survival and "P" is the probability of passage. *NOTE: The 2008 FCRPS Biological Opinion terms this parameter "dam survival".*

- **Passage-Route Survival:** The probability of survival for fish passing through an individual route to the release location of a tailrace reference group (at the downstream boundary of the tailrace).

- **Forebay Survival:** The probability of survival from the upstream forebay boundary to passage at the project.

- **Reference Group Releases:** For estimating the above survival parameters, reference groups shall be released at the downstream tailrace boundary line. At this location reference groups shall be released to best represent the lateral distribution and passage/migration timing of the population of interest.

- **Treatment Group Releases:** For estimating the above survival parameters fish tagged and released for treatment groups (whether direct or for virtual-release[2] groups) shall be released upstream of the zone of inference so passage through this zone best represents the spatial and temporal distribution of the population of interest.

[2] Virtual-release group being defined as study fish released well upstream of the zone of inference and regrouped at the upstream boundary of that zone.


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Image State of Oregon
© 2011 Google
7131 ft
44° 5.646' N 122°13.644' W
Jun 29, 2005
Eye alt 25953 ft
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May 23, 2011
1:23pm
Cul de Sac
Tailrace
Forebay
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image State of Oregon
©2009 Google
1151 ft
44° 7.708' N 122°14.518' W
elev 1607 ft
Eye alt 5025 ft