KARIN J. IMMERGUT, OSB #96314
United States Attorney
STEPHEN J. ODELL, OSB #90353
Assistant United States Attorney
District of Oregon
600 United States Courthouse
1000 S.W. Third Avenue
Portland, OR 97204-2902
(503) 727-1000

SUE ELLEN WOOLRIDGE
Assistant Attorney General
ROBERT L. GULLEY, Senior Trial Attorney
robert.gulley@usdoj.gov
RUTH ANN LOWERY, Trial Attorney
COBY HOWELL, Trial Attorney

Wildlife & Marine Resources Section
Benjamin Franklin Station, P.O. Box 7369
Washington, DC 20044-7369
(202) 305-0500 (ph)
(202) 305-0275 (fx)
Attorneys for Defendants

UNITED STATES DISTRICT COURT

DISTRICT OF OREGON

NATIONAL WILDLIFE FEDERATION, *et al.*

Plaintiffs,

v.

NATIONAL MARINE FISHERIES, U.S. ARMY CORPS OF ENGINEERS, and U.S. BUREAU OF RECLAMATION,
Defendants.

Civ. No. 01-00640-RE (Lead Case)
Civ. No. 05-0023-RE
(Consolidated Cases)

SECOND DECLARATION OF JOHN G. WILLIAMS NOAA FISHERIES SERVICE
(Injunctive Relief)

COLUMBIA SNAKE RIVER IRRIGATORS ASSOCIATION, *et al.*,

Plaintiffs,

v.

CARLOS M. GUTIERREZ, *et al.*,

Defendants.

I, John G. Williams, declare and state as follows:

1. I am a Supervisory Fisheries Research Biologist in the Fish Ecology Division, a research division of the National Marine Fisheries Service's (NMFS') Northwest Fisheries Science Center located in Seattle, Washington, a position I have held since 1990. In this position, I manage the Survival Program and oversee the Riverine Ecology Group with a complement of 33 full-time staff.

2. I am also an Affiliate Professor, School of Aquatic and Fisheries Sciences, University of Washington, Seattle, Washington.

3. I have worked as a research fisheries biologist in various professional capacities since 1980. During the course of my professional career I have conducted research and published studies concerning, among other topics, a variety of issues pertaining to salmonid[1] survival in the Columbia River system. A list of my research and publications, together with my educational degrees, is contained in my Curriculum Vitae, attached to this declaration as Exhibit A.

4. Previously, in this litigation, I prepared a declaration dated June 6, 2005. The opinions expressed in this declaration relate to and expand upon my opinions presented in that first declaration. A copy of that declaration is attached as Exhibit B.

5. In preparation of this declaration, I have reviewed the Plaintiffs' Motion for Further Injunctive Relief as well as the declarations submitted in support of that motion by Robert Heinith and Thomas Lorz and those incorporated by reference from Frederick Olney and Stephen Pettit. I have also reviewed the Declaration of Colonel Martin on the Corps of Engineers' intended FCRPS river operations for the 2006

[1/] "Salmonid" refers to both salmon and steelhead, although steelhead are classified as trout. Salmon and steelhead are also both anadromous, meaning they spawn and rear in freshwater but migrate to the ocean to grow to adulthood.

spring and summer migratory seasons. The opinions presented in this declaration draw upon my 25 years as a research fisheries biologist and, in particular, upon my most recent work with adult return rates of Columbia Basin salmonids presented in the NOAA Technical Memorandum, Effects of the Federal Columbia River Power System on Salmonid Populations, February 2005, a copy of which is attached as Exhibit C ., relevant excerpts of which are attached as Exhibit C (The complete report is available on the Internet at http://www.nwfsc.noaa.gov/publications/displayallinfo.cfm?docmetadataid=6061, last visited November 18, 2005. This report is also referred to as 'Williams et al. 2005').

