Paula Wilson

From: Kevin Lewis <kevin@idahorivers.org>
Sent: Friday, September 09, 2011 9:57 AM
To: Paula Wilson
Subject: Proposed rule - WQS/site-specific temperature criterion forSnake River/Hells Canyon, Docket No. 58-0102-1102

Paula,
Please include the Idaho Rivers United June 24, 2011 letter (and its attachments) regarding the proposed rulemaking for a new fall Chinook
spawning temperature criterion as a comment on the proposed rule.

If there is more information you need, please let me know.

Thanks!
Kevin

If you love a river…

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June 24, 2011

Barry Burnell
Idaho Department of Environmental Quality
Headquarters Office
1410 North Hilton
Boise, Idaho 83706

Subject: Comments on Negotiated Rule Making for Site Specific Temperature Criteria for Fall Chinook Salmon Spawning in the Hells Canyon Reach of the Snake River

Dear Mr. Burnell:

Idaho Rivers United (IRU) provides the following general comments on the above mentioned Rule Making. IRU is concerned that the existing standard is not fully protective of fall Chinook spawning in the Hells Canyon reach of the Snake River and weakening the existing standard will be even less protective.

At this time, there is little consensus among interested parties on the possible effects of the proposed rule change let alone the existing conditions in the affected river reach. IRU is concerned that early season returning fish may currently be encountering water temperatures in excess of accepted safe levels and raising the standard does nothing to protect listed stocks. Additionally, it is unclear what the composition of wild to hatchery fish is in the early returnees and whether wild stocks may be impacted in a greater percentage than hatchery fish.

Prior to the completion of rule making, IRU believes a full analysis of wild fall Chinook spawning population numbers and timing is necessary in order to ensure that any temperature standard is fully protective.

Finally, attached are comments previously provided to Oregon DEQ and a review by Dr. Richard Williams of Idaho Power's previous TEMP proposal.

Respectfully,

Kevin Lewis, Conservation Director
Idaho Rivers United

American Rivers · Idaho Rivers United · Northwest Sportfishing Industry Association · Save Our Wild Salmon · Trout Unlimited

January 28, 2011

Bill Blosser, Chair
Oregon Environmental Quality Commission
DEQ Headquarters Office
811 SW 6th Avenue
Portland, OR 97204
Re: Request for Denial of Idaho Power Company Petition for Rulemaking

Dear Mr. Blosser:

American Rivers, Idaho Rivers United, Trout Unlimited, Save Our Wild Salmon, and the Northwest Sportfishing Industry Association, respectfully request the Oregon Environmental Quality Commission (Commission) deny the petition filed by Idaho Power Company (IPC) to Initiate Rulemaking for Site Specific Temperature Criteria for Fall Chinook Salmon Spawning in the Hells Canyon Reach of the Snake River.

According to ORS 183.390, the Commission must consider a number of items when taking action on a petition for a rule amendment. This letter provides information and clear rationale that the IPC petition should be denied.

Idaho Power Company (IPC) is the owner and operator of the Hells Canyon Hydropower Complex (HCC or the Project). The HCC is located on the Snake River just south of the Hells Canyon National Recreation Area, and consists of three dams and reservoirs that inundate approximately 100 miles of the Snake River. The HCC currently blocks the upstream migration of fall Chinook salmon, spring/summer Chinook salmon, and steelhead, all of which are listed under the federal Endangered Species Act (ESA).[1]

For nearly ten years, the HCC has been involved in the Federal Energy Regulatory Commission (FERC) hydropower relicensing process; the Project's previous FERC license expired in 2005 and IPC has been operating the Project pursuant to annual licenses since that time. As part of the relicensing process, IPC must obtain water quality certifications from the states of Idaho and Oregon pursuant to Section 401 of the Clean Water Act.[2] Water quality certification of the HCC is one of the few remaining steps required before FERC may issue a new operating license for the project.

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[1] 16 U.S.C. §§ 1531-1544. All three of these populations are listed as threatened under the Endangered Species Act. *See*: 71 FR 834 (January 5, 2006)(Snake River steelhead); 70 FR 37160 (June 28, 2005)(Snake River spring/summer Chinook and Snake River fall run Chinook).

[2] 33 U.S.C. § 1341.

To date, IPC has withdrawn and resubmitted its water quality certification application a number of times. Different applications have proposed different approaches to provide reasonable assurance that water quality standards, including the existing temperature standards below the HCC, can be met. However, IPC has continually failed to provide sufficient information upon which the Oregon Department of Environmental Quality (ODEQ) can base its analysis, requiring ODEQ to repeatedly request additional information. Rather than develop a comprehensive proposal that demonstrates compliance with Oregon and Idaho water quality standards, IPC is now proposing to weaken the standard. Adoption of the new temperature standard proposed by IPC will effectively allow the company *to avoid implementing measures sufficient* to address the water quality impacts of the HCC. Such an outcome in a relicensing process that takes place only every 30 to 50 years is unacceptable, and places an undue burden on salmon and steelhead located below the HCC.

We respectively request that the Commission deny IPC's Petition for the following reasons:

First, the existing standard is, in our opinion, barely sufficient to protect the ESA listed populations of salmon, steelhead and bull trout that inhabit the reach below the HCC. Increasing the temperature standard – especially during the early part of the spawning season – threatens the productivity and genetic viability of wild stocks. IPC asserts that the recent increases in salmon runs below the HCC demonstrate that fall Chinook are spawning successfully and that the current conditions are supporting the beneficial use. We disagree with this assertion. Recent increases in numbers of spawning fall Chinook do not lead to the conclusion that the temperature violations are not adversely impacting the species. Many factors may be contributing to the increased numbers (including expanded hatchery supplementation), which may be occurring despite the adverse impacts in temperature.

In 2010, American Rivers and Idaho Rivers United contracted with Dr. Richard N. Williams[3] to examine IPC's proposed plan to address the temperature problem below HCC set forth in its October 15, 2009 water quality certification application. That application outlined IPC's proposed Temperature Enhancement Management Program (TEMP), a program that was abandoned in IPC's most recent application. In his report, Dr. Williams provides an extensive review of impacts, standards, and possible alternatives for meeting the existing temperature standard. While the report was written to review IPC's TEMP proposal, much of the review done by Dr. Williams remains relevant, particularly the discussion of adverse impacts to salmon and steelhead from elevated temperatures. We urge the Commission to incorporate Dr. Williams's review into its decision making process.

Second, the studies upon which IPC relies in making its request do not justify a weakening of the standard, particularly when the beneficial uses to be protected affect ESA listed species – in this instance spawning and incubation for Snake River fall Chinook, a threatened species.

The ESA requires adoption of a precautionary principle. Effective conservation management requires a conservative, species-protective approach to ensure that management decisions made

[3] Attachment 1 – Review of Idaho Power Company's Proposed Temperature Mitigation Projects Related to the Hells Canyon Complex (HCC), January 22, 2010.

in the face of uncertainty do not place the species further at risk.[4] The U.S. Supreme Court has recognized the importance of this approach in ESA decision-making, reasoning that "Congress has spoken in the plainest of terms, making it abundantly clear that the balance has been struck in favor of affording endangered species the highest of priorities, thereby adopting a policy which it described as 'institutionalized caution.'"[5] The ESA's policy of "institutionalized caution" requires that [t]he risk [presented by an action] must be borne by the project, not by the endangered species. . . .Congress clearly intended that [federal agencies] give the 'the highest of priorities' and the 'benefit of the doubt' to preserving endangered species."[6] Adoption of a weaker standard than currently exists places the risk of uncertainty squarely on the backs of listed stocks.

Third, as you are well aware, under federal regulation, changes to water quality standards are taken very seriously. Although IPC has failed to submit a water quality certification application that adequately addresses the temperature impacts of the HCC, it is our view that the current standard is achievable with existing technology and will not pose an undue financial burden on IPC. For example, should a temperature control structure be required to ensure compliance with water quality standards, there are numerous regional examples of dam operators installing similar structures at their projects. Portland General Electric recently installed a multi-million dollar temperature control structure and fish collection facility at the Pelton Round Butte Project; ODEQ found that the structure was necessary to address water quality impacts below the Pelton Round Butte Project and required its installation in its Section 401 water quality certification for the project. Under these conditions, the Commission should not contemplate a change to the existing standard.

For the reasons identified above, we respectfully request that the Commission deny IPC's Petition to Initiate Rulemaking for Site Specific Temperature Criteria for Fall Chinook Salmon Spawning in the Hells Canyon Reach of the Snake River. A higher temperature standard, as proposed by IPC, is inconsistent with Oregon's water quality goals and insufficient to protect the beneficial uses in the Snake River downstream of the Project.

Please contact any of us if you have questions or need additional information.

Sincerely,

Kevin Lewis
Idaho Rivers United

Brett Swift
American Rivers

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[4] *See* Noss, R.F., M.A. O'Connell, and D.P. Murphy. The Science of Conservation Planning. (Island Press. Washington, D.C. 1997)

[5] *Tennessee Valley Authority v. Hill,* 437 U.S. 153, 194 (1978).

[6] *Sierra Club v. Marsh,* 816 F.2d 1376, 1386 (9th Cir. 1987) (citations omitted) (emphasis added).

Kate Miller
Trout Unlimited

Liz Hamilton
Northwest Sportfishing Industry Association

Nicole Cordan
Save Our Wild Salmon

Review of Idaho Power Company's Proposed Temperature Mitigation Projects Related to the Hells Canyon Complex (HCC)

Dr. Richard N. Williams
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22 January 2010

for
Idaho Rivers United and American Rivers

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I. Executive Summary

The report examines Idaho Power Company's (IPC) plan to mitigate temperatures downstream of the HCC as part of the FERC relicensing process for the Hells Canyon Complex of Dams. Compliance with water quality standards, including temperature, is needed for IPC to obtain a Water Quality Certificate under Section 401 of the Clean Water Act. Idaho Power Company proposes a watershed-based riparian restoration program in upstream tributaries called TEMP (Temperature Enhancement Management Program) to mitigate for exceeding TMDL allowances in temperature below Hells Canyon Dam, particularly in October as Snake River fall Chinook are entering their spawning period. The TEMP plan is described in IPC's October 15, 2009 Hells Canyon Complex (HCC) Application for Certification under Section 401 of the Clean Water Act. The Hells Canyon Complex of dams (Brownlee, Oxbow, and Hells Canyon) is presently undergoing FERC relicensing (Hells Canyon Complex FERC N0. 1971 License Application). The new license would set operating parameters for the next 30 to 50 year operating period as set by FERC; consequently, it is important that new license measures adequately address the biological impacts on downstream salmonid communities presently impacted by HCC operations.

