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Department of Energy

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POWER BUSINESS LINE

May 1, 2000

In reply refer to: KEW-4

U.S. Army Corps of Engineers, Walla Walla District
201 North Third Avenue
Walla Walla, WA 99362-1876

ATTN: Lower Snake River Study

Thank you for the opportunity to comment on the Draft Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement. The Draft EIS reflects your willingness to address the relevant biological, economic and social issues raised in the regional effort to recover listed Snake River salmon.

The attached comments were prepared by BPA's air quality specialist and by Harza Engineering while under contract to BPA. These comments can be summarized as follows:

1. **Air Quality.** BPA suggests adding detail to address (1) the potential increase in Washington and Oregon's air emissions from fossil fuel generation that could replace the full 1550 MW of lost generation; (2) impacts of dust emissions from dewatered reservoirs in an already compromised airshed; and (3) the potential effects of increased diesel truck emissions to communities located along the existing transportation corridor.
2. **Alternatives and Non-Alternatives.** The current alternatives encompass a range of alternatives from breaching to existing condition. BPA suggests that Alternative 1 better describe the strategic benefits provided by the current hydrosystem operations, especially the FCRPS' operational flexibility to protect the fishery.
3. **Criteria for Selection of an Alternative.** As currently portrayed, it is difficult to comprehend all the
81 different biological, economic and social issues together. BPA suggests the addition of a table
illustrating the Decision Criteria with a summary of the data and analysis relevant to each alternative.
4. **Water Quality Issues.** The evidence suggests that large storage releases are not very helpful to
spring chinook migration. Should there be a decision to remove one or more dams, the benefits of
changed operations would need to be tested in that new environment. We think it is presumptuous at
this point to assume the benefits of changed operations in such a drastically changed environment.
Thus such decisions should be deferred. With the existing system, it appears that a potentially good
82 strategy might be to maximize transportation when water quality conditions are poor from either high
gas or temperature and maximize in-river migration when river conditions are good (normal to
moderately high natural runoff). Programs that diminish gas and improve temperature, especially late
summer, offer promise of even higher in-river survival rates. Coupled with increasing survival
estimates from NMFS, we are hopeful that such improvements would make significant enhancements
for summer migrants within the FCRPS.
5. **Biotic Issues.** We support the research that is underway to evaluate habitat improvements for adult migrants, spawning habitat and predator prey relationships. But quantification of the benefits from

such actions is needed in order to adjudge their merits and cost-benefits compared to other options we may employ.

6. **NMFS CRI and PATH Analyses.** Our major concern about PATH models and conclusions relate to assumptions about post-Bonneville mortality. If such mortality is low and current, albeit imperfect data suggest it is, conclusions about dam removal benefits are greatly exaggerated. Although we have no other simple or quick fixes to offer, it seems that improvements to all aspects of the life cycle provide greater benefits than focusing only on the hydro system improvements. Until experimental evidence shows that D (delayed mortality) values are in excess of 50%, we prefer to embrace a broader strategy.
7. **All-H Strategy.** In light of the above, we recommend continued collection of data to elucidate criteria for not only hydro system improvements (including the D value), but other H improvements.
8. **NMFS Analysis of Dam Removal.** We agree with NMFS conclusions that benefits of dam removal hinges on whether post-Bonneville survival rates are dramatically lower than rates measured within the hydropower corridor. We do not agree that a test of a "with" or "without dams" experiment is not possible. We offer a seminal idea that utilizes proven NMFS protocols.

We appreciate this opportunity and thank you in advance for consideration of our comments.

Sincerely,

Roy Fox
Manager for Federal Hydro Projects

2 Enclosures
Air Quality Comments
Comments Prepared for BPA by Harza Engineering

ATTACHMENT 1

Replacement Power and Associated Impacts
The EIS should assume the full 1550 MW for a replacement generation value. In addition, if the
Snake River dams are removed, it is highly likely that replacement generation will be located in
1, 2 Washington and/or Oregon. It is also likely that the replacement power come from natural gas
generation. We suggest discussing and visually presenting this potential increase in
Washington's and Oregon's fossil fuel generation emissions. This could be effectively presented
as a percent increase from status quo. Also, a discussion of these impacts on global warming is
needed.

Dust Emission
Wind blown dust is a problem in many areas east of the Cascades. The construction of
drawdowns and subsequent removal of reservoirs will exacerbate existing conditions and should
3, 4 be highlighted. Recent data on wind blown dust in Eastern Washington was not presented and
neither was Washington's exempted status associated with particulate standards because the
windblown dust is not controllable. The EIS does not mention data on sediment toxicity and/or
sediment hazardous constituents. Resuspension/volatilization of these constituents was not, but
should be incorporated as a component of windblown dust impacts.

