CENWD-PDD 6 October 2008

MEMO FOR: Andrew Kolosseus, Washington State Department of Ecology,
AMT Co-Chair
Agnes Lut, State of Oregon Department of Environmental Quality,
AMT Co-Chair

FROM: Rudd Turner, U.S. Army Corps of Engineers, AMT member

SUBJECT: Corps comments on draft report, "Evaluation of the 115 percent Total Dissolved Gas Forebay Requirement", by Washington State Department of Ecology and State of Oregon Department of Environmental Quality, dated September 4, 2008.

As requested, U.S. Army Corps of Engineers (Corps) comments on the Subject draft report are provided below. Thank you for the opportunity to comment on the draft document. This response has been coordinated with the Bonneville Power Administration (BPA).

Page 8, Executive summary, paragraph 1, sentence 1: The sentence states that both the States of Oregon and Washington are "required to make a recommendation" on the need for the 115% TDG forebay limit. The Oregon DEQ was instructed to evaluate the need for the 115% forebay limit by the Oregon Environmental Quality Commissioners following testimony given at a public hearing on the TDG waiver in June 2007. The report should explain briefly why the State of Washington also considers this a "requirement", or if there is another mandate driving their part of the process.

Page 8, paragraph 2, sentence 1: The weight of evidence approach means weighing two or more arguments and giving greater weight to the most plausible and relevant argument. The draft report needs to show how this weighting has been done to answer the question of need for the 115% TDG forebay limit.

Page 8, Executive Summary, paragraph 3, sentence 3: The original scope of the AMT question about the 115% TDG forebay limit included the PUD-owned dams in the Middle Columbia River, not just the Corps dams on the lower Snake and Columbia rivers. We were not aware that the scope of the question before AMT had been narrowed; please explain why this change occurred and how the Columbia River at the PUD dams will be considered.

Page 11, TMDL Overview, paragraph 1, sentence 1: The sentence is not correct. The TDG water quality standards for Oregon and Washington are not identical. As shown on page 9, Oregon's TDG standard includes a limit of 105% TDG in hatchery receiving waters and other waters of less than two feet in depth. Also the Washington standard includes the 115%/120% forebay/tailrace limits as a criteria adjustment to aid fish passage over hydroelectric dams (Chapter 173-201A WAC, page 15). These additional criteria should be included in the Overview.

Page 11, TMDL Overview, paragraph 4: The report states, "Elevated TDG levels are caused by water flowing over the spillways (spill events) at hydroelectric dams on the Columbia and Snake rivers. Water plunging from a spillway entrains air causing increases in TDG." To single out TDG produced from the spillway as the only source of TDG is an oversimplification of the TDG production on the Lower Columbia and Snake rivers. A more comprehensive understanding of TDG production, including natural sources, becomes especially important when considering data from the Camas Washougal area since it is a shallow reach and is affected by environmental factors. The Corps suggests that a new segment called, "Overview of TDG production" be added at the beginning of the "Background" section, with the following information included:

Based on many site specific TDG research studies, Biological Opinion RPA 132 studies on forebay gages, and the continuing fixed monitoring program, the Corps found that water spilled over the spillway is a primary source of TDG levels and there are other sources and processes that shape the total dissolved gas conditions at any sites.

Water spilled over the spillway is a primary source of TDG levels and can cause significant rises in TDG levels during the fish passage season. When the water flows over the spillway, air is trapped and entrained in the water causing the total dissolved gas levels to rise.

The other sources and processes that shape the total dissolved gas conditions at any sites include wind, photosynthesis and climate, as described below.

- High wind gusts can remove TDG from the river, producing a degassing effect that ranges from minimal to an 8% drop in TDG. The degassing effects of wind can be significant, especially in the Columbia River gorge area.
- The conversion of light energy into chemical energy by aquatic organisms through the photosynthesis process can generate TDG that has different oxygen isotope content than TDG generated through spill. Research has found that photosynthesis can produce a 1% to 2% TDG increase in shallow reaches.
- Warm, sunny weather can cause water temperatures to rise as much as 3.5 F which can result in a rise of 2 to 4% TDG. The magnitude of effect from climate (solar radiation and atmosphere temperature) is dependent upon the shallowness of the reach, and stratification of the pool. Shallow reaches like the tidal reach below Bonneville dam are more responsive to weather than deep reaches. Vertical stratification is more prominent in deep river reaches than shallow river reaches. When vertical stratification is an issue, then gage depth is important. This was the situation for the forebay gages that were lowered on the Lower Snake river and McNary in 2004. Because there is no thermal stratification in the tidal reach below Bonneville dam, the depth of the Camas gage is not an issue. Although the Camas gage is shallower (5 to 20 ft) than other forebay gages, it is accurately measuring the TDG levels in the dominant aquatic habitat. As such, it is well suited to monitor water quality in that segment of the water body and manage spill at Bonneville Dam and other lower Columbia projects.