6. This declaration details the biological effects of the Corps' intended 2006 operations on the listed salmonid ESU's for the Snake and Columbia Rivers. The declaration will cover the following points:

(a) Salmonid Life Cycle ¶¶ 12-18

(b) Hydropower System Management Options ¶¶ 1-21

(c) Smolt-to-Adult Returns for Spring Migrants¶¶ 22-33

(d) Summer Migrants: Snake River Fall Chinook ¶¶ 34-36

7. In my opinion, based on currently available data and analysis, the plaintiffs' proposed operation during the spring period would more likely harm the listed salmonid ESUs than the river operation proposed by the Corps of Engineers ("COE") for 2006, as described in the Declaration of Col. Martin. The COE proposal will likely return more adult Snake River Spring Summer Chinook and Snake River Steelhead than the Plaintiff's proposal. For Snake River Fall Chinook, which migrate later in the summer, the plaintiff's proposed operation presumes that it will return the highest number of adult returns, but neither positive or negative empirical evidence exists to support this supposition. Conducting a long-term study to understand how best to increase adult returns of this stocks appear critical to resolving uncertainties. The Corps' plan to "spread the risk" (transporting approximately 50% of the fall Chinook migration) will not affect the ability to conduct research.

INTRODUCTION

8. Fishery management of the Columbia River hydropower system involves a number of different techniques which attempt to balance competing interests not just among the many river uses, but among a number of different salmonid species. In fact, there are currently 13 listed ESU's within the system that all require different conditions in order to thrive. This complex system can be manipulated in a number of different ways to achieve those ends. However, in order to design and implement the most efficient and biologically sound operation for all of the species, we must first have a yardstick by which to measure success. As discussed below, the only true measure of success for salmon and steelhead is the *return* of spawning adults. After all, measuring one isolated component, for example juvenile reach survival, is meaningless unless those same juveniles return as adults to spawn thereby ensuring the survival and recovery of their species.

9. Because salmon and steelhead migration through the hydropower system must be evaluated as part of a complete life cycle, it is critical to understand that the ocean and the estuary play substantial roles in the survival of these fish to adulthood. We have learned that the most important objective for hydropower system management is to ensure that juvenile salmon and steelhead arrive in the estuary when they are ready for entry into seawater and when environmental conditions are optimal for their survival. The best available science on spring migration indicates that fish do not return as adults if they arrive in the estuary too early before they are sufficiently developed; and the same is true if they arrive too late when environmental conditions have deteriorated. In other words, spring juveniles return as adults at a higher rate when they arrive in the estuary at the optimal time in their development. While the same principles most likely apply to summer migrating fall Chinook, the data are uncertain about how best to achieve optimal timing for their entry into the marine environment.

10. In short, where the data and science is clear (as is the case with the spring migration), the hydropower system should be managed in such a manner so that the tools and techniques of the system are utilized in varying combinations in order to ensure that all juveniles (salmon *and* steelhead) arrive in the estuary at the optimal time, thereby maximizing returns for all species. And, where the data is equivocal (as in the case with fall Chinook), it will require additional research to provide the information necessary to inform decision makers on strategies for maximum adult returns.

11. As explained in the Declaration of Col. Martin, the Corps intends to implement two operations for FCRPS: one for the spring migration and another for the summer. The first (spring operation) capitalizes on existing data to maximize returns. The second (summer operation) relies on the strategy of "spreading the risk," a position clearly argued by the Plaintiffs as necessary under conditions of uncertainty. Additionally, the proposed operation will provide the ability to conduct research that will evaluate spill and bypass versus transportation to further our understanding in the face of uncertain data. The COE's proposed study of the effects summer conditions on Snake River Fall Chinook adult returns will likely provide useful information about whether increases in adult returns will accrue from transportation compared to bypassed fish. It will also provide data to show if the ratio in adult returns changes compared to conditions of no spill (transportation studies in 2001-2003 did not have conditions with spill), or with 2005 which had spill more in line with plaintiffs proposal. It will also provide information to determine if a change occurs in the percentage of adults that accrue from reservoir-type (yearling holdover fish) compared to ocean type (subyearling) migrants. For spring-summer chinook salmon and steelhead migrations, based on calculations fully explained below, it is my professional opinion that a dual strategy in the spring will provide the most biological benefit – namely higher returns – for salmon and steelhead. It is also my professional

opinion that Plaintiffs' proposed operation is likely to return fewer adult spring-summer chinook and steelhead than the operation proposed by the Corps.