Transportation
5 If dams are removed, the emissions from trucks will grow in the transportation corridor as trucks
replace barge transportation. EPA evidence suggests that there are increased carcinogenic risks
from diesel emissions that should be highlighted in the EIS.

Also, the document should present the resultant emission from each of the transportation studies
rather than averaging them. This allows for an easier assessment of which alternative would be
the most environmentally sound. In addition, we remain concerned that the emission factor
6 citations are still grouped together in Table 3.5. It would be more accurate to attribute each
emission to an appropriate citation. Rail car shortages have not been considered in the modeling
study found in 3.2.1. BPA strongly suggests that rail car shortages be calculated and planned for
in the modeling study, as barge transportation decreases.

ATTACHMENT 2

I. THE ALTERNATIVES AND NON-ALTERNATIVES

Overview

The EIS selects four alternatives and identifies six other non-selected alternatives. The selection of alternatives should receive further consideration. The EIS relies heavily on the PATH process and analyses and the Anadromous Fish Appendix. The problem of reconfiguration of the lower Snake River dams is hierarchical rather than linear. Many of the implemented changes would be contingent on choice of operations. Potentially the hydro system could be a variably operated system contingent on runoff. In short, the problem is more complex than simply four choices.

7, 8 The EIS identifies four alternatives. However, as presented, they are really two alternatives. Alternatives 1, 2 and 3 are all existing projects with more or less transportation built out to varying degrees. The fourth alternative is dam removal. Thus, the major dichotomy or choice is whether to retain transportation or remove the four lower Snake dams.

What is left out is whether to consider the potential that fish would migrate in-river with dams in place. NMFS data (Sanford and Smith, 1999) suggests that in five of fourteen comparisons (36%), in-river migrants returned more adults. In nine comparisons, transported fish returned more adults. NMFS research also showed that (a) juveniles that avoided detection returned more adults and (b) juveniles that out-migrated in high flow years returned more adults. Thus, it is possible to imagine a "configuration" and "operation" that would take advantage of these observations. For example (1) eliminate downstream transportation and transport only from Lower Granite Dam (2) minimize transportation in seasons or years of high flow (3) maximize transportation in times of low flow or poor water quality (high gas, warm water). None of these options are considered.

9 Dam removal is adjudged to be an all or none decision. This makes sense only if dam removal is a means of removing a "turbine" impact. A more important reason might be to consider dam removal if it could make a significant change in mainstem habitat. The benefits of such alternatives are not discussed in any quantitative way as to understand the contribution of increased production that might arise. For example, Lower Granite could be removed and Transportation could remain a tool for future mitigation. Also, without the context of the Lower Columbia dams and their operation, decisions about the lower Snake are only partial answers. For example, would transportation still be used at McNary?

Alternative 1 Existing Condition

10, 11, 12 Existing Condition is an unfortunate name because it implies *status quo*. It presumes unacceptability and biases the choice toward something else that must be better. Alternative 1 could be called "blended or mixed" path because it can use in-river, transport and could even include a dam removal if habitat gains were adjudged to be highly significant.

New cams and runners may improve the hydraulic turbine efficiency (more energy from the same water) and may be good for fish. But it probably will not help salmon recover with the "existing condition". The reason is simple, too few fish ever see the inside of a turbine with

"existing conditions". Every strategy employed is designed to keep fish out of turbines. Thus it is possible to bypass 90% of the fish into barges and maybe more if all technologies are employed. The Corps' estimate of turbine mortality is 7% on average. Even if modernized runners and cams cut mortality in half, 3% of 10% is only 0.3% times four dams is about 1% increase in juvenile survival. Current estimates to restore fish populations to increasing levels is
10, 11, 12 cont. minimally 2 to 10 times (200% to 1000%). Thus fixing cams and runners will make the greatest measurable difference to the existing system, or to any of the Alternatives under consideration only if operational decisions are made which result in more fish passing the dams through turbine routes.

Recommendation: There needs to be more analysis of in-river survival pathways before such expenditures would make any sense. There also should be consideration of an alternative that includes more in-river migration with dams. For now, it is doubtful that with any of the four Alternatives presented, that any measurable improvements to population levels would come from turbine improvements.