Page 11, TMDL Overview, paragraph 5, sentence 2: Suggest the sentence be rewritten to state: "Voluntary" spills are provided to help meet juvenile fish survival goals. Spill is one of several fish passage strategies that improve passage conditions. It is not the only action available

to aid fish passage. Also, juvenile passage performance standards in the 2008 FCRPS BiOp are percent survival levels for spring and summer migrants (96% spring and 93% summer).

Page 13, TMDL Implementation, paragraph 1, sentence 3: Edit the sentence: "...operational changes to dams to attempt to achieve the water quality standard for TDG." It is unlikely that operations or structural changes at dams will fully achieve the 110%/105% TDG state standards without drastically modifying current spill regimes and impacting fish survival.

Page 13, paragraph 3, sentence 2: The report states, "The current TDG fixed monitoring station system consists of tailrace and forebay monitoring stations at each mainstem lower Snake and Columbia River dam. While most of these stations do a credible job of reporting meaningful data, some stations produce questionable data." On page 17, there is also a statement questioning the forebay gage validity which says, "Although the forebay monitors were relocated and lowered deeper into the water column in 2004 and 2005, questions regarding their validity still exist." The many on-site specific TDG exchange research studies, RPA 132 TDG studies and the continuing fixed monitoring station program have shown that forebay gages accurately reflect the TDG levels in the dominant aquatic habitat of the hydroelectric dams. The Corps data from the existing TDG fixed monitoring stations provide accurate and reliable data that meets the QA/QC standards established through the regional water quality forum process. The gages are calibrated every three weeks to a primary and secondary standard as established through the regional forum process; USGS and the Corps perform data quality reviews daily and the gage exceed the 95% data completeness standard.

Page 16, paragraph 3, sentence 2: Add the Fish Passage Center to the list of regular attendees.

Page 16, Forebay Gauge History, paragraph 1, sentence 1: The sentence says, "Currently, there is no one single entity researching the validity (representativeness) of the forebay monitors. However, several past studies evaluated the application and use of the forebay monitors as it relates to fish passage spill." This statement does not properly reflect the extensive and consistent actions the Corps has taken to establish the accurate and representative fixed monitoring station system that exists today. The Engineering Research and Development Center (ERDC), formerly Waterways Experiment Station (WES), of the US Army Corps of Engineers performed 28 TDG exchange research studies on forebay and tailwater gages on the Lower Columbia and Snake Rivers. The Corps spent millions of dollars over a eleven year period (1996 to 2007) studying the impacts of project operations on total dissolved gas loading, TDG exchange processes and representativeness of the gages. These TDG research studies had multiple transects, with each transect containing multiple (2 to 8) gages that were installed to measure the TDG levels at different points across the river. Consistently, these research studies showed variability in TDG levels from gage to gage within the transect. The variability of TDG levels were found to be minimal with the forebay transect gages but more pronounced in the tailwater transect gages. These results reflect the fact that high TDG levels are generated from the spillway and forebay TDG levels are carried through the powerhouse so that TDG levels can be different at different points in the tailrace.

Page 18, question 2, paragraph 1: Additional spill will not increase fish passage; instead, it may increase the proportion of fish using the spillway to pass a dam. This could decrease

survival at projects with lower spill survival. In the last sentence, increased TDG may increase sublethal, chronic toxicity effects, not just gas bubble trauma, in aquatic species.

Page 18, Spill Volume Considerations: It is unclear what the purpose or message is in this section of the report. It states that setting or limiting spill volumes will occur in other FCRPS forums and not at AMT. This is correct for specific project spill discharge rates or percentages for fish passage. However, decisions on TDG limits can result in changes to levels of spill at projects, which in turn may have positive or negative impacts on fish survival and adult returns.