I. THE SALMONID LIFE CYCLE

12. Anadromous fish inhabiting the Columbia and Snake Rivers all originate in freshwater and grow to maturity in the ocean before they return to repeat their life cycle. As discussed above, the ultimate measure of success for salmon or steelhead populations is the number adults that successfully avoid natural or anthropogenic mortality on their migration, survive to adulthood in the ocean, and return to spawn. To appreciate this feat it is important to recognize that each spawning salmon or steelhead faces innumerable natural obstacles. For example, each spawning Snake River Chinook salmon female will deposit approximately five thousand eggs in spawning area gravel. If two of those eggs survive to maturity to produce spawning adults then the salmon have replaced themselves and the population remains stable. Figure 1 below, illustrates the life stages of Snake River

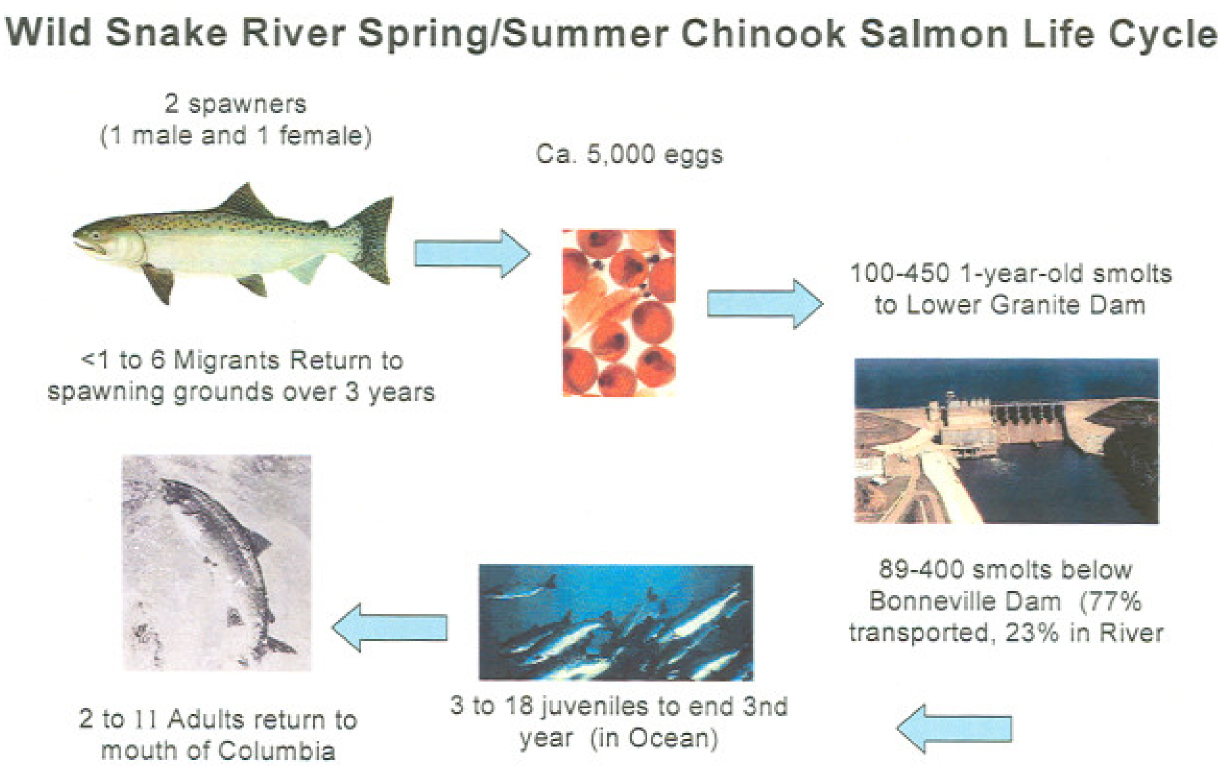

Figure 1. Representative life cycle of Snake River spring/summer Chinook salmon.

spring/summer Chinook salmon, which is similar to that of all salmonids. Clearly, a basic fact of salmon biology is that the vast majority of salmon that begin life as an egg will not, under any circumstances (natural or artificial), survive to adulthood. Since substantial mortality is a natural part of the salmonid life cycle, the focus for their recovery should not only be on how many survive a particular phase of their life cycle, but on how many complete the life cycle itself. Thus, the fact fish survive a particular river reach at a higher rate under a particular river operation does not necessarily mean they will return as adults at a higher rate.