New back-up pumps for ladders are being designed in case of pump failure. Currently, the adult passage facilities operate two ladders per project. Ladders have been in operation since the projects were constructed. Presumably if one pump failed, another ladder would remain functional. Rationale for this expenditure is unclear as evidence of pump failure frequency and consequence is not presented. More information is needed as to why this will help recover salmon and how we would measure it's benefit.

13, 14 **Seven other system improvements** to "existing condition" are suggested. If these improvements are implemented prior to final selection of a preferred alternative or operating scenario, they could be wasted expenditures. In general, no monitoring or evaluation tests are presented to demonstrate that the improvements would provide measurable fish benefits if alternatives 1, 2 or 3 are selected. Nor is any indication given how much difference there would be in acute survival of fish. A pervasive problem throughout the document is that many "fixes" are being applied, but there is no cohesive strategy tied to where fish are being directed…i.e. spillways, barges, turbines, JBS's etc. and what the resulting overall system survival improvement would be.

Alternative 2 Maximum Transport

Alternative 2 is almost identical to Alternative 1 except voluntary spill would be reduced or eliminated. All "improvements" would be similar to Alternative 1. It simply eliminates NMFS strategy in the 1995 BiOp of allowing about 50% of the juvenile salmon to migrate 'In-river". In this case, about 95% of the juveniles would be transported out from the three upstream projects.

15, 16 To select this Alternative, one would need evidence that Transportation is as good as in-river migration, with, or without dams. Current evidence from NMFS survival studies do not unequivocally show that this is the best option or that it is sufficient to recover Snake River chinook. However, in nine of fourteen comparisons, transported fish returned as many or more adults than in-river migrants (data from Sanford and Smith, 1999). Thus, it is imperative to focus interim operational decisions on resolving uncertainty associated with delayed mortality.

Alternative 3 Major System Improvements

Alternative 3 is almost identical to Alternative 2 except the SBC surface collector and Behavioral Guidance System (BGS), would get more fish into barges primarily at Lower Granite Dam. The concept is a "super-collector" project where 90+ percent of Snake River juveniles would be removed into barges or trucks to transport from Granite to below Bonneville Dam. The Corps acknowledges that further expenditures for facilities at the three downstream projects "would be less needed".

17, 18 The super collector concept is a double-edged sword. It concentrates transportation at one facility. It eliminates most in-river migration. Evidence suggests that collecting fish more upstream in the system does provide higher adult returns.

However, consider if the collecting system ever fails, or there is an "overload" on the capacity of the system—concentrating fish may lead to greater disease transmission, predation, and higher D value (delayed mortality). Such a one-dimensional super-collector could become a super failure. It is putting all the eggs into one basket. It is the exact opposite of NMFS strategy to "hedge" bets by diversifying fish improvements across the system. By its very condition, nature is more diverse and inefficient. This Alternative 3 super-collector paradigm is the exact opposite of what nature provided in Columbia River salmon—diversity. It has high risk if seen as "the fix".

19, 20, 21 An alternative that might provide for intermittent operation of a super-collector at Lower Granite Dam may make sense. Under very poor flow conditions fall chinook could be exposed to poor water quality conditions. A super collector could be a "safety net" to reduce in-river mortality. During spring migration, high flows can produce lethal TDG conditions. Collecting and transporting would allow an occasional risk to avoid possibly a worse circumstance. It could reduce other in-river mortalities.

Alternative 4. Breaching

Alternative 4 is the earth embankment removal of the four dams. This would lower reservoirs to natural-river level. Key elements include appropriate engineering to facilitate reservoir/river hydraulic control during construction using spillways at first, then modified turbine passages to drain the lower half of the reservoir while embankment materials are excavated and removed. A variety of engineering and legal elements are identified, from rip-rap of channels to management of the de-watered inundation zones.

22, 23, 24 Rationale for only considering the four dam removal (not one two or three, or, for that matter, Columbia River dams) does not seem to be based on fish benefits or recovery logic, "…removal of only one dam would eliminate major navigation… and would curtail options for collecting and transporting juvenile fish" (page 3-7). The logic of removing dams must be based on the conclusion that it is the failure of transportation or other "with-dams" alternatives to facilitate recovery. It should not be based on whether transportation can still be accomplished. Thus, why would transportation be part of the picture? If the decision is to be based on science of recovery, then breaching must be based on comparisons of juvenile to adult returns from in-river versus transported fish. Currently, neither in-river survival nor transport survivals are returning sufficient adults for either to gain recovery.

