**OFFICIAL COORDINATION REQUEST FOR**
**NON-ROUTINE OPERATIONS AND MAINTENANCE**

**COORDINATION DATE-** 15BON45 WS LFS air entrainment test
**PROJECT-** Bonneville Lock and Dam
**RESPONSE DATE- 23 July 2015**

**Description of the problem-** Corps personnel first identified an air entrainment issue with the Bonneville WA Shore Lamprey Flume System (LFS, **Figure 1**) in June 2013. Corps biologists and FPOM representatives are concerned about the potential impacts of large volumes of air boils/bubbles on salmon and steelhead passage behavior in the vicinity of the North Downstream Entrance (NDE, **Figure 2**). In 2013 and 2014, surface observations of the entrained air plume led to daytime restrictions on flow settings (valve openings). See MOCs 14BON42 and 14BON14 for reference.

Small-scale air venting modifications to the LFS system in 2013 and 2014 were not successful and the Corps design team is currently evaluating potential solutions, including operational adjustments. No-cost changes under consideration include (a) partially closing an air vent that is contributing to the problem; (b) partially closing the knife gate leading to upper entrance of the LFS, thereby providing a blockage that will force air to leave the system away from NDE.

The design team proposes to conduct a 2-3 day test to evaluate response of the entrained air plume to the no-cost changes identified above, under a range of flow conditions (control valve open 25% to 80%, **Table 1**). Each condition/treatment will be evaluated for 10-20 minutes to allow hydraulic conditions within the system to stabilize between changes. Flow settings to be used for treatments 13 through 28 will depend on observations made for the initial round of testing, but will likely be in the 25% to 60% valve opening range. This test will overlap with the planned July 29 ROV inspection of the WA Shore Ladder, which requires reduced attraction flow. Fish units will be turned off during the ROV, which will allow Corps personnel to more easily isolate effects of treatments on entrained air emanating from the upper LFS entrance. Follow-up observations on July 29-30 will allow the team to also observe conditions during normal operations.

**Type of outage required-** None. Testing requires some operation of the LFS above the 40% or 50% (depends on tailwater conditions) water supply control valve opening previously approved by FPOM.

**Impact on facility operation-** None, aside from the variance noted above.

**Date of impacts –** 29-30 July 2015

**Length of time for repairs-** Up to 3 days of testing (up to 28 treatments; 10-20 minutes per treatment) during daylight hours. As practicable, higher flow treatments (>40% valve opening) will be conducted during off-peak hours (10:00 to 14:00) to minimize any potential impacts on passage.

**Expected impacts on fish passage-** The proposed testing coincides with summer upstream migration of summer Chinook, summer steelhead, sockeye, and Pacific lamprey. The 10 year daily average counts at Bonneville (2004-2014) are summarized below, though it is worth noting

that the 2015 summer Chinook run is larger than average, the sockeye run is much larger than average, and early run number suggest a smaller than average or average steelhead run:

| Date | Chinook | Steelhead | Sockeye | Lamprey |
|---|---|---|---|---|
| 29-Jul | 421 | 4258 | 51 | 385 |
| 30-Jul | 413 | 4466 | 35 | 309 |

The Corps anticipates that operation of the LFS at the higher flow settings (above 40% valve opening) will result in a visible plume of air immediately downstream of the NDE, potentially causing temporary migration delay fish attempting to enter the fishway. Due to the intermittent nature of the testing and the time of year (no sea lion predation), there will likely be little impact on adult salmonids or lamprey as a result of the operation. This test will partially coincide with the ROV inspection of the WA Shore Ladder, which means reduced overall fish attraction to Powerhouse 2 and the fishway entrances.