13. To track the life cycle performance of salmon and steelhead populations under different conditions, scientists compare the numbers of juvenile salmon that have left the spawning and rearing habitat and begun their migration to the estuary and ocean (the life stage when salmon are referred to as "smolts") with the numbers of those fish that return as adults. Thus, the number of fish in the smolt life stage is compared with the number of those smolts that complete the cycle and return as adults to a location where the smolt was observed on its way down the river. This is referred to as Smolt-to-Adult Return ratio, or SAR, generally expressed as a percentage.

14. For example, by the time they reach the smolt life stage only 2-9% of the original eggs of Snake River spring-summer Chinook salmon have survived to the smolt stage. Petrosky et al. 2001. Thus, we would expect to see between approximately 100 and 450 smolts produced for each pair of spawning adults. Generally speaking, and over a long-term average, if two adults return to spawn from the spawning pair's eggs, we consider that population to be maintaining itself without growing or diminishing. If 100 smolts produced 1 adult, it would equate to a 1% SAR. Similarly, if 400 smolts produced 4 adults, it would also equate to a 1% SAR. As identified in Figure 1, the general expected number of adults returning ranges between 1 and 11. This equates to SARs ranging from < 1 to > 4. If productivity in freshwater is low and only 100 smolts are produced, it will take a

minimum SAR of 2% to return 2 adults. On-the-other hand, if freshwater productivity is higher and 300 smolts are produced, a SAR of 0.67% would lead to a return of 2 adults. Of course, to return two adults to spawning areas would require higher SARs to account for adult losses from harvest, predation, upstream passage, or pre-spawning mortality.

15. It is important to note that besides anthropogenic causes of mortality, ocean conditions also play an extremely important role in the salmon and steelhead life-cycle. Studies have shown that ocean conditions affect the performance of salmonid stocks more substantially than any differences in effects between varying hydropower system operations and resulting migratory conditions. Williams et al. 2005, Exhibit C. Trends of adult return rates more closely track ocean conditions than they track variables in passage conditions through the hydropower system. Exhibit C. In fact, when we evaluated ocean-climate indices for the North Pacific Ocean, we found a direct similarity between trends in these indices and the rate of returning salmon experiencing these conditions. Scheuerell and Williams 2005. When these ocean conditions are less favorable for Columbia River salmon their return rates (SARs) are lower. Conversely, when those indices record more favorable conditions the salmon return at higher rates. See Memorandum For Robert Lohn from Usha Varanasi, Director, Northwest Fisheries Science Center, dated May 26, 2005, and attached as Exhibit D.

16. This point may be illustrated by the following example. As the following Figure 2 illustrates, listed Snake River Spring/Summer Chinook salmon experienced very similar spill and flow conditions in 1996 and 1999 during their passage downriver from April through June. Yet, the SAR for the 1999 outmigration (4.03%) was almost 14 times that of the fish migrating out in 1996 (0.29%) as illustrated in the following Figure 3. In other words, the 1996 and 1999 smolts experienced