Alternatives Not Considered

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The above four alternatives are really only two alternatives: breaching and some form of Transportation, with or without spill. The Corps has identified a variety of other options that may make sense, but for one reason or another have been eliminated from further consideration. The following are comments as to the potential value for these other options.

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In River Option No Transportation with Flow Augmentation. Currently NMFS is testing a version of this option with PIT tag protocols. Data suggest that certain groups of fish that do not encounter JBS systems have returned more adults than groups that have been transported or encountered many JBS systems.

Such a strategy could be especially good in high flow (high snow pack) years when in-river survival is highest and spill is high. It could be alternated with Transportation in normal and low flow years when transport may return more adults. This strategy may provide a better hedge than simply going with an all-or-none Transport or Breach option.

28, 29, 30

Maximized Transport Four Dam w/ SBC Collectors. Elimination of this concept seems justified in that existing system can remove about 95% of migrants at three dams. However, if Maximizing Transport Alternative 2 is selected, it may make sense to develop similar facilities at Little Goose to avoid all eggs in one basket discussed above, yet maximize collection efficiency at two dams.

Construction of similar facilities at Lower Monumental and Ice Harbor do not seem justified as 80% of the juvenile spring chinook and steelhead could be transported upstream.

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Adaptive Migration Strategy w/ No Spill. This option should be considered a variation of In-River No Transportation. Instead of using spill, fish would be transported or released to the river by voluntary hydraulic controls in the JBS.

Due to suspicions that JBS's may have delayed mortality associated with them, experiments should be done before adopting this strategy. Instead, use of spill may be a less risky means to hedge transportation as is done under Existing Conditions Alternative 1. Elimination of this option was done because testing SBC's is incomplete. This or some similar option should remain open.

Drawdown and No/Yes Snake Flow but Yes Columbia Flow Augmentation.

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Even with existing dams, there is no evidence that increased flow provides anything but minor survival benefits to spring migrants (Olsen *et al.*, 1998). If dam removal were selected, it would be easy to conduct survival tests from Lewiston to McNary under varying storage scenarios. The costs and benefits of flow regimes could be decided at that time. The default case should be return to maximized storage under dam removal scenario until it is proven inadequate for migrants.

Fall chinook migrated under even lower flows prior to storage dams.

Discharge in the Columbia should be evaluated on its own merits and with data from the Columbia; specifically data on migrants and water quality in the Columbia and its estuary. Such an evaluation must also consider whether Transportation would be used at McNary and with

33, 34, 35 cont. appropriate comparisons with in-river survival rates in the Lower Columbia. In short, the use of storage with dam removal should await data from those scenarios.

36, 37 **Dam (Powerhouse, Spillway, Navigation Lock) Removal**. If dam removal is selected, it seems unlikely that the projects would be reconstructed in the foreseeable future. If the concrete structures are left in place, the primary consideration should be river hydraulics, construction costs and flood issues, not reconstruction of the projects.

If Alternative 4, Embankment Removal is selected, critical studies of the stability of the structures, hydraulic conditions for fish and safety would be the primary concerns.

II. CRITERIA FOR SELECTION OF AN ALTERNATIVE

38 The primary ingredient needed in the EIS is a means to objectively measure the Alternatives available. Unfortunately, there is no clear measuring stick, formula or set criteria given. Especially critical is whether it is necessary or prudent to select Alternative 4 because of the large societal costs associated with it. There are four key questions that must be answered unequivocally. The most significant issue imbedded in the EIS is, can we preserve salmon without removing these dams? And if we think we can, then what other opportunities exist to prevent extinction? The primary ingredient needed in the EIS is a means to objectively measure the Alternatives available.

39, 40 **1. Is the ocean primarily responsible for adult return rate?**
The Corps EIS presents voluminous data to corroborate that the ocean has an important role (*vis.* Mantau *et al.*, 1997: Welsh *et al.* 1999). However, no one can predict the future of ocean conditions and the reason that stocks are near extinction does not seem to be driven by the ocean alone. The ocean has varied in decadal patterns of high and low productivity. Yet extinction seems to be related to human activities in the basin (harvest, dams, irrigation) during the past 100 years (Lichotowich, 1999) combined with several decades of predominantly warm ocean and droughty climate. Thus, it does not seem rational to blame the ocean as the only cause of salmon decline nor the only source for recovery. It will greatly affect the rate of recovery.