The Idaho Power Company's TEMP watershed approach appears unlikely to adequately address water quality standard violations below the HCC during the September-October time period when Snake River fall Chinook are entering the reach and preparing to spawn. The TEMP plan describes a well-considered process to work toward achieving its goals; however, it lacks adequate details on stakeholders, project review and selection, specific target restoration projects, and assurances that stakeholders and private landowners are ready and willing to participate in the plan. These uncertainties raise questions and make it difficult to assess the likelihood of success of the TEMP plan. Large portions of the lower Boise and Payette Rivers, two of the major tributaries above the HCC, are in private ownership, which will slow or not allow the implementation of restoration work, based on my experience in other watersheds where lands are primarily in private hands. Additionally, biological responses of the riparian systems on tributary rivers are uncertain and will require decades, perhaps well in excess of the 40-year license period, to respond at a scale that will significantly reduce water temperatures flowing into the HCC. These factors, coupled with the loss of cooling benefits that will occur in the lower portions of major tributary systems flowing into and through the HCC (Boise, Payette, Owyhee rivers) and predictions of the impacts of climate change in the Pacific Northwest, make it extremely unlikely that the watershed-based TEMP plan can adequately address temperature mitigation below HCC.

Finally, IPC should evaluate the use of Temperature Control Structures (TCS), which have been used successfully in many rivers systems impacted by large storage dams (Sacramento, Clearwater, Green, Colorado, McKenzie, and Flathead) to mitigate temperature effects and successfully restore more seasonal flows and natural thermal regimes downstream of the projects for the benefit of local fish and wildlife. Installation and operation of a TCS on Brownlee Dam could likely successfully mitigate for temperature impacts downstream of HCC in most years, thereby increasing productivity, stability and sustainability of fall Chinook and steelhead populations in the Snake, Salmon, and Clearwater rivers. Moreover, installation and operation of a TCS could occur in a matter of a few years (3-5), rather than the 40-80+ year time horizon of IPC's TEMP approach.

II. Purpose of Report

This report reviews Idaho Power Company's August 8, 2008 Hells Canyon Complex (HCC) Application for Certification under Section 401 of the Clean Water Act (Idaho Power Company, Hells Canyon Complex FERC N0. 1971 License Application; last revised 15 October 2009). The Hells Canyon Complex of dams (Brownlee Dam, Oxbow Dam, and Hells Canyon Dam) is presently undergoing FERC (Federal Energy Regulatory Commission) relicensing. The new license would set operating parameters for the next operating period, which could range from 30 to 50 years; consequently it is important that any new license contain measures that adequately address the impacts of the HCC, including the biological impacts of the HCC on downstream salmonid communities presently impacted by HCC operations. A critical part of the relicensing requirements is for Idaho Power Company to obtain a Clean Water Act 401 water quality certificate from both Idaho and Oregon, as the HCC straddles the Snake River between the two states. Obtaining the 401 certificate is one of the last remaining issues in the relicensing process.

The report examines Idaho Power Company's proposed plan to mitigate temperatures downstream of the HCC. Idaho Power Company (IPC) proposes a Temperature Enhancement Management Program (TEMP) that relies on a watershed approach to mitigate temperature effects of the HCC. The primary focus of the review will be to assess whether IPC's proposal is adequate (or the likelihood that it is adequate) to deal with the downstream temperature issues below the HCC. I also briefly discuss a mitigation alternative to the TEMP approach proposed by IPC – the use of a temperature control structure (TCS). Temperature control devices have been used successfully to resolve downstream temperature issues and to restore a degree of natural seasonal flows to riverine ecosystems in the Colorado, Sacramento, Flathead, Green, and Mackenzie Rivers. Finally, I discuss the potential application of TCS to resolve downstream temperature concerns in the Lower Snake River reach below Hells Canyon Dam.

III. Approach

I reviewed Idaho Power Company's application for a Clean Water Act § 401 Water Quality Certificate (8/8/08), as well as supplements dated 2/20/09 and 10/15/09). I reviewed IDEQ and ODEQ's 2004 Snake River – Hells Canyon Total Maximum Daily Load (TMDL) white paper. I also reviewed some correspondence between IPC, EPA (Environmental Protection Agency), and CRITFC (Columbia River Inter-Tribal Fish Commission). Finally, I discussed the IPC § 401 application with Bob Heinith (CRITFC), Ben Cope (EPA), and John Palmer (EPA) to better understand their ongoing concerns over the HCC relicensing and IPC's violation of water quality standards.

I discussed lake and reservoir ecology with Dr. Jack Stanford, Director of the Flathead Lake Biological Station (University of Montana) in Polson, Montana, an expert on regulated rivers and on lake and reservoir ecology. I discussed riparian habitat response timing and riparian cooling capabilities with Dr. Pete Bisson, Senior Ecologist with the Pacific Northwest Research Station (US Forest Service). Finally, I discussed the efficacy of temperature control structures (TCS) to resolve downstream water quality and ecological issues with Dr. Stanford and briefly with Brian Marotz (Montana Department of Fish, Wildlife, and Parks) who has

experience with TCS installation and use at Hungry Horse Dam in the Flathead River subbasin. Documents reviewed are referred to throughout the text. Dates are given for memos and letters; technical reports and scientific references are listed in the Literature Cited section at the end of the report.[1]

IV. General Background - Hells Canyon Complex and Idaho Power Company

Hells Canyon, the deepest canyon in North America, lies on the boundary between Idaho to the east, and Oregon and Washington to the west. Much of the canyon, approximately 70 miles in length and 10 miles in width, is in public land ownership, including the Hells Canyon Wilderness Area and the Hells Canyon National Recreation Area. The Recreation Area is abutted by the Payette National Forest to the east in Idaho and the Wallowa-Whitman National Forest to the west in Oregon (Figure 1).

In the 1940s, Idaho Power Company saw the potential for hydropower development in the Hells Canyon area and applied in 1947 to FERC (then called the Federal Power Commission) to build a three-dam complex in Hells Canyon. The license was granted in 1955 and Brownlee, the first of the three HCC dams, was completed in 1958 (Chapman 2009).

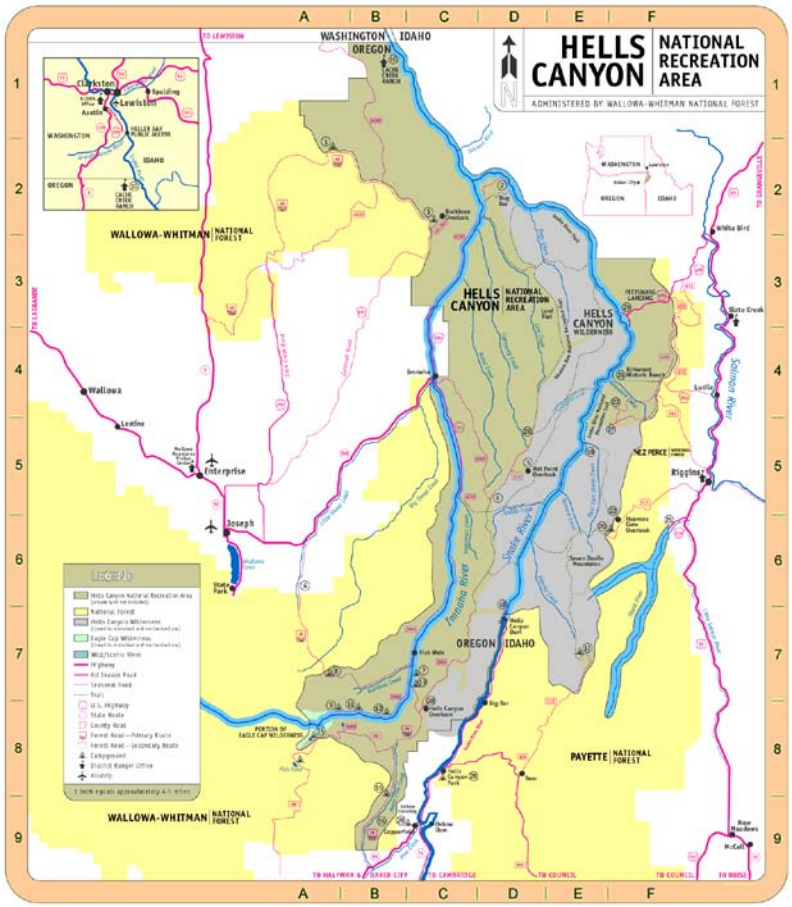

Figure 1. Map of Hells Canyon National Recreation Area and adjacent lands (from USFS Hells Canyon National Recreation Area website).

[1] All documents reviewed for this report are listed in Appendix 1. Technical reports and scientific literature are cited within the text and full references provided in the Literature Cited Section.

Oxbow Dam (12 miles downstream) was completed in 1961; Hells Canyon Dam (26 miles downstream from Oxbow) was completed in 1967. None of the three dams allows fish passage today, although passage was included in the original license and subsequently attempted. Fish passage planning and implementation was delayed and confounded by two downstream proposals to build high storage dams in Hells Canyon. Neither of the two proposals came to fruition, but uncertainty associated with them and the difficulty they would have posed for fish passage, made fish passage efforts at the HCC a lower priority than they might otherwise have been.

Fish passage activities for the HCC began in the early-1950s with a variety of plans and experiments on fish ladders for adult passage; however, like elsewhere in the Columbia River Basin, providing passage for (or collecting) downstream migrating juveniles proved difficult – extremely so in the case of the large, slow-moving and thermally-stratified Brownlee Reservoir. By 1958, Idaho Power had abandoned passive passage for adult migrating salmon and steelhead via ladders in favor of a trap-and-haul passage system, moving the trap successively downstream with the completion of Oxbow (1961) and Hells Canyon (1967) dams. For the next six years, adult salmon and steelhead were trapped, then trucked around Brownlee Reservoir and released into the Snake River above the reservoir.