Results from the 2014 radio-telemetry evaluation of salmonid behavior in response to the LFS suggest that operation of the LFS at or below the current 40% or 50% valve opening limit did not result in passage delays for tagged summer Chinook salmon. From the executive summary of Johnson et al. (2015):

> *For adult spring Chinook salmon, mean NDE entrance efficiencies were significantly lower (P< 0.001) in 2013 (0.26) and 2014 (0.23) compared to pre-modification years (1996-2010 mean = 0.37). Spring Chinook salmon NDE entrance times were slightly slower in 2013 and slightly faster in 2014 than in pre-modification years; collectively, there was not a statistical difference in entrance times between pre- and post-modification years (P = 0.927). In contrast, mean entrance efficiencies for adult summer Chinook salmon were significantly higher (P < 0.001) and entrance times were faster (P = 0.005) than values from pre-modifications years. Differing results in the same passage metrics among runs and species suggest that the observed values were not directly related to the newly-constructed LFS. Adult Chinook salmon exit ratios, times from the PH2 NDE entrance to the base of the ladder, and the ratio of fish approaching and entering the NDE versus the SDE were within the range of values observed in pre-modification years. Observed differences in passage metrics between pre- and post-modification years suggested that any effects of the LFS were small relative to environmental factors and other unmeasured factors.*

## Comments from Bonneville Project Fisheries-

## Comments from agencies-

NOAA Fisheries - -----Original Message-----
From: Gary Fredricks - NOAA Federal [mailto:gary.fredricks@noaa.gov]
Sent: Monday, July 13, 2015 1:52 PM
To: Mackey, Tammy M NWP
Cc: Tackley, Sean C NWP
Subject: [EXTERNAL] Re: FPOM: official Coordination - 15BON45 WS LFS air entrainment test (UNCLASSIFIED)

Tammy, Also, the 29th (of July) also just happens to be the day the Portland District chose for the Bonneville Dam performance study meeting, which most of these people (including Sean) should be attending. I notice that the dates of impact are 29-30, July, however the next paragraph says this will take three days....? Also, normally I would agree with the implication that a short delay of fish is likely of little consequence without sea lions in the tailrace, however, not at these water temperatures. Under the length of time paragraph, the words "as practicable" should be deleted. Unless the ROV inspection is occurring, any testing above the 40% level should be done off peak passage hours. Overall, I'm not really comfortable with doing this test this time of year given the issues we are seeing for adult passage this year. Thanks, Gary

**NWP-PM-E -** -----Original Message-----
From: Tackley, Sean C NWP
Sent: Wednesday, July 15, 2015 1:12 PM
To: Welton, Brent C NWP; Turaski, Michael R NWP; Schlenker, Stephen J NWP; Zorich, Nathan A NWP; Mackey, Tammy M NWP; Hausmann, Ben J NWP; Royer, Ida M NWP; Bissell, Brian M NWP; Derugin, Andrew G NWP
Cc: Gary Fredricks; Aaron Jackson; lort@critfc.org; Brian McIlraith; Trevor Conder (trevor.conder@noaa.gov)
Subject: FW: [EXTERNAL] Re: FPOM: official Coordination - 15BON45 WS LFS air entrainment test (UNCLASSIFIED)
Importance: High

Classification: UNCLASSIFIED
Caveats: NONE

Hi all,

Please see Gary's email below. Most of his concerns (time of day, etc) were easy to address, but we had a good discussion regarding the exceptionally poor river conditions and mortalities we're seeing out there this year and the need to minimize risk. We agreed that exercising caution seems reasonable in a year like this, when all fish are stressed already. He understands what we were trying to test and thought it would be great if a simple, in-season operational adjustment (i.e. partial closure of the upper entrance gate) could benefit lamprey THIS year.

As such, we agreed that the following path made the most sense:

1. Move forward with the test, but do any and all higher-flow (>40%) testing during the ROV, when attraction to the ladder will be minimal. This should only be done between 10 and 2 (off passage peak hours). The PDT needs to look at the test plan to identify the critical >40% valve opening treatments to look at, and work closely with BON on this so we can plan accordingly. Ida, how long do you anticipate the AWS attraction flows to be shut down?

2. If there are any "slam dunk" operations that allow higher discharge, consider changing LFS ops as appropriate for the remainder of the season.

3. Come back sometime in the fall (before the Dec. 15 juvenile bypass shutdown) to evaluate the full range of treatments. It is important to note that this test doesn't influence the proposed structural fixes and therefore won't affect the design schedule. Operational changes would simply complement the structural modifications to the system. Aside from the desire to see if we can boost LFS attraction flows this season and to test when tailwater elevation is somewhat lower, it isn't critical that the full test be done in July.

Thoughts? Copying folks who may be interested in attending.

Gary, please chime in if I missed something.