41, 42 **2. Should we continue to rely on transportation? It has not saved salmon.**
The basic argument against using Transportation is that it has been in use for twenty years and salmon are still headed for extinction. The counter argument is that transportation has kept them from going extinct (Anderson, 1997, 2000). One possible criterion for selection of Transportation or the In-river path is to choose whichever path returned 30% more adults (Harza, 1996). Another possible criterion is to choose an alternative that could achieve a 1.5% return rate. It appears that neither path is returning 30% more adults than the other, at least consistently. And neither path is achieving the 1.5% adult return rate.

Based on this result, it does not appear likely that changes to the hydropower system alone, with or without transportation, are likely to achieve recovery. We believe that improvement to other aspects of salmon life cycle will be needed, in addition to hydro system improvements. This should be mentioned in the EIS summary.

43, 44 **3. Is it possible to improve in-river survival without dam removal?**
NMFS survival data (Sanford and Smith, 1999) suggests that juvenile survival in-river is improving. In 14 experimental comparisons among in-river versus transported test populations,

in-river migrants beat transports in five (36%) of the tests. However, transportation returned more adults than in-river migrants in nine of the comparisons. Thus, it is possible in some circumstances for in-river migrants to return as many adults as transported juveniles. However,
43, 44 neither approach is returning 1.5% adult return rates with recent patterns of ocean conditions.

cont. Thus, although in-river migration via spill has been a primary tool of choice by NMFS to reduce jeopardy, by itself, it does not look like it will be the salvation of salmon. Additionally, the use of flow deflectors to reduce dissolved gas have been partially successful, but show increased fish mortality from increased turbulence.

4. What about the Delayed Mortality Question?

Delayed mortality was recognized as a potential source of error in estimating the number of adult salmon that should return based on the estimates of the number of juveniles that were known alive downstream of the hydro system (see Anderson, 1996). PIT tag data from a small group of juveniles accidentally released into the river in 1989 returned an inordinately large number of adults compared to all other groups of test fish (Harza, 1994). These accidentals were never detected until the returning adults were detected in fish ladders. This means that the juveniles passed through turbines or spillways in route to ocean. Or in other words, avoided JBS's entirely. This observation has been corroborated with recent data from NMFS. It shows a decline in juvenile survival and adult returns for fish that encounter more than one juvenile bypass system (Pizzimenti, 1999a, b). Unfortunately there is no real data to corroborate exactly what additional mortality is coming from transportation, nor its cause. Nor do we know why survival is lower for fish with multiple passes through the JBS systems.

45, 46 PATH (1999) has seized upon this concept and using theoretical population estimates concluded that unexplained losses are much larger. These unexplained losses when "cycled" through population models, show transportation losses almost meet or exceed losses from the hydro system. The conclusions are predictable. PATH models show that Transportation can never exceed the benefits from in-river migration.

If these unexplained losses are small, on the order of 10%, it will not matter. If they are large, on the order of 50%, then transportation has limitations for juvenile survival and adult return rates that are similar to the in-river system. Data from NMFS (Stanford and Smith, 1999) and CriSP modeling (Anderson, 1996) suggest it is more likely to be 10%.

Outside of PATH models with their assumptions, there is no demonstration that unexplained losses are as large as 50-66% of the population alive at the tailwater of Bonneville Dam. The best data estimates suggest the losses are 10-20%. What is needed are definitive experiments and data.

A Biological Simulation of Dam Removal Experiment.

An experiment can provide the data needed to measure discrepancies in the acute juvenile survival rate from the hydro system versus the chronic juvenile ocean survival rate as reflected in
47, 48, the adult return rate. This discrepancy is D. The experiments are simple modifications of
49 protocols already proven by NMFS since 1991 (e.g. Muir *et al.*, 1998).

Test groups of fish are released upstream of Lower Granite Dam and downstream of Ice Harbor Dam such that they mix in route to the ocean. The losses from the acute mortalities at the dams are calculated. Once subtracted, the two groups of fish are subjected to similar down river and ocean conditions. They should return similar adult return rates verifying a low or non-existent D value. If multiple dam experiences have a significant effect on survival, then there will be fewer adults produced from the test group that passes through the lower Snake River Projects. This would suggest a large D value.

47, 48, 49 cont. The corollary experiment could test transportation for its D value. A similar group of fish would be marked and transported from Lower Granite Dam. Adult returns from this group are compared with those that migrated in-river from Lower Granite and from Ice Harbor. If transported adult return rates are lower than those fish released downstream of Ice Harbor (with acute mortalities from dams included in the calculation), then the difference reflects the effect of D.

Without such experiments, hypotheses about D values are just hypotheses and cannot be treated as facts. Currently, PATH models treat these hypotheses as "facts" in their models, *i.e.* "assume" they are true. It will take about five years to conduct this experiment with one replicate.