By 1964, even the trap-and-haul passage system was abandoned after recognizing the ongoing water temperature problems above the project and the failure to achieve passage for juvenile salmonids through Brownlee Reservoir and Brownlee dam. At this point, mitigation efforts shifted from trying to maintain Chinook and steelhead populations above the HCC to hatchery-based production for returns of these species into the Snake River below the HCC primarily for recreational harvest. Artificial production for spring Chinook and summer Chinook was directed to the Rapid River and Pahsimeroi hatcheries, respectively, on the Main Salmon River. Hells Canyon steelhead production used hatchery facilities at Niagara Springs (Hagerman) in the Thousand Springs area. Acclimation and release facilities were also developed along the Snake River below Hells Canyon Dam, such as those at Pittsburg Landing, for release of fall Chinook smolts (NPCC 2009). Fall Chinook continue to use the Snake River below the HCC for spawning and rearing habitat; indeed, they are one of the foci of the IPC § 401 Clean Water Act application and of this review.

V. Water Quality Standards and the HCC TMDL

A. *The Clean Water Act*

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the physical, chemical, and biological integrity of the nation's waters (33 USC § 1251.101). For waters that fail to meet CWA water quality standards and are listed as impaired (a 303(d) listing under the Clean Water Act), a TMDL (total maximum daily load) must be developed for the pollutants causing the impairment and the TMDL must be set at a level to achieve water quality standards. Idaho Department of Environmental Quality (IDEQ) and Oregon Department of Environmental Quality (ODEQ) jointly developed a TMDL for the Snake River–Hells Canyon reach (RM 409 to RM 188) in 2004 (IDEQ and ODEQ 2004). The SR-HC reach

(or some portion thereof) is 303(d) listed as impaired for the following pollutants: bacteria, mercury, nutrients, pesticides, pH, sediment, and temperature.

B. *Hells Canyon Complex and TMDL Allowances*

The HCC has significantly altered the seasonal flow and temperature patterns in the downstream Snake River area resulting in biological impacts on native species, including Snake River fall Chinook salmon, listed as threatened under the Endangered Species Act (ESA). This is a common result of large-scale impoundments, particularly serial impoundments, such as occurs within the HCC and the larger Snake River basin system (Poff et al 1997; Stanford et al 1996; ISG 1999). River temperatures below HCC are unnaturally cool in the spring and early summer, and unnaturally warm in the late summer and fall, as compared to the pre-development natural river (IDEQ and ODEQ 2004; EPA 2008). River water temperatures below the HCC violate a number of standards from Idaho, Oregon, and Washington, including Oregon's "natural seasonal thermal pattern" standard, which calls for restoring a more natural annual thermal pattern by correcting the elevated temperatures coming out of HCC during the late summer and fall period (IDEQ and ODEQ 2004; EPA letter of 4/9/09).

Currently, water flows coming out of HCC during September and October exceed TMDL maximum weekly temperature allowances during the late summer and at the start of the fall Chinook spawning season of each year (IDEQ and ODEQ 2004). The increased temperatures have the potential to adversely affect spawning, incubation, hatching, rearing, and outmigration life-history segments for fall Chinook salmon and steelhead; however, the primary impact is on fall Chinook, which are fall spawners rather than on spring-spawning steelhead.

Idaho Power Company's Hells Canyon Complex (HCC) Application for Certification under Section 401 of the Clean Water Act addresses temperature violations of the water quality standards. The 303(d) listing is for the entire SR-HC reach from RM 409 to 188. The primary focus of the application – and of IPC's proposed TEMP mitigation – is for the river section below HCC (RM 247 to 188) from late August through early November when fall Chinook are migrating into the Snake River system, staging prior to spawning, and spawning. Specifically, the EPA-approved Snake River-Hells Canyon TMDL assigned a temperature load allocation for the outflow from Hells Canyon Dam during the salmonid spawning season of October 23 through April 15. The load allocation specifies Project outflow temperatures of no greater than a 7-day average maximum (7DAM) of 12.8 °C when Brownlee Reservoir inflow temperature is less than a 7DAM of 12.8 °C and no more than a 0.14 °C increase in outflow water temperature relative to inflow temperature when inflow is greater than a 7DAM of 12.8 °C.

Based upon TMDL temperature modeling, the SR-HC TMDL did not assign a temperature load allocation to the HCC for temperature standard excursions occurring within the Project reservoirs or for temperature excursions that occur downstream of the Project during the non-spawning season of April 16 – October 22. Responsibility to address the temperature excursions experienced within and downstream of the reservoirs during this spring-to-early-fall period was assigned wholly to those anthropogenic activities occurring upstream of the

Project that cause waters flowing into Brownlee Reservoir to be excessively warmed and exceed temperature criteria.

Additionally, Oregon standards require that the seasonal thermal pattern in the Snake River must reflect the natural seasonal thermal pattern (NSTP: OAR 340-041-0028(4)(d)). The purpose of temperature criteria is to protect designated temperature-sensitive beneficial uses, including specific salmonid life cycle stages, when and where those occur. In addition, both Oregon and Idaho have a seven-day average maximum of 20.0ºC for protection of the aquatic life and salmon and steelhead migration corridor beneficial uses and a seven-day average maximum of 13.0ºC after October 23rd for protection of the salmonid spawning. Neither of these criteria are addressed in the TMDL, although they are applicable to the CWA 401 application.

C. *Idaho Power Company's Mitigation Responsibility*

The HCC delays the cooling of the Snake River by about three weeks. A comparison of seasonal temperatures in the Snake River reach before and after construction of the Hells Canyon complex is shown in Figure 2.

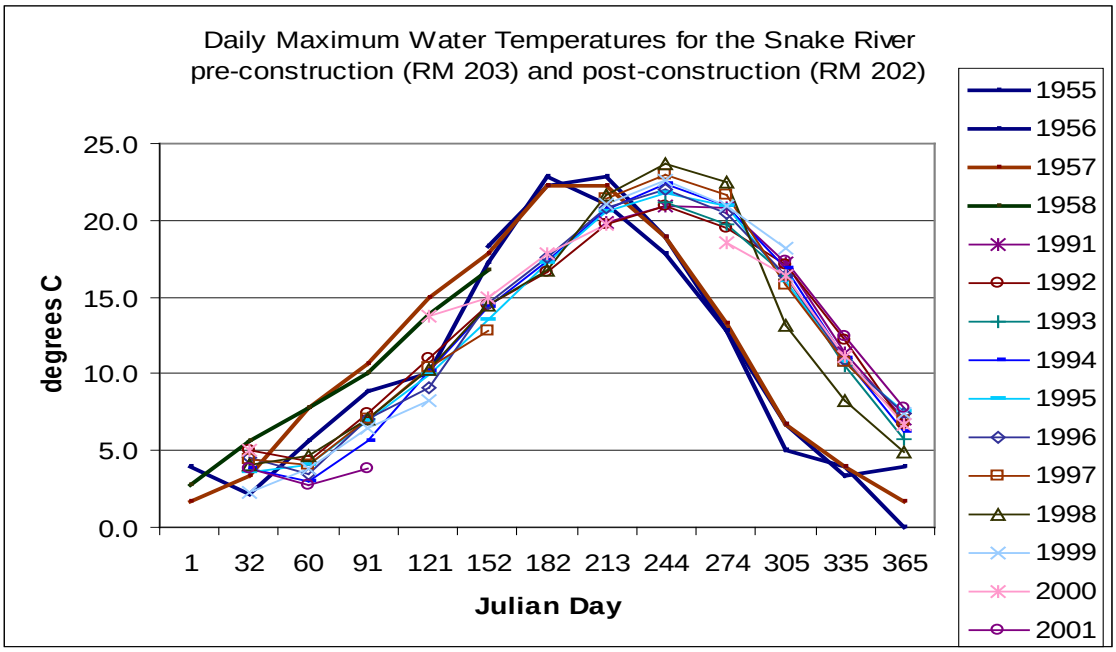

Figure 2.

Seasonal temperatures in the Snake River at RM 202 and RM 203[2] pre- and post-construction of the Hells Canyon Complex (from EPA 2008)

Both the pre-development (1955-1958) and the post-development (1991-2001) plots show peak temperatures in the 23 – 24°C range; however, the peak of the post-development curves are shifted 3-5 weeks later into the fall impinging on the start of the fall Chinook spawning season as compared to the pre-development curves. For example, absent the

[2] River miles 202 and 203 lie approximately midway between the present day locations of Hells Canyon Dam and Lewiston, Idaho, in the Snake River reach where fall Chinook presently spawn in the late fall.

HCC, the Snake River would cool to the 13°C spawning criteria by mid-October, but with the HCC, the Snake River does not attain 13°C until early November.

EPA noted that the HCC causes the Snake River to be approximately 3.4°C warmer from mid-September through October and that this impact extends from Hells Canyon Dam (RM 247) to the confluence with the Salmon River (RM 188) (April 9, 2009 letter to IDEQ and ODEQ). This increase through the HCC (3.4°C) seems to occur regardless of whether the year is wet or dry, hot or cool. Such factors may change the average inflow and outflow temperatures from year-to-year, but the outflow temperatures remain 3.4 to 3.6°C higher than inflow temperatures. Therefore, when inflow temperatures to Brownlee Reservoir are less than a maximum weekly maximum temperature of 13.0°C, EPA estimated IPC's mitigation obligation at 2.7°C. With respect to Oregon's NSTP (natural seasonal thermal pattern) standard, EPA estimated IPC's temperature reduction responsibility at 3.1°C from mid-September until October 23. After October 23rd, the 13.0°C criteria apply again.

In contrast, IPC estimated its mitigation responsibility to be approximately 60% of the 2.7°C that EPA estimated, attributing the remainder to anthropogenic sources above the HCC, which are beyond IPC's control. Although estimating a smaller mitigation responsibility (1.6 rather than 2.7°C), IPC does recognize that their load allocation holds them fully responsible for the total excursion above the spawning criterion (2.7°C) and their proposal in the CWA 401 application was to address the full allocation. With respect to Oregon's NSTP (natural seasonal thermal pattern) standard, IPC asserts that increased temperatures below HCC from September through October (and into November) are caused entirely by two factors: 1) increased water temperatures coming into the HCC from tributary systems such as the Boise and Payette Rivers, as a result of development and habitat degradation in those systems; and 2) an increase in the residence time and consequent delay in the transit time of the water stored in the HCC of approximately three weeks time. Using these arguments, IPC asserts that its actual responsibility and obligation to mitigate for the fall increased temperatures is smaller than estimated by EPA. EPA in its April 9, 2009 letter to IDEQ and ODEQ rejected IPC's estimates and methods of arriving at the lower estimates.