Cheers,
Sean

**Final results-** Due to low flows and high water temps this action will go forward as follows:

Complete any and all higher-flow (>40%) testing during the ROV inspection, when attraction to the ladder will be minimal. Testing will only be done between 1000 and 1400 (off passage peak hours). The PDT will identify the critical >40% valve opening treatments to look at and work closely with BON. Consider changing LFS ops as appropriate for the remainder of the season. Come back before 15 December to evaluate the full range of treatments.

It is important to note that this test doesn't influence the proposed structural fixes and therefore won't affect the design schedule. Operational changes would simply complement the structural modifications to the system.

-----Original Message-----
From: Tackley, Sean C NWP
Sent: Wednesday, July 29, 2015 4:19 PM
To: Hausmann, Ben J NWP; Royer, Ida M NWP; Bissell, Brian M NWP; Derugin, Andrew G NWP; Zorich, Nathan A NWP; Wertheimer, Robert H NWP; Gary Fredricks - NOAA Federal; Trevor Conder (trevor.conder@noaa.gov); ed.meyer@noaa.gov; lort@critfc.org; Brian McIlraith; erick.s.vandyke@state.or.us; Kiefer, Russ; Skalicky, Joe; BPA Scott Bettin; Lopez-Johnston,Siena M (BPA) - KEWM-4; Roberts,David A (BPA) - KEWU-4; Mackey, Tammy M NWP; Aaron Jackson; Statler, Dave; Bob Rose (rosb@yakamafish-nsn.gov); Jen Graham; Rerecich, Jonathan G NWP; Eppard, Matthew B NWP
Cc: Welton, Brent C NWP; Schlenker, Stephen J NWP; Roth, Lindsey A NWP; Turaski, Michael R NWP; Kuhn, Karen A NWP
Subject: BON WA Shore Lamprey Flume testing notes - 7/29 (UNCLASSIFIED)
Importance: High

Classification: UNCLASSIFIED
Caveats: NONE

All,

Today's Bonneville WA Shore Lamprey Flume System (LFS) entrained air testing yielded some very useful information. As coordinated with FPOM, we piggy-backed on the ROV inspection of the WA Shore Ladder (during which AWS flow was suspended). This allowed us to get a good look at discharge of entrained air from the LFS' upper entrance area (in the vicinity of the ladder's North Downstream Entrance) under a variety of operational conditions. We focused on documenting response of the entrained air to changes in (1) LFS water supply discharge, as measured by adjusting the % opening of the controlling butterfly valve, and; (2) partial closure of the knife gate located at the junction of

the upper LFS entrance thimble, with the intent of forcing air to "burp" upstream rather than on the fishway side.

The PDT will be compiling notes, video, and photos for further FPOM discussion regarding future settings, but below are a few highlights:

1. Verified that all air that is discharging on the fishway side (in vicinity of NDE and the upper flume) is emanating from the thimble, thereby "hugging" the south wall of the fishway entrance area, regardless of the treatment. In other words, just as we suspected, the entrained air isn't evenly distributed across the width of the NDE. This is good from a salmon passage standpoint.

2. Partial gate closure had a very significant effect on presence of entrained air in the NDE area (on the fishway side of the wall). In fact, the only operations of major concern occurred when the gate was fully open (normal operation) and the butterfly valve opening was above 60%.

3. With the gate fully open, there was a clear threshold somewhere between 50% and 55% in which we went from seeing zero air inside the fishway to seeing a slight, but steady, boil in this area. Concurrently, there was very little air visible on the outside of the fishway, along the bulk of the LFS. Thus, the LFS is able to vent air properly and with almost no discernible effect on the tailrace at about 50% valve opening. 60% didn't look too bad at all and is our current cap.