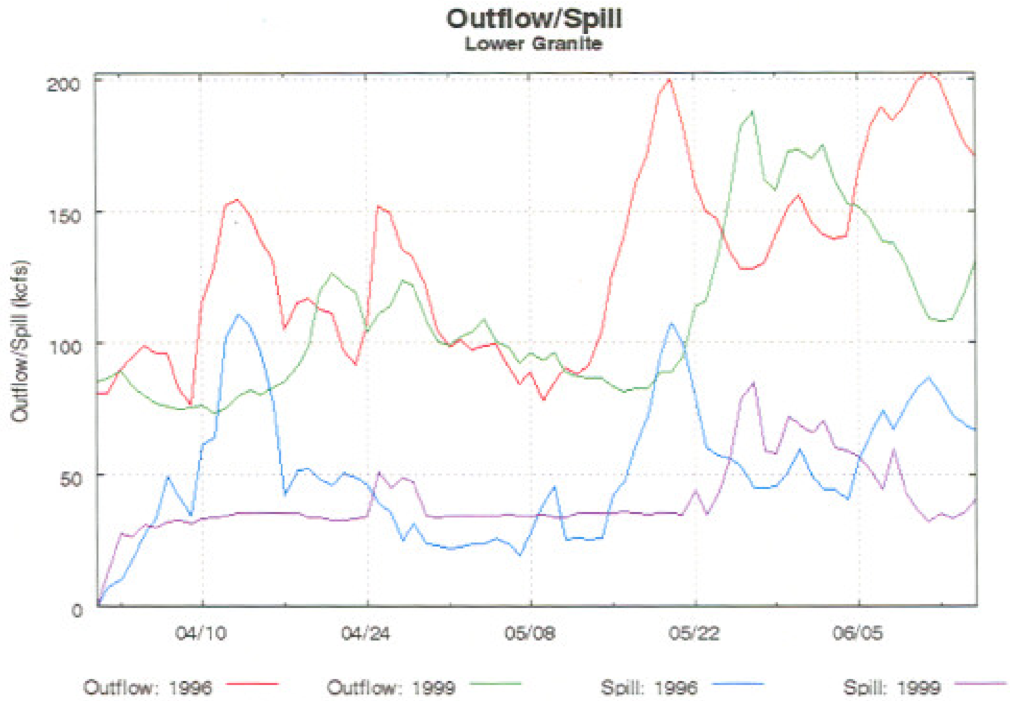

Figure 2. Graphs of spill and flow at Lower Granite Dam in 1996 and 1999 show the similarity in flow and spill during the two migration years.

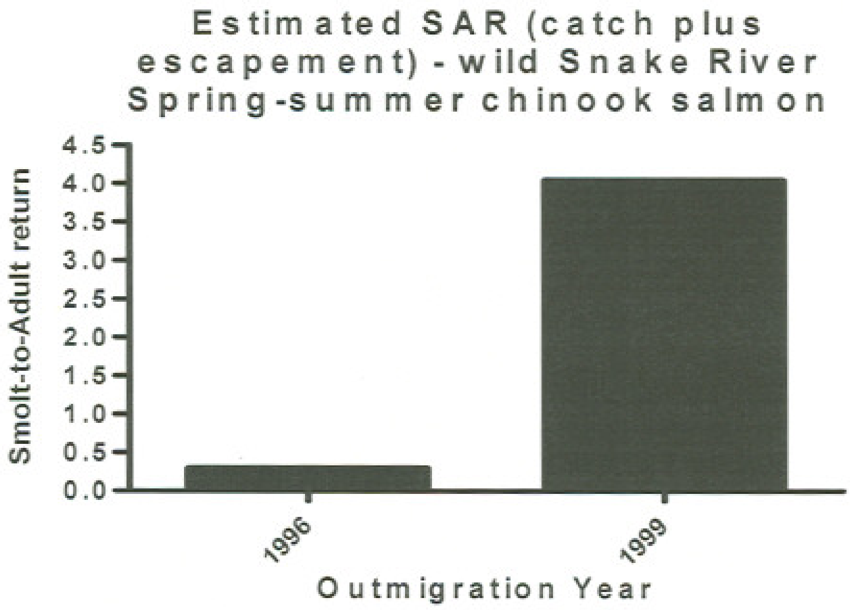

Figure 3. Smolt-to-adult return rates for wild Snake River spring/summer Chinook salmon that migrated to the ocean in 1996 and 1999 under similar flow and spill conditions (see Figure 2).

relatively the same downriver migration conditions, but the 1999 adults returned in much greater numbers. To explain this, ocean conditions were generally poor through the mid-1990s when the 1996 outmigrants were entering the ocean. Scheuerell and Williams 2005. In contrast, ocean conditions were more favorable in 1999 through 2002 when the 1999 outmigrants were in the ocean. Scheuerell and Williams 2005. Thus, fish that migrated during similar conditions through the hydropower system returned at wildly different rates with little to no relationship to hydropower migratory conditions that they experienced during their juvenile outmigration.