VI. IPC Clean Water Act Section 401 Application

A. *Background*

Idaho Power Company's HCC is in the final stages of relicensing by FERC. One of the last steps in the process for IPC is to obtain Clean Water Act § 401 water quality certificates from the states of Oregon and Idaho. IPC's Clean Water Act § 401 water quality application covers a range of water quality issues associated with the HCC; however, this review is limited to its treatment of water quality temperature standards below the HCC.

B. *Estimating Temperature Increases due to the HCC*

Critical to determining IPC's responsibilities for the temperature violations occurring between late summer and late fall below HCC and IPC's obligations to mitigate for the temperature increase, is determination of the temperature increase and estimating what portion of it can be attributed to the HCC. Several methodologies were used to estimate the

impact of the HCC on water temperatures below the HCC by EPA and IPC. These are briefly desribed here.

The EPA's 12/10/08 Discussion Paper (pp. 2-4) examined temperature effects of the HCC in three ways: a comparison of pre-and post-construction water temperatures downstream of Hells Canyon Dam; a comparison of inflow and outflow temperatures for HCC; and modeling temperature inputs and outputs (i.e., an energy balance) for HCC. IPC also used modeling to estimate the effects of the HCC on temperature below the project (as discussed below), but used a different methodology than EPA.

i. Comparing Snake River Temperatures Pre- and Post- HCC Construction

Comparing seasonal temperatures in the Snake River reach before and after construction of the Hells Canyon complex (Figure 2), both pre-development (1955-1958) and post-development (1991-2001) plots showed peak temperatures in the 23 – 24°C range. However, temperature curves shifted 3-5 weeks later into the fall after development, impinging on the start of the fall Chinook spawning season. This comparison is straightforward and clearly shows how slowing river flows through the HCC, shifted the natural seasonal temperature pattern below Hells Canyon Dam 25-40 days later into the fall.

ii. Comparing Inflow versus Outflow Temperatures for HCC

The alteration of Snake River water temperatures below the Hells Canyon Complex is also clearly seen in Figure 3, where waters flowing out of the HCC are about 3.4°C warmer than the temperature of waters flowing into HCC (RM 247).

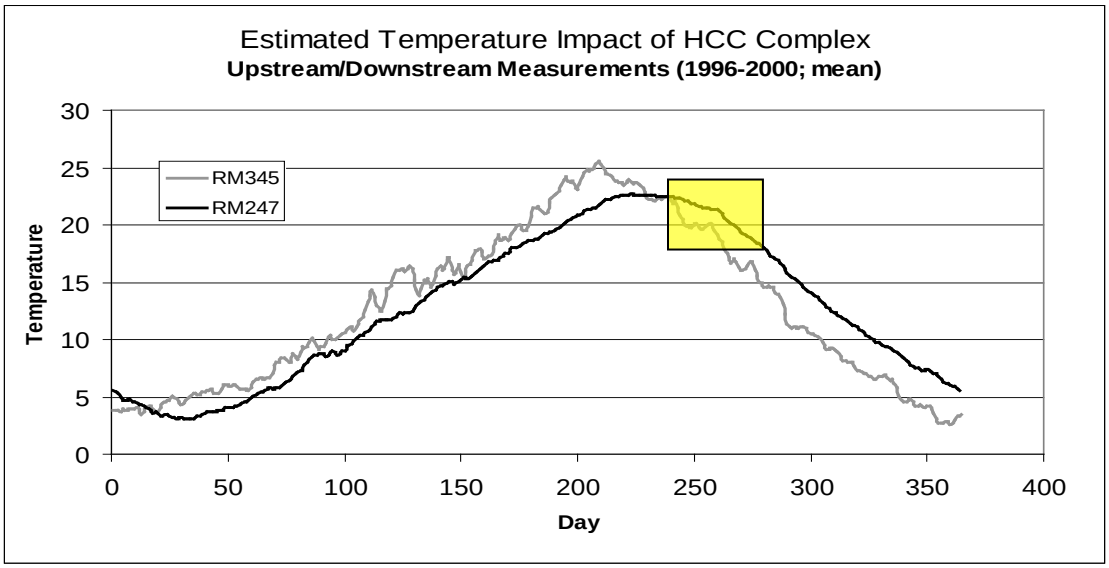

Figure 3. Seasonal temperatures measured at the inflow (RM 345) and outflow (RM 247) of the Hells Canyon complex (from EPA 2008).

This increase appears to occur regardless of variation in annual flow levels (low or high) or summer season temperatures (cold, medium, or hot).[3] The increased water temperatures are readily seen in Figure 3 for the fall and early winter period starting in mid-August (~day 230) and continuing until mid-January. The highlighted yellow rectangle in Figure 3 shows the time period (early September until October 23) and increased temperature concerns relative to the initiation of spawning by fall Chinook salmon and to IPC's application for a water quality certificate.

The HCC also changes the annual natural seasonal temperature pattern of flows in the Snake River below the project. For example, flows coming out of HCC at RM 247 (the darker line in Figure 3) are cooler than incoming flows (lighter line) for the first half of the year (roughly from late January through early August), then the pattern reverses with water temperatures below HCC roughly 3.4°C higher than incoming flows.

Biologically, these flows are unnaturally colder during the first half of the year and unnaturally warmer in the second half of the year, as compared to the pre-development river. This has a general negative effect on the native biological community downstream (which evolved for millennia in the pre-development river with a natural seasonal temperature pattern) and a specific negative effect on threatened fall Chinook salmon. The increased temperatures have the potential to adversely affect spawning, incubation, hatching, rearing, and outmigration life-history segments for fall Chinook salmon and steelhead (Groves et al 2007; McCullough 2007); however, the primary impact is on fall Chinook, which are fall spawners rather than on spring-spawning steelhead.[4]

iii. Estimating the Temperature Impact of HCC Using Models

The third approach used to estimate the temperature impact of the HCC (suggested by EPA) was to model the temperature inputs and outputs in the HCC using an energy balance budget. This is a common limnological approach, best shown conceptually in Figure 4, where the modeling exercise attempts to quantify the inputs and outputs shown in the diagram into a mathematically balanced input/output equation. This approach was undertaken by both IPC and CRITFC and will be discussed in more detail below in Section VIII, which examines the efficacy of the TEMP mitigation approach offered by IPC.

IPC also analyzed the temperature effects of HCC in its February 20, 2009 Clean Water Act Section 401 application supplement for temperature associated with the HCC FERC relicense. IPC relied on its Ehist model to estimate temperature impacts of the HCC. One of the core assumptions in Ehist is that the natural temperature condition of the Snake River above the HCC is equivalent to the Salmon River in central Idaho. Consequently, IPC

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[3] See Table 1 in EPA letter of 4/9/09.

[4] See Groves et al 2007, a white paper for IPC that reviews the effects of HCC temperature outflows on fall Chinook salmon spawning, as well as the extensive critique of the Groves et al paper by CRITFC's Dale McCullough (2007) for the Nez Perce Tribe. The two papers constitute a comprehensive review of temperature effects on salmon spawning, fecundity, egg survival, hatch out, fry survival, juvenile migration, etc. IPC asserts that the altered temperature regime acts either positively or is benign relative to fall Chinok life history impacts, while McCullough disputes this based on small evidence from Snake River fall Chinook studies, but a large comparative scientific literature base. Additional discussion of HCC impacts on fall Chinook is provided in EPA's 12/10/08 Discussion Paper.

asserted that the warm waters flowing into the HCC in early fall are unnaturally warm and are due to upstream anthropogenic sources, thereby further offsetting the 3.4°C HCC impact and reducing IPC's responsibility with regard to attaining the 13°C criteria. IPC estimated its mitigation obligation as 1.6°C, rather than the 2.7°C responsibility identified by EPA.

EPA, in its April 9, 2009 letter to IDEQ and ODEQ, soundly rejected IPC's analysis and its use of the Ehist model to estimate HCC impacts and IPC mitigation obligations. EPA noted that the Ehist model is a good peer-reviewed model, but questioned how it was being used and its results interpreted by IPC.

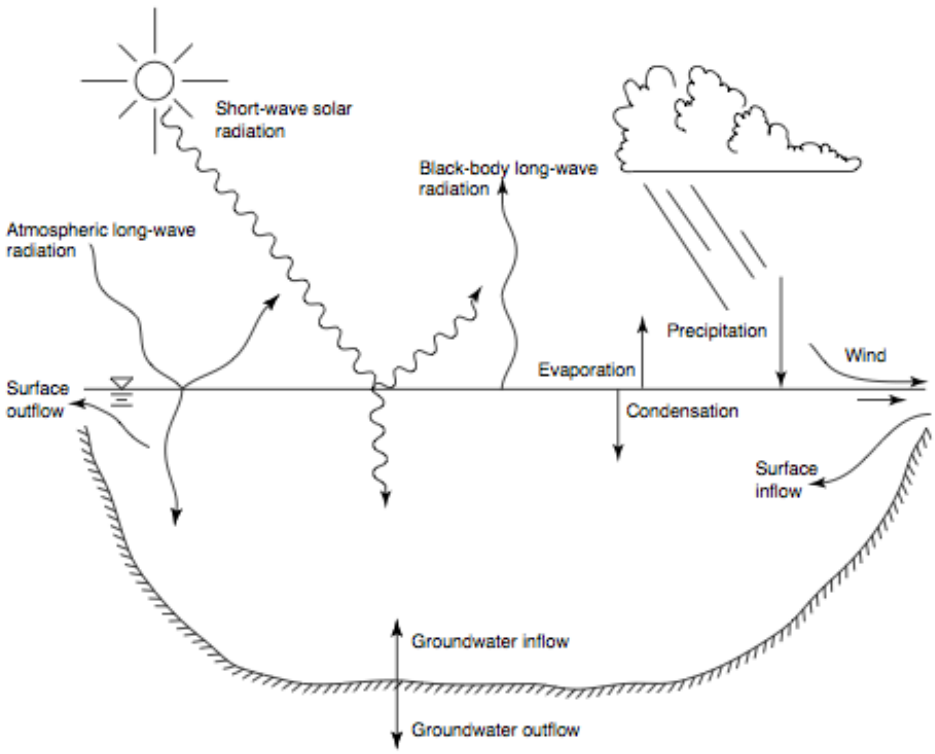

Fig. 9.1. Schematic of the energy inputs to a lake.