At Lower Monumental Dam, for example, higher spill levels will mean less transportation of juvenile fish. The COMPASS analysis completed for AMT showed a very small increase in Snake River spring/summer Chinook with this operation, but a larger decrease in survival for Snake River steelhead which greatly benefit from being transported below Bonneville Dam. This may be a consequence of further relaxing the TDG limit from where it is now, if the Action Agencies decide to manage spill up to the more relaxed TDG limits. The states should factor this effect into their decision.

Page 18, paragraph 2, bullet 3: CSS = Comparative Survival (not Comparable Survivability) Study

Page 22: The synthesis report says, "The FPC ran scenarios with differences in planned operations ranging from the base case (what was actually implemented in that year) to what would occur if there was no spill management except for the 120% TDG requirement (meaning projects were not managed to a specific spill program but spilled the full volume of water to the 120 % TDG). The non-baseline scenarios were defined as:

Scenario B: Spill that would have occurred if all projects spilled to the 120% cap on days when spill was restricted by the 115% downstream forebay (but not the 120% tailrace)

Scenario C: Spill that would have occurred in that year if all projects spilled to the 120% cap (limited by planned operations).

Scenario D: Spill that would have occurred in that year if all projects spilled to the 120% cap (not limited by planned operations)."

These descriptions need to be more comprehensive so that readers are able to understand why the Fish Passage Center can estimate an additional 5.9 to 58.0 MAF will result from removing the 115% TDG standard when the Federal analysis says that an additional 0.4 to 5.0 MAF will occur. The additional descriptions that should be included are: An Excel spreadsheet was used to estimate changes in spill volumes; involuntary spill was removed from all scenarios; one spill cap per project was used for all scenarios in all years; Scenario A and B used the spill operations for the years studied; Scenario C used some spill operations proposed in litigation; scenario D replaced the current 2008 FCRPS Biological Opinion required spill operations with a 24/7 spill to the gas cap spill regime. Since spillways may not be the highest survival passage route at a project, more spill does not necessarily improve fish passage.

The Fish Passage Center's scenarios C and D in their spill analysis modified current required spill operations. Information from these two scenarios was used throughout the states' synthesis report. The inclusion of information on Fish Passage Center's scenario C and D is inappropriate, confusing and misleading since modifying required spill operations is not part of the discussion

of whether the 115% TDG standard is needed. As a result of including scenario C and D Table 3 on page 22 shows additional spill of 5.9 to 58.0 MAF would occur if the 115% forebay TDG standard was removed. Based on many SYSTDG modeling simulations, it is necessary to modify required spill operations to gain 5.9 to 58 MAF of additional spill *in addition to* removing the 115% TDG standard. Spill operations are an archetype of the "management issues" that WDOE and ODEQ have said are not within the AMT's purview.

Page 25, USACE Analysis (SYSTDG), paragraph 1, sentence 2: The statement is not correct. The Fish Passage Center commented on the Corps' draft analysis (AMT document # 620).

Page 25, USACE Analysis (SYSTDG), paragraph 2, sentence 2: The date of the draft BiOp used in the Corps' analysis was October 31, 2007, not March 17, 2008.

Page 26, Figure 6: This figure shows the increase in spill (Percent increase over base case) based on Corps SYSTDG analysis of spill volumes. The Corps was not able to duplicate this graph as a seasonal average and it appears that the highest monthly percentage averages were used to create this graph. If this is the case, then it is not a proper representation of the SYSTDG model results.

Pages 27 – 28 and 42 - 44: Figure 7 – 9 on page 27 - 28, Table 12 and 13; and Figures 16 and 17 on page 42 – 44 need to be labeled seasonal averages (absolute).

Page 28, Table 4: This table needs to be labeled absolute percentage of water spilled.

Page 29, Figure 10: In this figure, HYDSIM Analysis is a better description than the current label of "BPA calculated".

Page 29: The descriptions on Table 5 and 6 on page 29 could be more informative by using FPC – Excel spreadsheet instead of FPC; BPA - HYDSIM instead of BPA; and USACE – SYSTDG instead of USACE.

Page 29, Table 6: This table needs to be labeled relative to percentage additional spill amount. Also, using a percent of a percent is not a statistically reliable methodology.