17. While natural mortality and ocean conditions measured by ocean-climate indices are beyond human control, one element of the life strategy for these fish, common to all stocks affected by the hydropower system, is the timing of their arrival in the seawater environment. In my opinion, a survival advantage will accrue to juveniles that arrive in the estuary when: (1) they have sufficiently matured for the transition from freshwater; (2) their size limits losses to predation; and (3) when the conditions in the estuary and nearshore ocean are optimal for their survival. When this timing is right and all of these factors are met, the juvenile outmigrants are much more likely to return to the freshwater spawning grounds as adult salmon or steelhead several years later, i.e., a higher SAR percentage. However, fish that arrive too early because they are transported before they are ready to enter the estuary, at too small a size, or outside the migratory timing of the bulk of the juveniles; or conversely, fish that arrive in the estuary too late when left in the river to migrate through each reservoir and dam, will have lower levels of adult returns as those described above. Williams et al 2005, Exhibit C. Moreover, Snake River Fall Chinook may have recently evolved a strategy to avoid arriving in the estuary before they are ready. As discussed in my previous declaration, Exhibit B at ¶¶ 5-9, a small percentage of these fish hold over in reservoirs, sometimes until the year following the year they would have normally migrated, during which time they grow to be larger fish that can avoid

predators and are more fit for their transition to seawater. Again timing for arrival in the estuary is critical, in my opinion, which is bourne out by the fact that these hold-over Fall Chinook, which only represent approximately 3% of the juvenile population nevertheless contribute more than 50% of the returning adults. See Exhibit B, First Williams Declaration at ¶ 6 - 8.

18. In short, hydropower system management that disrupts this timing of the life cycle is more likely to reduce the number of returning adults. Thus, the most important factor for salmon and steelhead survival (that we can control) is an operation or management scheme that ensures that juveniles arrive in the estuary at the optimal time – not too early, and not too late. As discussed below, there are a number of different hydropower system management options to ensure arrival in the estuary at the optimal time.

II. HYDROPOWER SYSTEM MANAGEMENT OPTIONS

19. Over the last twenty years, the respective agencies have developed structures and operational strategies to increase the survival of juvenile salmon migrants while reducing their travel time to the ocean. These strategies include: (1) bypass systems to divert salmon from turbine intakes and channel them to outfalls below the dam ("by-pass"); (2) a transportation system that collects the bypassed fish into barges with controlled environments in which the salmon are taken around the intervening dams and released safely to the river below Bonneville Dam ("transportation"); (3) when fish are not transported or diverted through a by-pass structure, passage is provided over spillways, a route of dam passage with often the highest survival of all routes ("spill"); and 4) flow augmentation strategies. Spillways have been modified to reduce the entrainment of gas at levels harmful to fish. Currently new technology is being developed that greatly improves the efficiency, survival and attraction for passage of juvenile salmonid migrants over the spillways, called removable spillway weirs, or RSWs. Programs to reduce predators in the reservoirs also increase survival for fish

migrating in the river as do cold water reservoir releases during the summer to reduce water temperatures.