Figure 4. Diagram of energy inputs into a lake or reservoir (from Solocolofsky and Jirka 2004).

EPA believed, and I concur, that the Salmon River watershed is much different that the Snake River in southern Idaho, and its use as baseline for estimating HCC impacts is speculative and unwarranted. EPA strongly supported the IDEQ and ODEQ TMDL analysis, which used the current condition upstream of HCC as the baseline for analysis of impacts and assignment of the HCC's TMDL load allocation (i.e., its mitigation obligation).

IPC's analysis of the temperature impacts of HCC also rely on an assertion that the HCC impoundments are not a heat source (IDEQ and ODEQ 2004; IPC Section 401 Application) in and of themselves. In other words, IPC's analysis of the downstream temperature effects created by the HCC and its obligations to mitigate for them is related solely to the increased temperature of waters coming into the HCC and not due to any additional heat increase in water temperatures caused specifically by the HCC series of reservoirs and the slowing of water travel time through the HCC. This assertion is not supported by the limnological literature. Lakes and reservoirs are well-recognized as absorbing solar and atmospheric radiation (Figure 4; Imboden and Wuest 1995; Socolofsky and Jirka 2004; Fraley et al. 1979). This means that a reservoir system such as the Hells Canyon Complex, particularly with a reservoir like Brownlee that is large and long should in fact be an additional source or heat energy into the river system. Thus, large reservoirs with slowed water transit time put heat into the aquatic system, while river sections below the impoundments naturally move toward reset – their natural or normative flowing state with respect to seasonality, temperature, flow regimes, etc., – with increasing distance below a dam or impoundment point (Ward and Stanford 1979; Ward and Stanford 1983; Stanford et al. 1996; Poff et al. 1997; Williams 2006).

Thus, IPC differs from EPA, CRITFC, and IDEQ/ODEQ (as represented in their 2004 TMDL analysis) in their view of the amount of their mitigation responsibility. IPC estimated its mitigation responsibility to be approximately 60% of the 2.7°C that EPA estimated, attributing the remainder to anthropogenic sources above the HCC, which are beyond IPC's control. In spite of this assertion, IPC does recognize that their load allocation holds them fully responsible for the total excursion above the spawning criterion (2.7°C) and their proposal in the CWA 401 application is their proposed approach to address the full allocation.

VII. IPC's TEMP Mitigation Approach

IPC proposes a Temperature Enhancement Management Program (TEMP) that takes a watershed approach to mitigating temperature effects of the HCC. The goal of the TEMP is to implement a series of watershed improvement and flow augmentation projects upstream of the Hells Canyon Complex that combined would meet the load allocation given to IPC for the HCC in the SR-HC TMDL. Many of the proposed measures include riparian plantings, wetlands enhancements, and the like, that will take years to mature and yield thermal benefits; however, addressing the root causes of increased water temperatures and general water quality degradation upstream of the HCC will produce long-term benefits.

IPC's watershed-based restoration approach (TEMP) relies on a recognized and proven EPA approach for developing watershed plans (USEPA 2005). IPC intends that it serve as a foundation for a region-wide, integrated watershed approach where partnerships can be built that implement solutions toward a common water-quality goal. The EPA watershed planning process is designed to address all water-quality-limiting aspects within a watershed and provides a six-element template for addressing temperature at the watershed level: 1) building partnerships; 2) characterizing the watershed; 3) finalizing goals and identifying solutions; 4) designing an implementation program; 5) implementing the program; and 6) measuring progress and making adjustments.

IPC's plan is that within the first fifteen years after issuance of the new FERC license, projects would be implemented that are calculated to yield thermal benefits of 127 billion BTU/day. Indeed, the 15-year mark /127 million BTU/day are project benchmarks, that if not met, will initiate greater stakeholder and Watershed Advisory Council (WAC) review and an adaptive management process to better address implementation of the TEMP program. Projects would continue to be implemented after the first fifteen years at a pace and scale to produce at least 211 billion BTU/day of realized thermal benefits as soon as practicable, but no later than the end of the new license term. IPC asserts that the 211 billion BTU/day thermal load reduction target is a representation of the SR-HC TMDL load allocation.

Program implementation for TEMP is described in general terms (pp. 183-231) in IPC's recent (October 15, 2009) revision of its Clean Water Act Section 401 application. While the program appears to be a good model of watershed level coordination and planning in its early phases, the application provides little detail on the specific working groups or on specific watershed or riparian projects that are to be implemented. Much is left undescribed (other than the process), creating uncertainty about the likelihood of success for the project's goals.

VIII. Efficacy of IPC's TEMP Approach to resolve temperature issues

Idaho Power Company's proposed TEMP plan to mitigate temperatures downstream of the Hells Canyon Complex of dams using a watershed approach of habitat restoration has many long-term positive attributes for the Snake River and its tributary watersheds above the Hells Canyon Complex; however, I believe it is unlikely to adequately address water quality standards below the HCC, as described in IDEQ and ODEQ's (2004) TMDL analysis, during the term of the FERC relicense.

IPC has proposed two mitigation actions to address water quality issues below HCC. These are: 1) cloud seeding to increase snowpack and water from the Boise, Payette, and other tributary rivers flowing into Brownlee Reservoir and the HCC; and 2) a watershed-based set of riparian restoration projects in the tributaries above HCC. Both approaches are described in Chapter 7 of IPC's February 20, 2009 supplement to its FERC application for certification under Section 401 of the Clean Water Act. This report does not address the efficacy of cloud seeding to increase snowpack in the Snake River (and tributary) watershed as a method to decrease the temperature of waters flowing into the HCC. The remainder of the report examines the efficacy of the watershed-based mitigation approach, as well as examining alternative mitigation actions.

IPC's watershed approach and the TEMP methods and objectives (general though they are) have considerable merit for aquatic ecosystem restoration in the Snake River (and its tributary) watersheds and would provide significant biological and socio-cultural benefits if the program successfully reached its goals. Proposed TEMP projects could include watershed improvement projects (such as stream-side fencing to increase riparian vegetation, and water management to reduce warm water discharges) and flow management and augmentation measures (such as irrigation fallowing, recharge, water acquisitions, and weather modification). Indeed, stakeholders and agencies should be

pursuing these types of projects and the watershed-level objectives outlined by IPC following the IPC described process (or a similar one) because of the biological and societal benefits that would accrue for water use efficiencies and aquatic ecosystem health in southwestern Idaho, regardless of the HCC relicensing and downstream water issues.

Nevertheless, it is my opinion that the TEMP approach outlined by IPC is unlikely to yield results that meet the TMDL load allowances for the HCC in the timeframe of the relicensing period for reasons (described more fully in the following sections) that include: 1) the loss of cooling effects through the HCC; 2) the length of time required for riparian restoration; 3) the difficulty of implementing partnerships on private lands; and 4) the effects of climate change.

A. Attenuation: Loss of Cooling through the HCC

Even if the projects envisioned and implemented by IPC created cooler tributary stream water temperatures, that benefit would be reduced substantially in the lower sections of major tributary rivers (Boise, Payette, Owyhee, etc,) prior to reaching Brownlee Reservoir. Reviews by EPA and CRITFC scientists using various models have demonstrated (even with liberal assumptions) that cool water produced by riparian habitat improvements above the HCC would be significantly reduced by the time the water reached Brownlee Reservoir. For example, Berger et al. (2009a) modeled water temperatures in the Lower Boise River (near Middleton) and estimated loss of cooling benefit from there to the mouth of the Boise River to be 33%, with losses to the head of Brownlee Reservoir reaching 55% under the 2001 modeling scenario (Figure 5). Thus, nearly half of the cooling benefit derived from tributary riparian restoration activities will likely be lost before the cooler water even reaches Brownlee Reservoir.

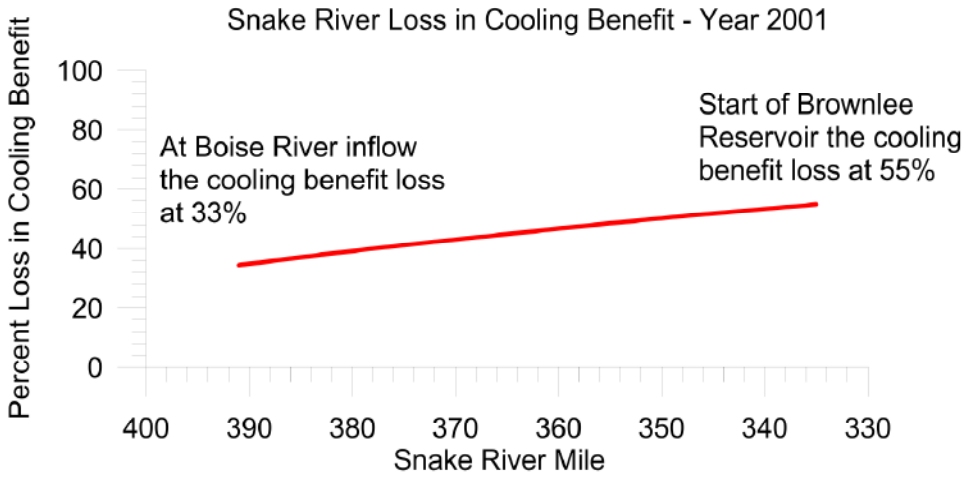

Figure 5. Modeled projection of loss of cool water created by riparian improvements in the Boise River downstream (Berger et al. 2009).

After entering the HCC, the slowing of water transit time through the HCC, and energy inputs from solar and atmospheric radiation into the water mass, will further degrade any cooling

benefit from the tributary systems flowing into HCC (Berger et al. 2009b). IPC's modeling suggests that they will lower water temperatures in the Lower Boise and Payette Rivers from late summer temperatures of 25°C to 20°C – and retain that cool water benefit into and through the HCC. This amount of degree change in water temperature is large and equal to 9°F. Such cooling gains may be possible in degraded minor streams and creeks once, willows and other riparian vegetation mature and shade the stream and the stream channel deepens, but they seem very unlikely in the larger sections of the lower Boise and Payette rivers where bankside shading can cover less than 25% of the river surface. Berger et al's modeling work (2009a) predicted up to a 55% loss of cooling benefit as water moved through these river systems and into the HCC.