Page 30, paragraph 1: The Corps agrees that the states need to be careful in using the spill volume analyses in making a decision on the 115% TDG forebay limit. However, the issue is not so much how to compare analyses as it is which of the analyses are most valid and relevant to the question before the states? The report does not discuss this aspect of the information at all, and it needs to. Which assumptions in the studies are the most valid to the specific question before AMT? Results were quite different between the NOAA/BPA/Corps analyses and those provided by the Fish Passage Center, USFWS, and CRITFC. The report needs to weigh in on the information provided, and do more than simply recite what data were presented at the meetings. This is true for both the physical and biological information. Such an assessment is lacking in this report, and it is key to making a defensible decision. Moreover, the states' report should acknowledge that SYSTDG and HYDSIM are management tools that are regularly used to determine FCRPS operations, often on a daily basis. An additional issue is that, while comments on the presentations were acknowledged, and there were a lot of them, the states do

not report doing anything with the comments. How were the comments considered? Which were the most relevant and valid in providing insight to the question before the states? This needs to be explained in the report as well.

Pages 34 – 35, Figures 13 – 15: These relationships are not relevant to the AMT spill question if the year 2001 is included. It was an extremely low flow year with very little project spill. Analyses with 2001 removed show little relationship between spill and water travel time with survival. Also the spill changes likely to occur from removing the 115% TDG forebay limit are very small relative to the ranges on the graphs.

Page 36, paragraph 3: Zero change in survival carried out to 3 decimal places is zero as far as the science is concerned, and it should be zero as far as management decisions are concerned. There is no biological meaning to carrying out survival estimates to the maximum precision and saying there would be a "small positive difference between alternatives". This conclusion is not valid, and it should be removed from the report.

Page 38, paragraph 1, last sentence: The transport statement should not be attributed to AMT, since it does not represent the views of all AMT members and participants, including the Corps. Transportation is one of a number of management options considered in the Federal analysis, as well as the analyses by the Fish Passage Center and USFWS. Assumptions about river management are embedded in all the AMT analyses, and they cannot be ignored in discussions about effects of maintaining or removing the 115% forebay limit.

Page 40, Synthesis of FPC, USFWS, NOAA and CRITFC Analyses: This section treats all the analyses equally and therefore is incomplete. Which of these conclusions is the most valid, in the view of the states? Why are they more valid? What conclusions do you draw from the information provided? This is a key part of the states' decision rationale and it is an essential part of the final report.

Page 40, paragraph 1, sentence 2: The "simulated" data in the Federal modeling analyses are based on empirical data. There is significant overlap and consistency between the two types of information.

Page 46, paragraph 5: The Ecology literature review was the most thorough of the reviews submitted to AMT. It has important recommendations on page 5 that should be included in this paper. Ecology noted that significant data gaps exist in a number of important areas related to TDG impacts on fish and other species, and that, until more is known about effects, caution is advised. The Corps and BPA support this conclusion.

Page 52, GBT Monitoring Program, Table 18: The FPC results show an upswing in external signs of gas bubble trauma in sampled fish when TDG levels approach or exceed 115% of saturation at the tailrace of the next project upstream. This indicates that 115% TDG may be a safer waiver limit than 120%, or at least that the 115% forebay limit should be retained if it does not cause significant survival loses at dams. In addition, gas bubble trauma signs are sometimes reported inriver when TDG levels are less than 115%. These data, combined with the results of the literature reviews, indicate that 115% TDG saturation in the river is a good measure of overall ecosystem health and may be used as an indicator of a reasonably safe condition for most

aquatic organisms. TDG levels above 115% are associated with increased toxicity effects and represent a higher risk of TDG effects on aquatic species.

Page 54, Agencies Decisions: We assume that the states will include more than the decision itself in this section. The final section should include:

- Responses to AMT members' comments on the draft synthesis report.
- Methods for weighting and results pertaining to the weighting of the various pieces of technical information.
- How AMT members' comments on technical reports throughout the process were used to weigh the technical information.
- Decision rationale: Which information is most relevant to the question, and how the technical information leads to the states' decision.
- How the decision helps move the lower Columbia and Snake rivers water bodies towards the TMDL goal of attaining the 110%/105% TDG water quality standard.