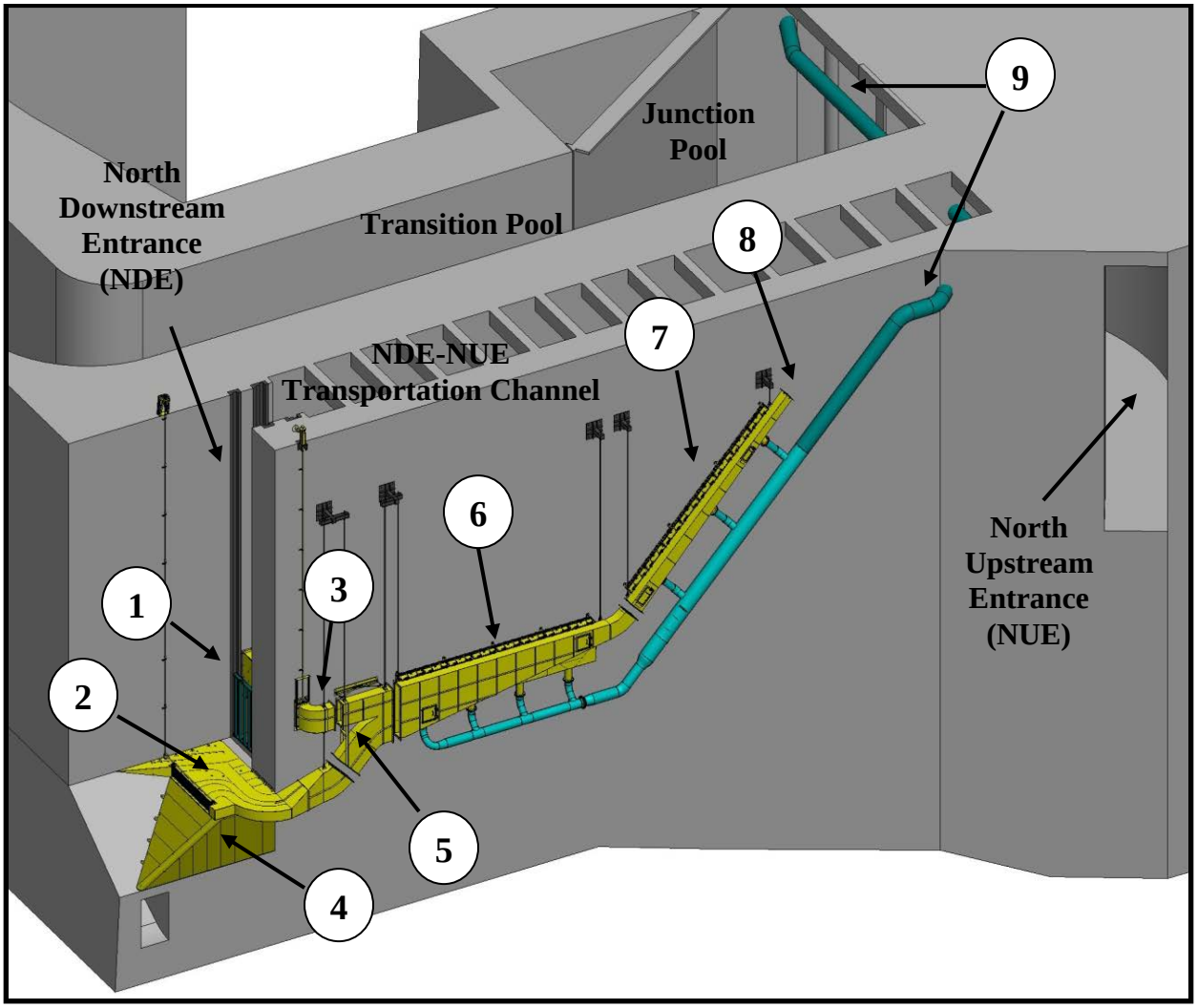
4. The PDT will be recommending some combination of gate closure and higher discharge. One possible "sweet spot" that appeared to strike a good balance of lamprey attraction flow, velocity within the flume in the vicinity of the gate, and presence of entrained air involved a 1 ft gate opening (about 25% of fully open position) and 70% butterfly valve opening. At this setting, there was a light stream of bubbles from the thimble area, with an intermittent and relatively light boil approximately every 40-50 seconds.

At the end of the testing, the team compared notes and decided to leave the flume setting at 1 ft gate opening and 60% valve opening (on local control). This should be considered an interim operation until we can discuss test results with FPOM and agree on setting that will at least get us through the end of the current passage season. I'll reach out to FPOM on this once the PDT has put together our notes. Brian McIlraith was present and may be able to share his observations as well.