20. Research concerning the effects of the hydropower system on juvenile salmonids in recent years indicates that the efficacy of these strategies to increase juvenile salmonid survival varies by strategy and species and is often inconclusive. As discussed above, the ultimate test of any strategy is the number of returning adults for juvenile fish affected. Again, the timing of the juvenile salmonid's entry into seawater appears to be a critical consideration. Beyond this factor, the research is less conclusive about which strategies are important for juvenile fish survival. For example, the research results are currently inconclusive concerning the benefits of increasing flows as a strategy for increasing juvenile salmonid survival within the hydropower system. For spring migrating juvenile yearling salmonids the relationship between flow and their survival within a migration season appears weak and inconsistent. Williams et al. (2005). In the years other than 2001, a record low water year in which there was low survival, estimated mortality per day of yearling salmon migrants actually decreased even though river flows were slowing down. Exhibit C, p. 79. In fact the available research indicates that high temperatures were a more significant factor affecting survival of juvenile yearling Chinook than were other parameters such as flow (water partical travel time) and even the percentage of spill. Exhibit C, p. 85. In the face of this uncertainty it is important to focus on strategies that increase the numbers of returning adults, as the Corp proposes for the spring migration, and otherwise pursue research that will add to our knowledge of how well different strategies increase adult returns.

21. Before implementing these measures in various combinations, hydropower managers must first consider the variation among the different Columbia Basin stocks of salmon and steelhead in their anadromous life strategy. There are salmon and steelhead that migrate to the ocean in the spring

after living a year in freshwater.[2] There are other stocks of salmon that migrate out in the summer in the same year they hatch from eggs.[3] Some stocks spawn in upper tributaries[4] and lakes[5] while others spawn in the mainstem river channels.[6] Some currently rely on hatcheries to maintain the stock.[7] Importantly, not all species of salmon or steelhead respond to different operating strategies the same or with uniform benefits. Thus, hydropower management must develop an operating strategy or combination of strategies that takes into account differential benefits for individual stocks and weighs them to attain the best possible benefits when considering all different salmonid stocks.

III. SMOLT-TO-ADULT RETURNS FOR SNAKE RIVER SPRING MIGRANTS.

22. As discussed below, from research on spring-summer (yearling) Chinook salmon and steelhead stocks, there are now extensive survival and adult return studies that compare the relative benefits of different techniques and provide information about the choice of the optimal combination of operating strategies. Exhibit C, the NOAA Technical Memorandum "Effects of the Federal Columbia River Hydropower System on salmonid stocks," (provides a summary of evidence how different SARs accrue from different juvenile migration histories). Although these studies are not conclusive, as is the case with most scientific studies, these data provide a basis for making reasoned decisions on how to manage the hydropower system to increase adult returns for all the species.

2/ e.g. Snake River Spring/Summer Chinook, Upper Columbia River Spring Chinook, Mid-Columbia River Steelhead, Snake River Steelhead and Snake River Sockeye salmon.

3/ E.g. Snake River Fall Chinook Salmon although some individuals may wait to migrate when they are yearlings.

4/ Spring migrating Chinook and steelhead.

5/ Snake River Sockeye salmon

6/ Snake River Fall Chinook and Columbia River Chum salmon.

7/ Snake River Sockeye salmon and Upper Columbia River Spring Chinook.

23. Extensive evaluation of fish PIT-tagged as juveniles that have returned as adults have provided information to compare the relative SARs for fish migrating out under different management strategies and under varying environmental conditions. The studies show how the various salmonid species respond differently to various operating strategies. Recently, data also indicate that fish of the same species have different adult return rates depending on what time of the season they migrated through the hydropower system.

A. **Snake River Spring/Summer Chinook**

24. SAR studies for spring migrating Snake River juvenile wild and hatchery Chinook salmon indicate that the earliest fish that migrate in the river through the hydropower system have higher SARs than fish collected and transported; whereas, after a transition period somewhere between the 2^{nd} to 4^{th} week in April, fish collected and transported to below Bonneville Dam have a higher SAR than fish that migrate in-river through the hydropower system. The SAR data supporting this conclusion for the Snake River Spring/Summer Chinook ESU are presented in the following Figure 4: The lines in Figure 4 demonstrate the trend in SARs toward higher adult returns for transported fish as the fish begin their migration later in the season. The vertical scale represents the ratio between SARs for fish that migrated in-river compared with SARs for transported fish. On that scale, the value of "1", at which a horizontal line crosses the graph, represents the point at which SARs for in-river and transported fish are the same. The value of "6" at the upper end of the vertical scale means that transported fish return as adults six times the rate at which in-river fish return as adults. The horizontal scale has the date at which the fish were detected migrating past the first FCRPS dam, Lower Granite Dam. Data for three stocks of fish are tracked by the three lines tracing from left to