III. WATER QUALITY ISSUES

50, 51 **Using Flow and Velocity to Save Salmon?** During studies of Drawdown for the Northwest Power Planning Council (Harza, 1994), the rationale for doing drawdown was to increase velocity in the river. The rationale for velocity was that the ocean presented a "window" of opportunity for migrants to arrive when conditions were best. There is no evidence that indicates that velocity per se or a specific arrival time conveys a strong measurable survival benefit within years (See Olsen *et al.*, 1999 for a review of the issue). Thus rationale to use storage to increase velocity to save salmon remain without basis. Higher discharge may change the hydraulics at a dam, and hence juvenile or adult passage mortality, but these are very different and measurable phenomena.

Flood vs. Drought Years.

52, 53, 54, 55 NMFS has based their BiOp flow targets at Lower Granite and McNary dams based on inter-annual comparisons (NMFS, 1998, 1999a,b,c). Inter-annual comparisons show greater survival of migrants in flood years compared to drought years (Sanford and Smith, 1999). However, in their review, Olsen *et al.*, 1998, indicate that in drought conditions, it is impossible to meet NMFS BiOp (1998) flow targets at McNary and Lower Granite dams for spring/summer migrants. There is not enough water in storage to change a drought year into a flood year. The few experiments evaluating the relationship of juvenile survival to velocity in the hydropower system have not shown any strong cause-effect relationship within year (e.g. Giorgi *et al.*, 1994; 1997, *In* Olsen *et al.*, 1998). Thus use of storage with any of the alternatives seems to provide limited benefits above certain hydraulic minima, and very high system costs.

Environmental Cues To Migration.

56, 57 Spring chinook juvenile migration is correlated with a variety of environmental cues including: discharge, turbidity, temperature change, increasing day-length, and Julian day. Some observations suggest that spring freshets stimulate physiological changes associated with migration. Attempts to simulate freshets with experimental pulsed releases from storage have had mixed results, but show some promise as a means to cue spring chinook to migrate.

Fall chinook juvenile migration is more protracted with juveniles migrating more slowly and over a longer period of months and later in the year. Lower flows at this time may have greater

56, 57 cont. impacts on temperature and hydraulic passage conditions at dams. However, the conclusion that these fish need to be flushed could be completely erroneous. Limited PIT tag data showed that fall chinook migrating out of the system in late fall months actually returned more adults than the far more numerous early migrants that left the system in late summer (Pers. Comm., Kevin Malone). The evolutionary strategy of fall migrants appears very different than spring migrants and "treatments" that may be good for spring migrating smolts may not apply to fall migrants and vice versa.

The two most significant issues related to mainstem habitat that are affected by dam operations are temperature (Yearsley, 1999) and dissolved gas (Maule *et al*., 1997). The Corps has programs to monitor both gas and temperature. Recent reviews suggest there is a need for a real time deterministic model of thermal behavior in the Snake (Harza, 1999a).

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Total Dissolved Gas

Total dissolved gas (TDG) levels above 120% are known to harm juvenile fish. Levels above 110% may be found to violate Clean Water Act standards. The Corps has designed, constructed and tested flip lips in the Lower Snake dams and is monitoring the TDG levels. Opportunities to reduce spill and yet retain high fish passage efficiencies include modifying spillways for surface spill (Harza, 1994). Such structures could pay for themselves on water saved in less than one month of operation. The Corps tested one such prototype at The Dalles. Unfortunately, high levels of spill at adjacent gates may have obscured benefits in increased fish guidance efficiency.

Opportunities for similar spillway bypass exist at the three most downstream Lower Snake Dams as alternatives to surface bypass/collectors (SBC) and at potentially much reduced cost. The combined SBC at Lower Granite with guidance curtain is showing high levels of guidance and should be pursued further if in-river path is part of the selected alternative. However, as long as the possibility exists that dam operations could be found in conflict with Clean Water Act initiatives, it is imperative we reconcile the somewhat mutually exclusive objectives of the Endangered Species Act, as currently interpreted and implemented by NMFS, and those of the Clean Water Act, as currently interpreted by EPA.