IPC's analysis of the benefits of the proposed mitigation project did not include consideration of the continuing erosion of any cooling benefit from the incoming tributary waters as water slowly moves through the HCC system. IPC acknowledged that attenuation (the erosion of cooling benefit) will occur as water moves through the HCC, but considered it too complex and uncertain to model. Attenuation occurs as the water transit time of the Snake River slows in the HCC series of reservoirs, mixes with reservoir water, and absorbs incoming solar and atmospheric radiation.

Finally, the reservoirs themselves in the Hells Canyon Complex will also serve as sources of heat input into the HCC, something not considered in the IPC Section 401 application. If the upriver habitat mitigation measures work and lower inflow stream temperatures of water from the Boise, Payette, Bruneau, Jarbidge, and Owyhee rivers occur as proposed, the delayed residence time of water in the HCC series of dams, particularly Brownlee, will add heat back into the energy budget for the HCC (see Figure 4). This will make it even more difficult for IPC's TEMP Mitigation program to succeed. Solar and atmospheric heating can be significant heat inputs into lakes and reservoirs, particularly during the summer months in dry desert climates, as noted by IDEQ and ODEQ (2004) in the following quote.

> *"It is well recognized that in hot, arid climates such as that in which the SR-HC (Snake River – Hells Canyon) TMDL reach is located, natural atmospheric heat sources will have a noticeable influence on water temperatures." (p. r; Executive Summary).*

All of this is important, because it suggests (rather strongly) that even if IPC's riparian habitat mitigation measures work in the upstream tributary rivers to decrease the temperature of water flowing toward the HCC, additional heating will occur in the lower tributary rivers, the main Snake River, and in the HCC reservoirs through solar and atmospheric radiation as water slowly moves through the HCC. This additional heating coupled with the attenuation issue discussed above, will make it even less likely that the downstream temperature mitigation targets proposed by IPC can be reached. This is also the conclusion reached by EPA scientists in their various analyses (EPA discussion paper of 12/10/08 and 4/9/09 letter to IDEQ and ODEQ) and by CRITFC (Columbia River Inter-Tribal Fish Commission) staff in their recent technical and policy issue overview paper (11/13/09).

B. *Length of Time for Implementation and Biological Response*

Another issue of concern for the proposed TEMP mitigation approach, is the length of time required to achieve the proposed habitat restoration and water quality results, regardless of whether the proposed actions are capable of achieving the temperature reductions suggested by IPC. The watershed approach proposed by IPC has potential merit for restoring ecosystem stability and natural ecological services (cooler water, increased macroinvertebrate diversity, enhancing native fish species, etc,) in all of the tributary systems identified (Boise, Payette, etc.). Indeed, habitat and riparian restoration activities are being widely implemented throughout the Columbia River Basin's watersheds, including many in Idaho (Salmon, Clearwater, Owyhee, Boise, Payette, etc.; NPCC 2009). However, it is well recognized within these areas of activity, achieving the desired habitat outcomes and increasing water quality measures is a long-term process. In most cases, this will take many years, or more likely decades, to obtain measureable changes in habitat conditions and water quality (ISRP 2005, 2006, 2007).

Implementing habitat restoration activities at a scale large enough to significantly reduce late summer water temperatures in the Boise, Payette, and Owyhee rivers will be a daunting, but ecologically worthwhile program. Lessons from the Columbia River experience suggest a certain level of caution and skepticism is warranted, in that most fish, wildlife, and habitat projects fail to achieve their desired outcomes, at least at the level of success often described in the initial proposals (ISRP 2005, 2006, 2007). Moreover, typically projects come to fruition more slowly than planning and implementation documents describe. With respect to IPC's TEMP mitigation approach, even if it is able to achieve its desired outcome – and this seems unlikely as described above (Section VIII.A) – realization of the project's goals will take decades of habitat work and biological responses.

I discussed IPC's watershed restoration approach with Peter Bisson, Senior Ecologist and Team Leader for the US Forest Service's Pacific Northwest Research Station. Dr. Bisson is an internationally recognized expert on tributary habitat restoration and salmon ecology and has worked throughout the Columbia River Basin including the Snake River. He lauded the emphasis on tributary habitat restoration and the ecological benefits those actions would provide. However, he cautioned that restoration activities occur quickly only in very small tributary systems (creeks and streams), while the growth and maturation of riparian habitat (and the resultant cooling of water) in small rivers, such as the Little Weiser River cited in the IPC application[5], will take decades (30 to 60+ years). Larger systems, such as the Boise and Payette Rivers, take far longer to experience the cooling effects of riparian restoration and riparian development, and even when mature, will never provide significant shading and cooling in the larger rivers where the width of the river greatly exceeds the shading area of bankside vegetation. As a result, Dr. Bisson felt it extremely unlikely that the habitat-based approach advocated by IPC would be able to achieve the temperature cooling benefits required by the SR-HC TMDL load allowance.

Finally, as a salmon ecologist and geneticist, I find it difficult to support a program such as IPC's TEMP program that has a horizon for fruition of 40 to 80 years in the future. IPC's

[5] See IPC 10/12/09 application (p. 205) for Section 7.1.1.4.1.2., Example Riparian Vegetation Claimed Thermal Benefit Calculation for the Little Weiser River example and thermal shading calculations.

description of the TEMP program recognizes that the riparian restoration program will take time to implement (administrative, planning, project review and selection, contracting, etc.) even before on-the-ground work starts. IPC also recognizes that the biological response will take time; though its statement, "*The riparian vegetation may take several years to develop and mature"*[6] suggest it is very optimistic about biological response times in an arid cold-desert shrub-steppe environment. Assuming IPC's TEMP program reaches its mitigation goals by the end of the FERC license – something I think unlikely – this 30 to 50 year time period represents approximately eight Chinook salmon generations, leaving Snake River fall Chinook under an unfavorable selection regime for an unacceptably long period of time. The longer present day salmon populations are presented with a selection regime that differs markedly from the natural seasonal regime in which they evolved, particularly if it pushes them into sub-optimal life history performance as seems to be the case for fall Chinook in the Hells Canyon reach, they will lose genetic diversity, fitness, and resilience. Recent papers by Araki and colleagues show the rapidity with which artificial selection can effect population fitness levels in summer steelhead (Araki and Blouin 2005; Araki et al. 2007a, 2007b, 2007c), so concerns about the persistent fall period water quality violations and their potential effect on Snake Rifer fall Chinook population fitness seem warranted.

C. *IPC and Partnerships on Private Land*

IPC's expected riparian cooling benefits rely on significant habitat improvements on lands in the lower portions of rivers such as the Boise, Payette, and Owyhee, where the lands in question are largely in private ownership; however, the IPC application contains only a general protocol for implementation of the TEMP program[7], rather than specific details of stakeholders, partners, incentive programs, and a list of potential projects. Without some demonstration of the willingness of private landowners to participate in the TEMP projects on tributary stream and river systems that run through their private lands, it is hard to judge how effective the TEMP approach might be. Experience in other subbasins in the Columbia River Basin, has shown that private land owners are often slow, reluctant, or even strongly opposed to participation in streamside habitat restoration projects undertaken by state, federal or Tribal agencies, or by large corporate entities, unless there are worthwhile incentive programs in place to foster their participation. In the case of certain subbasins in the Columbia River basin, such as the John Day and the Grande Ronde, it has taken 20+ years in many instances for local ranchers to participate in stream enhancement programs such as the federal Conservation Reserve Enhancement Program (CREP), which offer financial incentives (tax relief and significant cost-sharing) for voluntary participation. The lack of demonstrated partners for the TEMP program and the lack of an existing administrative structure within which to implement it, create significant uncertainties about the likelihood that the TEMP program can be implemented as described or that it can achieve its goals (15-year interim goal or 40-year final goal) in the timeframe it describes.

D. *Impacts of Climate Change*

Modeling of climate change in the Pacific Northwest predicts that river temperatures will increase in the late summer and fall in eastern Washington (representative of the Hells

[6] See p. 221, IPC § 401 application of 12 October 2009.
[7] See Section 7.1.1.6, pp. 220-228 in IPC § 401 application of 12 October 2009.

Canyon reach) (ISAB 2007; Mantua et al. 2009). This would likely make it more difficult to reach the 13.0°C standard and avoid the upper limit of 20.0°C during the late August-late October time period. Thus, water temperature increases expected from climate change – factors beyond IPC's influence or control – may make it more difficult for IPC to achieve flows out of the HCC that do not violate TMDL allowances.

Mantua and colleagues at the University of Washington's Climate Impacts Group modeled climate change in river temperatures throughout Washington State and their potential effect on freshwater salmon habitat. Their models predict, for example, that the number of weeks water temperatures in the Lower Snake at Tucannon exceed 21°C will roughly double from approximately 4 in 2010, to 8 in 2050 (Figure 6).

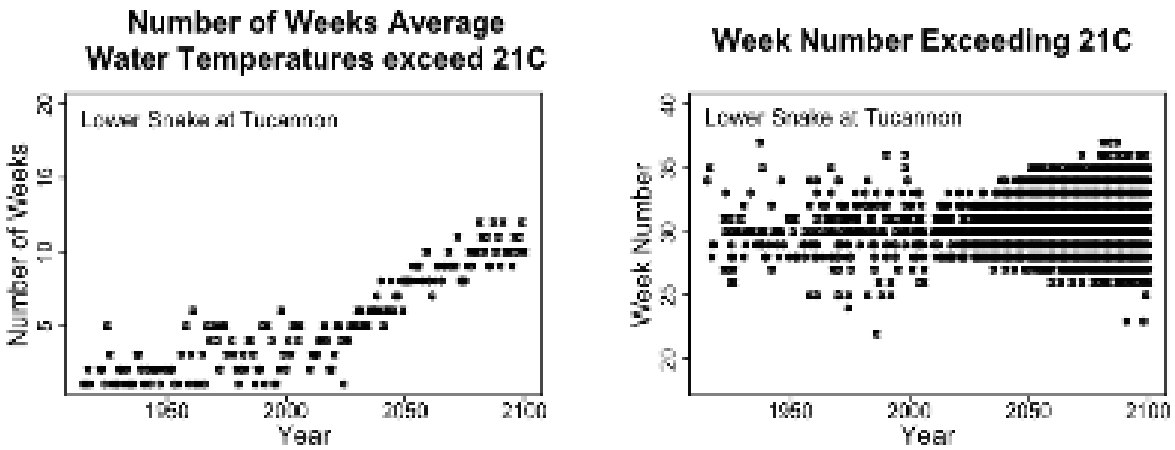

Figure 6. Past records and future projections of the number of weeks, as well as which weeks, that water temperatures will exceed 21 degrees C (Mantua et al. 2009).