Best,
Sean

"Take a method and try it. If it fails, admit it frankly, and try another. But by all means, try something." - Franklin D. Roosevelt

Please email or call with questions or concerns:
Sean C. Tackley
503-808-4751
sean.c.tackley@usace.army.mil




1. Upper Entrance
2. Lower Entrance
3. Thimble, Closure Gate, and Elbow Flume Section
4. Filler Plate
5. Flow Splitter Flume Section
6. Downstream “School Bus” Flume Section
7. Upstream Flume Section
8. Lamprey Flume System (LFS) & Lamprey Passage Structure (LPS) Junction (LPS not shown)

9. Gravity Water Supply Pipe

**Figure 1.** Isometric rendering of the Bonneville Washington Shore Lamprey Flume System.

**Figure 2.** Bonneville Washington Shore Ladder, North Downstream Entrance (NDE), showing the plume of water and air emanating from the upper entrance of the Lamprey Flume System (LFS). This plume appears when the valve controlling water supply to the LFS is set at approximately 40% open or greater. The design team will observe and record response of the plume to simple operational modifications.

**Table 1.** Preliminary schedule of proposed LFS test treatments on July 29-30. Results from tests 1 through 12 will determine flume flow (valve opening) settings for further evaluation in treatments 13 through 28.

| Test No. | Date | Est. Start Time | Flume Flow Valve Opening | Upper Entrance Opening Height (ft) | Air Valve % Open |
|---|---|---|---|---|---|
| 1 | 29-Jul | 10:00 | 80% | 4.50 | Setting 1 |
| 2 | 29-Jul | 10:20 | 80% | 4.50 | Setting 2 |
| 3 | 29-Jul | 10:40 | 80% | 4.50 | Setting 3 |
| 4 | 29-Jul | 11:00 | 60% | 4.50 | Setting 1 |
| 5 | 29-Jul | 11:20 | 60% | 4.50 | Setting 2 |
| 6 | 29-Jul | 11:40 | 60% | 4.50 | Setting 3 |
| 7 | 29-Jul | 12:00 | 40% | 4.50 | Setting 1 |
| Lunch break (20 min) | | | | | |
| 8 | 29-Jul | 12:40 | 40% | 4.50 | Setting 2 |
| 9 | 29-Jul | 13:00 | 40% | 4.50 | Setting 3 |
| 10 | 29-Jul | 13:20 | 25% | 4.50 | Setting 1 |
| 11 | 29-Jul | 13:40 | 25% | 4.50 | Setting 2 |
| 12 | 29-Jul | 14:00 | 25% | 4.50 | Setting 3 |
| 13 | 29-Jul | 14:20 | Flow 1 (TBD) | 2.25 | Setting 1 |
| 14 | 29-Jul | 14:40 | Flow 1 | 2.25 | Setting 2 |
| 15 | 30-Jul | 10:00 | Flow 2 (TBD) | 2.25 | Setting 1 |
| 16 | 30-Jul | 10:20 | Flow 2 | 2.25 | Setting 2 |
| 17 | 30-Jul | 10:40 | Flow 1 | 1.00 | Setting 1 |
| 18 | 30-Jul | 11:00 | Flow 1 | 1.00 | Setting 2 |
| 19 | 30-Jul | 11:20 | Flow 2 | 1.00 | Setting 1 |
| 20 | 30-Jul | 11:40 | Flow 2 | 1.00 | Setting 2 |
| 21 | 30-Jul | 12:00 | Flow 1 | TBD | Setting 1 |
| Lunch break (20 min) | | | | | |
| 22 | 30-Jul | 12:40 | Flow 1 | TBD | Setting 2 |
| 23 | 30-Jul | 13:00 | Flow 2 | TBD | Setting 1 |
| 24 | 30-Jul | 13:20 | Flow 2 | TBD | Setting 2 |
| 25 | 30-Jul | 13:40 | Flow 1 | 0.50 | Setting 1 |
| 26 | 30-Jul | 14:00 | Flow 1 | 0.50 | Setting 2 |
| 27 | 30-Jul | 14:20 | Flow 2 | 0.50 | Setting 1 |
| 28 | 30-Jul | 14:40 | Flow 2 | 0.50 | Setting 2 |