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Temperature

Temperature in the Snake River is known to exceed 75 F in August and September and is deleterious to migrating adults and juveniles (Karr *et al.* 1992). Currently, the Corps operates Dworshak Dam based on recommendations from the agencies and tribes. However, no accurate or dependable model or data set exists to predict real time downstream thermal benefits from such operations (Pers. Comm., Rich Domingue). Current models are mostly inadequate because of severe data limitations. Harza (1999b) recommended a detailed monitoring program to include meteorological data that would enable deterministic models to predict downstream temperatures in real time. An associated decision support system would enable dam operators to regulate reservoir releases to achieve specific thermal targets. Similar opportunities exist for the Hells Canyon complex and in the Clearwater River. Both are being investigated by Idaho Power and IDWR respectively.

IV. BIOTIC ISSUES

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Upstream Passage

Evaluation of salmon counts from harvest and dam counts suggests significant discrepancies of unaccounted fall chinook. The literature on upstream passage of salmon and steelhead suggests

about 3% unaccounted loss per project (Bjornn *et al.*, 1993, 1994, 1997, *In* Peters *et al.*, 1997). Radio-tag studies of adult spring chinook and steelhead suggest many fall chinook adults may be
65, 66 cont. migrating into lower river tributaries or either spawning or dying in the reservoirs, especially Bonneville pool (Harza, 1998b). Enforcing harvest of fall chinook may also be difficult due to harvest methods and accounting procedures. More detailed studies especially of fall chinook are needed to understand the effects of harvest on losses of fall chinook in the lower Columbia before they reach the Snake. Additionally, monitoring of the effectiveness of law enforcement should reveal its benefits (Pizzimenti *et al.*, 1998).

Spawning Habitat.

Battelle studied potential spawning and rearing habitat in the Lower Snake and Columbia rivers if dams were removed (USGS Workshop, August 1999 and Dauble *et al.*, 1999). Lowering of McNary pool and removal of Ice Harbor and Lower Monumental dams have potential to restore spawning habitat of fall chinook according to workshop participants. Arguments of whether these areas would be colonized by threatened Snake River fall stocks versus Hanford reach stocks, and whether it makes a difference, should be debated. This debate should include a thorough discussion of the phenotypic and genotypic traits used to identify the stocks, as well as
67, 68, 69 which of those traits are the object of conservation efforts. A major problem of many of the analyses to date is they have not identified specific goals to achieve and how these goals would translate to objectives for the specific, quantitatively described populations of interest.

Aside from specific stocks, it is unclear whether NMFS, PATH or any group has modeled the incremental benefits from such increases in in-river production. If not, these should be factored into any future evaluation if dam removals are to be considered. Up until now, most analyses of dam removals have focused on how many fish turbines and spillways kill rather than quantifying other benefits relating to habitat. Removals of tributary dams to open blocked habitat is becoming a topic of mitigation discussion in the lower Columbia Basin (Sandy River and White Salmon rivers are two examples). This topic was not addressed in the EIS but seems important for an overall recovery plan.

V. NMFS REVIEW OF PATH

NMFS (A-Fish Appendix) provides an excellent review of the PATH modeling and analytical process. The PATH process uses the reductionist approach that attempts to break the physical world down into its individual parts and then put them altogether. The whole of the salmon problem is thereby understood as the sum of the composite parts. Unfortunately, the composite parts are numerous. So are the uncertainties about their individual measures and their interactions with each other. NMFS points out that as a result PATH has made thousands of model runs to evaluate every possible combination of attributes many by "assumption." The reason for the variety of analyses is a lack of clear data to base the models. Distillation and
70, 71 comprehension of these thousands of models becomes burdensome and might require as much effort as went into the analyses. The results are summarized in box-wire diagrams showing that resulting predictions vary significantly with assumptions.

There is some rationale to accept PATH conclusions *prima facie* as it was a collaborative effort of many qualified scientists each reviewing, critiquing and contributing, albeit not always agreeing. The results present a set of hypotheses and probabilities about comparing the Dam Removal option to leaving dams in place. Not surprisingly, Dam Removal options suggest less likelihood of future extinctions of Snake River salmon than leaving dams in place. But the

70, 71 cont. probabilities suggest that dam removal is no sure thing to avoid extinction. This conclusion is to PATH's credit. And although for fish, removal is better than keeping the dams, the odds are less than 2:1 that it is necessary. This is because many other factors affect future existence of salmon that are not modeled by PATH. This needs to be mentioned in the summary of the EIS.