When the anticipated effects of climate change over the duration of the 30 to 50 year FERC license for HCC are factored in (Figure 6), IPC's TEMP plan seems even less likely to be able to mitigate for downstream fall temperature increases in the Lower Snake River. Mantua et al. (2009) predict increases of 1-3°C in average water temperatures for streams in eastern Washington including the Hells Canyon reach.

IX. Efficacy of TCS to solve Impoundment Temperature Problems

In river systems with large storage reservoirs, strategic water releases can be used to mimic natural seasonal flow and thermal patters that foster the life history patterns native fish populations exhibited prior to development. Temperature control structures (Figure 7) allow water to be pulled from different depths within the reservoir to achieve specific outflow temperatures for the benefit of downstream fish, wildlife and aquatic ecological communities.

For example, on Oregon's McKenzie River, Cougar Dam had altered the natural river hydrograph and water temperatures to the point that native Chinook populations were

declining. After installation of a 350-foot tower on the face of Cougar Dam in 2005 (Figure 7), water temperatures normalized downstream on the McKenzie River and Chinook numbers are increasing.

Figure 7. Photographs of Cougar Dam on the McKenzie River in Oregon and installation of the temperature control tower that was built on the upstream face of the dam in 2005 after the reservoir was drawn down to allow construction. Slots seen in the photo at right show where water can be selectively pulled from different depths within the reservoir in order to achieve the desired temperature in the outflow from Cougar Dam.

The TCS at Glen Canyon Dam on the Colorado River allows warmer sediment-laden waters that are essential to native fishes such as the bonytail and humpback chubs to thrive. Prior to the installation of the TCS at Glen Canyon, coldwater releases from the depths of Lake Powell suppressed native Colorado River fish's distributions and life histories. TCS systems have been used in a variety of large storage dams on western rivers to successfully achieve more natural seasonal temperature patterns and fishery benefits (Vermeyen 2003).

In northern California, a temperature control device was installed on the upstream face of Shasta Dam in 1996. Shasta Dam, 602-foot tall, was constructed on the Sacramento River in 1945. The TCS system, constructed for approximately $80 million, was modeled after the successful TCS structure installed in the 1970s on Utah's Flaming Gorge Dam to achieve fishery benefits. The 350-foot deep device on Shasta Dam allows multi-level selective water withdrawal in order to control the temperature of water released from Shasta Dam downstream into the Sacramento River for fishery benefits (Vermeyen 2003). TCS water withdrawals were initiated in 1997 and results of the project have been dramatic. The TCS releases achieved target river temperatures almost continuously, particularly during the critical time periods for salmon reproduction. Sacramento Chinook salmon populations appear to have improved since 1997. US Bureau of Reclamation (operators of Shasta Dam) have also added TCS systems to Hungry Horse Dam in Montana, and to California's Folsom Dam, Whiskeytown Dam, and Lewiston Dam to achieve fishery conservation goals.

X. TCS and the Hells Canyon Complex

Based on the successful use of TCS systems on many other large storage dams in the western US, as well as the modeling conducted by EPA on cool water storage and availability within Brownlee Reservoir, it seems likely that installation of a TCS system on Brownlee Dam would allow IPC to achieve the temperature targets established by the TMDL analysis of IDEQ and ODEQ (2004).

The use of a TCS system to achieve temperature targets below HCC has been part of an ongoing dialogue between IPC, federal and state agencies, and the Tribes for several years. As early as March 2003, NOAA Fisheries (then the National Marine Fisheries Service), Idaho Department of Fish and Game, and various Indian Tribes (Nez Perce and CTUIR) recommended installation of a selective withdrawal device (TCS) for Brownlee Dam to Idaho Power Company. IPC rejected the recommendation claiming no evidence of negative impacts on downstream fall Chinook salmon and a concern that flows out of a TCS could lead to reductions in water quality below HCC. IPC asserted that even if negative impacts were to occur, they would resolve them using a habitat and watershed approach – a philosophy reflected in IPC's Section 401 CWA application (10/12/09) and its TEMP mitigation program.

In their 12/10/08 Discussion Paper, EPA argues for a TCS to alleviate temperature concerns in the Snake River below HCC as the most certain approach. EPA scientists note that Oregon DEQ's modeling refutes IPC's assertion (based on IPC modeling) that a TCS would lead to reductions in water quality and cause water temperature problems outside of the September-November target period[8].

I agree with CRITFC and EPA scientists that further serious consideration should be given by IPC to the potential installation of a TCS at Brownlee Dam to address the fall HCC water quality violations. Evidence from other successful TCS systems (examples provided in Section IX above) strongly suggest that a temperature control structure has the potential to effectively mitigate HCC impacts, including returning lower Snake River temperature patterns back to a more normative historical pattern in which the salmon evolved. Finally, use of a TCS on Brownlee Dam in combination with coolwater releases from Dworshak Dam on the North Fork of the Clearwater, may provide additional flexibility to help address climate change impacts on summer water temperatures and reduced stream flows at key times – important factors that could contribute to achieving salmon management goals. Cooling flows from HCC would augment the coldwater releases from Dworshak on the North Fork Clearwater River resulting in cooling the Snake and Clearwater rivers as they reach Lower Granite pool.

Modeling by Portland State University (PSU) engineers (funded by CRITFC) showed that in two of the three years analyzed, there was enough cold water in the Brownlee Reservoir hypolimnion to meet the downstream temperature requirements for fall Chinook spawning below HCC (Berger et al 2009b). They also determined that more cool water would be available in warmer low flow years (when it would be needed most), than in cooler high flow years. Output from the 35kcfs tower model for Brownlee Dam showed that temperatures

[8] Shown on p. 14, EPA 12/10/08 Discussion Paper.

below HCC could be reduced by an average of 3°C from early September through early November using a TCS. This amount is approximately the temperature increase caused by HCC during this period and is sufficient to address the downstream temperature violations.

Finally, modeling by both EPA and PSU showed that cool water released from Hells Canyon dam significantly reduced temperature effects in the 100-mile reach between Hells Canyon Dam and the upstream end of Lower Granite Dam pool (Figure 8). Cooling benefits were reduced by 39–50% over the 100-mile reach based on two representative study years (McCullough et al. in review).

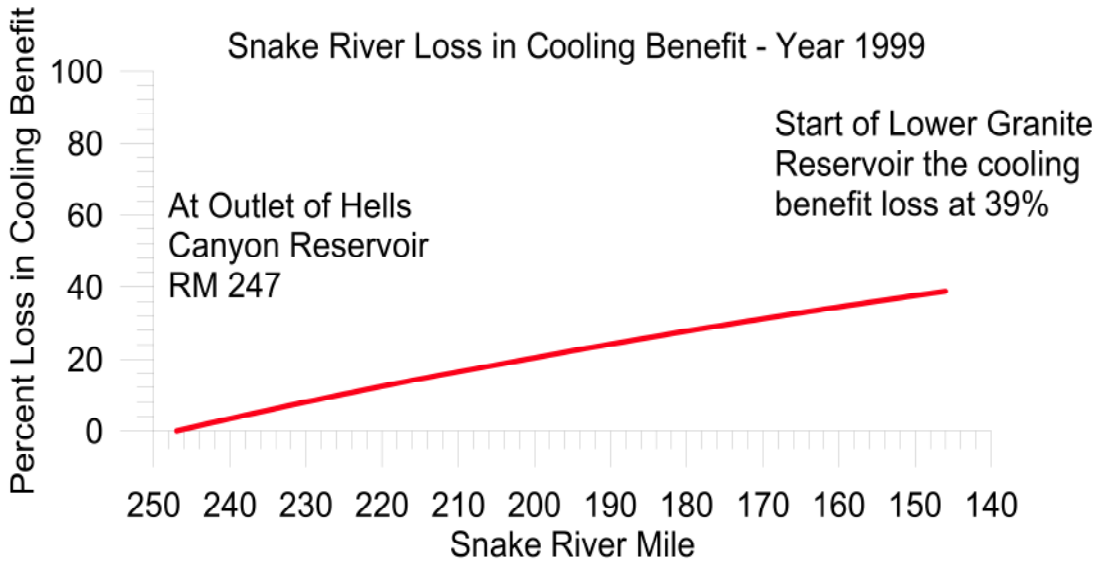

Figure 8. Estimated loss of benefit from cool water between HCC and Lower Granite Reservoir for 1999, a high flow year (from McCullough et al., in review).

XI. Conclusions

In summary, Idaho Power Company's TEMP watershed approach of habitat restoration to mitigate temperatures downstream of the Hells Canyon Complex of dams seems unlikely in and of itself to adequately address water quality standard violations below the HCC during the September-October time period when Snake River fall Chinook are entering the reach and preparing for spawning. The TEMP approach and plan as outlined in IPC's Section 401 application lacks adequate detail to assess the likelihood of success. Biological responses of the riparian systems on tributary rivers are uncertain and will require decades, perhaps well in excess of the 30 to 50 year license period, to respond at a scale that will significantly reduce water temperatures flowing into the HCC. Large portions of the lower Boise River and Payette River, two of the major tributaries, are in private ownership, which will slow or eliminate the implementation of restoration work, based on experience in other watersheds where lands are primarily in private hands.