72, 73, 74 PATH's assumptions about 48 to 100 years in the future assume that environmental conditions in 1999 will be the same as in 2047 or 2098 except whether there will be eight, four or three mainstem dams standing between Astoria and Lewiston. But human population growth and all it entails in land use, agriculture, water use, potential for contamination, loss of open space, timber harvest, fish harvest, recreation needs, and energy consumption, i.e. things we know affect aquatic habitat, are not considered to change in these simplistic models. For this reason, we should view the salmon problem as simply not one of dams. NMFS tries to take this approach. That is to look at all aspects of the salmon environment within the political and economic setting of 1999. They look at all factors affecting salmon which include: habitat, harvest, hydropower, hatcheries and the ocean. This broad based approach is called the All H Strategy and we believe it has merit and needs inclusion in the EIS summary

VI. THE ALL-H STRATEGY

The All-H strategy embraces the EDT Multi-species Framework in that it integrates all stages of the life cycle and provides measurable treatments with a targeted goals and performance criteria (Harza, 1998a). As an initial set of criteria, Habitat treatments are designed to increase egg-to-smolt survival measured at Lower Granite Dam from 3-5% to 7-10%. Hatchery treatment is designed to assure that 380 smolts per female arrive at Lower Granite Dam. Hydro goals are to deliver 75% (285) of the arriving smolts to below Bonneville Dam. In addition, the Hydro system would be responsible for 78% survival of the adults from Bonneville to Lower Granite dams. Harvest is a tool that would be turned on or off to assure a minimum adult escapement of at least 0.6% (SAR value).

75, 76 Using such an approach, we followed a spawning pair of fish through their life cycle to see whether they under-replace, over-replace or just replace themselves. We tested this under sensitivity of variable ocean productivity and then varied each one of the four H's (Figure 1-unpublished model). Using these criteria, we found that (1) under good ocean conditions, the spawning pair would produce more than two recruits if habitat, hatchery or hydro goals were met, but not under existing conditions. And regardless of single H improvement, none could replace themselves under similar circumstances if poor ocean conditions prevailed. Harvest if maintained at 24% levels could not achieve positive recruitment levels under average ocean conditions. If all four H's were improved, one adult pair could recruit three spawning pairs (300% increase) in good ocean years and with 24% in-river harvest. But in poor ocean years, the population cannot maintain itself even if harvest in ocean and rivers is zero.

Such numbers can be considered place-holders for more defensible performance criteria. They demonstrate that it is generally not possible to increase the salmon population without improvement to All-H's and under poor ocean conditions. The only defense against severe declines is to curb harvest, even when all other H's have been improved. It also shows that when all H's have been addressed, there will be salmon to harvest in copious numbers. We think such hypotheses need to be made in the EIS.

77, 78, 79, 80

VII. NMFS ANALYSIS OF DAM REMOVAL VS. OTHER SOLUTIONS

NMFS chose to use a demographic model, more sophisticated than the simple spreadsheets presented above, but similar in approach. It enabled them to evaluate relative impacts if fish are removed or added from a variety of factors including harvest, hydro, hatchery, habitat or ocean changes. They demonstrate that these other factors, alone or in combination, can have as large an impact on directionality of population change as dam removal. They acknowledge that dam removal can have positive effects on population growth. However, the net benefit of dam removal largely hinges on how large the delayed mortality affect is from dams or transportation downstream of the FCRPS.

77, 78, 79, 80 cont.

The data is currently mixed about D values, and not surprisingly because no experiment has ever been conducted to actually control for variables that may be affecting it. NMFS suggests that the ideal experiment is a "with-dams" and "without-dams" test, but this is "not possible" (Appendix A-2-12). It may be possible, at least in part. As described above, using the same group of test fish, split in their release locations, one can examine the adult return rates of fish that experience (1) transportation, (2) eight mainstem dams in-river and (3) four mainstem dams in river. If the smolt-to-adult return (SAR ratios are similar among the groups, then D values for the Lower Snake Dams are of little consequence. Dam removal has a much lower benefit. If D values for transported fish, or D values for fish that see eight dams in- river are twice as large as the group that passes only four dams, then dam removal has a much higher benefit, at least with regard to 'extra mortality' factors. This experiment cries out to be done before any decision to remove dams is made, if the decision is to truly reflect potential benefits to fish as well as economic comparisons with other tools.

NMFS does not seem to acknowledge that delayed mortality can also come from the in-river "dams" experience as well as from the "transportation experience". This is why it is important to do the above experiment comparing in-river four-dam experience, with in-river eight-dam experience. That experiment should also estimate the frequency of contact with JBS systems, as these systems may be more deleterious than passage through spillways and or turbines. This latter fact is evinced by reduced adult returns from fish that have higher in-river detection rates or fish that are transported lower in the system (Harza, 1994; 1996; Pizzimenti, 1999; NMFS, Appendix A).

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