Temperature control structures (TCS) have been used in many rivers systems impacted by large storage dams (Sacramento, Clearwater, Green, Colorado, McKenzie, Flathead) in order

to mitigate temperature effects and successfully restore more seasonal flows and natural thermal regimes downstream of the projects for the benefit of local fish and wildlife. Installation and operation of a TCS on Brownlee Dam could successfully mitigate for temperature impacts downstream of HCC in most years, and in combination with cool water flows from Dworshak Dam, add considerable flexibility for balancing cool water releases in the Clearwater River and the Lower Snake River. Achieving these goals would likely increase productivity, stability and sustainability of fall Chinook and steelhead populations in the Snake, Salmon, and Clearwater rivers by reducing adult pre-spawning mortality and increasing juvenile growth and survival.

Finally, the surest way to resolve late summer and fall temperature effects downstream of Hells Canyon Complex would be to use a combination of a TCS at Brownlee Dam and a watershed habitat restoration program on the tributary systems flowing into Brownlee (as proposed by IPC). The combination of the two approaches would reduce the thermal load entering Brownlee Dam and provide managers with even greater flexibility (via the TCS) to successfully address downstream temperature issues in the Lower Snake and Clearwater rivers. Additionally, the watershed restoration activities and riparian enhancement above HCC would provide biological and societal benefits beyond the thermal benefits identified by IPC.

XII. Literature Cited

Araki H, Blouin MS. 2005. Unbiased estimation of relative reproductive success of different groups: evaluation and correction of bias caused by parentage assignment errors. *Molecular Ecology* 14:4097-4109.

Araki H, Waples RS, Ardren WA, Cooper B, Blouin MS. 2007a. Effective population size of steelhead trout: influence of variance in reproductive success, hatchery programs, and genetic compensation between life-history forms. *Molecular Ecology* 16:953-966.

Araki H, Ardren WR, Olsen E, Cooper B, Blouin MS. 2007b. Reproductive success of captive-bred steelhead trout in the wild: Evaluation of three hatchery programs in the Hood River. *Conservation Biology* 21:181-190.

Araki H, et al. 2007c. Genetic effects of captive breeding cause a rapid, cumulative fitness decline in the wild. *Science* 318:100-103.

Berger CB, Wells S, McCulla A. 2009a. The impact of Idaho Power Company's proposed temperature mitigation projects on temperatures in the Boise River and Snake River. Technical Report EWR-02-09. Water Quality Research Group, Dept. of Civil and Environmental engineering, Portland State University. May 2009. 24 pp.

Berger CB, Wells S, McCulla A. 2009b. Brownlee Reservoir cold water analysis and downstream impact on cooler water temperatures released from Hells Canyon Dam. Technical Report EWR-XX-09. Water Quality Research Group, Dept. of Civil and Environmental engineering, Portland State University. September 2009. XX pp.

Chapman, D. 2—9. Hells Canyon Dam; Columbia River History. Northwest Planning and Conservation Council website. www.nwcouncil.org/history/HellsCanyon.asp.

Groves PA, Chandler JA, Myers R. 2007. White paper: The effects of the Hells Canyon Complex relative to water temperature and fall Chinook salmon. Idaho Power Company White Paper. Final Report to Hells Canyon Complex, FERC No. 1971. July 2007.

Imboden DM, Wuest A. 1995. Mixing mechanisms in lakes, in Lerman A, Imboden DM, Gat JR, eds, Physics and Chemistry of Lakes, Springer Verlag, pp. 83–138.

ISAB (Independent Scientific Advisory Board). 2009. Climate change impacts on Columbia River Basin Fish and Wildlife. ISAB 2007-02; Report to the Northwest Power and Conservation Council. May 11, 2007.

ISG (Independent Scientific Group). 1999. Scientific issues in the restoration of salmonid fishes in the Columbia River. Fisheries 24:10-19.

ISRP (Independent Scientific Review Panel). 2005. Retrospective Report 1997 - 2005. Northwest Power and Conservation Council. 2005-14. Portland, Oregon.

ISRP (Independent Scientific Review Panel). 2006. Final review of proposals submitted for Fiscal Years 2007-2009 Funding through the Columbia River Basin Fish and Wildlife Program. Northwest Power and Conservation Council. ISRP, 2006-6. Portland, Oregon.

ISRP (Independent Scientific Review Panel). 2007. 2006 Retrospective Report: An analysis of results reporting in FY 2007-09 Columbia River Basin Fish and Wildlife Program project proposals, guidance to improve future reporting and program evaluation, and a summary comparison of FY 2007-09 project recommendations from the ISRP and Council with each other and past reviews. ISRP 2007-01; Report to the Northwest Power and Conservation Council. March 1, 2007.

IDEQ (Idaho Department of Environmental Quality) and ODEQ (Oregon Department of Environmental Quality). 2004. Snake River – Hells Canyon Total Maximum Daily Load (TMDL). Technical Report; June 2004.

Mantau N, Tohver I, Hamlet A. 2009. Impacts of climate change on key aspects of freshwater salmon habitat in Washington State. In Chapter 6 in *The Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate*, Climate Impacts Group, University of Washington, Seattle, Washington.

McCullogh D. 2007. *Review of* Groves, P.A., J.A. Chandler, and R. Myers. 2007. White paper: The effects of the Hells Canyon Complex relative to water temperature and fall Chinook salmon. Final Report. Hells Canyon Complex, FERC No. 1971. July 2007.

NPCC (Northwest Planning and Conservation Council. 2009. Columbia River Basin Fish and Wildlife Program. Pre-publication Copy. Document 2009-02. Northwest Planning and Conservation Council, Portland, Oregon.

Poff NL, Hart DD. 2002. How dams vary and why it matters for the emerging science of dam removal. BioScience 522:659-668.

Poff NL, Allan JD, Bain MB, Karr JR, Prestegaard KL, Richter BD, Sparks RE, Stromberg JC. 1997. The natural flow regime: A paradigm for river conservation and restoration. BioScience 50:769-784.

Socolofsky SA, Jirka GH. 2004. Mixing in lakes and reservoirs. Chapter 9 in "Special Topics in Environmental Fluid Mechanics"; on-line book available at https://ceprofs.civil.tamu.edu/kchang/ocen689/ocen689.htm

Stanford J A, Ward JV, Liss WJ, Frissell CA, Williams RN, Lichatowich JA, Coutant CC. 1996. A general protocol for restoration of regulated rivers. *Regulated Rivers* 12:391-413.

U.S. Environmental Protection Agency (USEPA). 2005. Handbook for Developing Watershed Plans to Restore and Protect Our Waters. United States Environmental Protection Agency (USEPA) Office of Water, Nonpoint Source Control Branch, Washington, D.C. EPA 841-B-05-005.

Vermeyen T. 2003. Providing California hydropower while improving salmon habitat. http://www.sacramentoriver.org/article.php?article_id=2

Ward JV, Stanford JA, eds. 1979. The Ecology of Regulated Streams. Plenum Press, New York.

Ward JV, Stanford JA. 1983. The serial discontinuity concept of lotic ecosystems. Pages 29–42 in Fontaine TD, Bartell SM, eds. Dynamics of Lotic Ecosystems. Ann Arbor (MI): Ann Arbor Science.

Williams RN, editor. 2006. Return to the River: Restoring Salmon to the Columbia River. Elsevier Academic Press. New York.

XIII. Appendix 1: List of Documents Reviewed

A. Idaho Power Company Documents

Idaho Power Company Clean Water Act § 401 application Water Quality Certificate application.

Idaho Power Company. 2009. Hells Canyon Complex FERC No. 197 License Application. Idaho Power Company, 15 October 2009. Boise, Idaho.

Idaho Power Company. 2009. Supplemental Information on Temperature Issues: IPC Hells Canyon Complex Application for Certification under Clean Water Act § 401. 20 February 2009. Boise, Idaho.

Idaho Power Company. 2005. Response to FERC Additional Information Request WQ-2©: Detailed Evaluation of Alternative Temperature Control Structures: Appendix A. Temperature Control Structure model influence on Lower Granite Reservoir. Idaho Power Company, September 2005. Boise, Idaho.

Groves PA, Chandler JA, Myers R. 2007. White paper: The effects of the Hells Canyon Complex relative to water temperature and fall Chinook salmon. Idaho Power Company White Paper. Final Report to Hells Canyon Complex, FERC No. 1971. July 2007.

B. EPA Documents

U.S. Environmental Protection Agency (USEPA). 2009. Letter to IDEQ and ODEQ [Review of IPC 401 supplement on temperature]. 9 April 2009. Seattle, Washington.

U.S. Environmental Protection Agency (USEPA). 2008. Draft EPA Discussion Paper [Potential benefits to Snake River fall Chinook and steelhead from cooler September through early November water temperatures in the Hells Canyon Reach of the Snake River]. Discussion Paper; 10 December 2008. Seattle, Washington.

U.S. Environmental Protection Agency (USEPA). 2005. Handbook for Developing Watershed Plans to Restore and Protect Our Waters. United States Environmental Protection Agency (USEPA) Office of Water, Nonpoint Source Control Branch, Washington, D.C. EPA 841-B-05-005.

C. CRITFC Documents

CRITFC Staff. 2009. Technical and Policy Issue Overview of the Hells Canyon Hydropower Complex – FERC Relicensing and 401 Water Quality Certification Process. White Paper; 13 November 2009; Columbia River Intertribal Fish Commission, Portland, Oregon.

McCullough D. 2007. *Review of* Groves, P.A., J.A. Chandler, and R. Myers. 2007. White paper: The effects of the Hells Canyon Complex relative to water temperature and fall Chinook salmon. Final Report. Hells Canyon Complex, FERC No. 1971. July 2007.

D. Other Documents

IDEQ (Idaho Department of Environmental Quality) and ODEQ (Oregon Department of Environmental Quality). 2004. Snake River – Hells Canyon Total Maximum Daily Load (TMDL). Technical Report; June 2004.

Berger CB, Wells S, McCulla A. 2009a. The impact of Idaho Power Company's proposed temperature mitigation projects on temperatures in the Boise River and Snake River. Technical Report EWR-02-09. Water Quality Research Group, Dept. of Civil and Environmental engineering, Portland State University. May 2009. 24 pp.

Berger CB, Wells S, McCulla A. 2009b. Brownlee Reservoir cold water analysis and downstream impact on cooler water temperatures released from Hells Canyon Dam. Technical Report EWR-XX-09. Water Quality Research Group, Dept. of Civil and Environmental engineering, Portland State University. September 2009. XX pp.