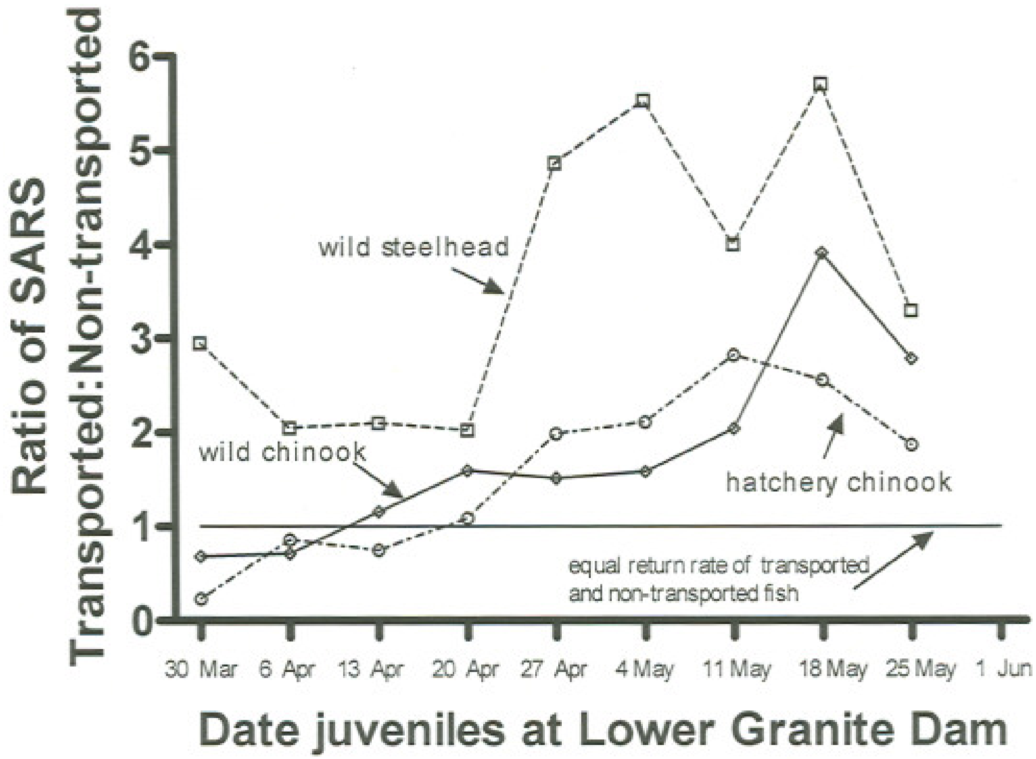

Figure 4. Average weekly ratios of SARs (SARs of transported fish divided by SARs of non-transported fish - sometimes referred to as T/C) for Snake River Chinook salmon and steelhead. The averages for Chinook came from data for the transportation years of 1998, 1999, 2000, and 2002. The averages for steelhead came from data for the transportation years 1999, 2000, and 2002. Ratios <1 indicate that non-transported fish have a higher SAR than transported fish.

right across the graph. The Snake River Spring/Summer Chinook ESU are represented by the two lines for wild and hatchery origin fish that begin on the left at the bottom left corner of the graph. (Data for steelhead are also displayed, as discussed below.)

25. These data demonstrate that Chinook juveniles that begin their migration past Lower Granite Dam prior to mid-April (where the values are less than 1) are more likely to return as adults if they are not transported but instead left to migrate in-river. After this time, however, the data show (where the values are greater than 1) that transported fish return at a higher rate as adults than fish left to migrate in-river. This trend of in-season SAR variability is based on SAR data from 1998, 1999,

2000 and 2002. Williams et al.2005 shows various trends for different migration years between 1995 and 2000, Exhibit C at p. 29-32. The data for 2002 are new since the earlier analyses were completed. It is important to note that, as Figure 5 (below) depicts, the total number of Chinook migrating

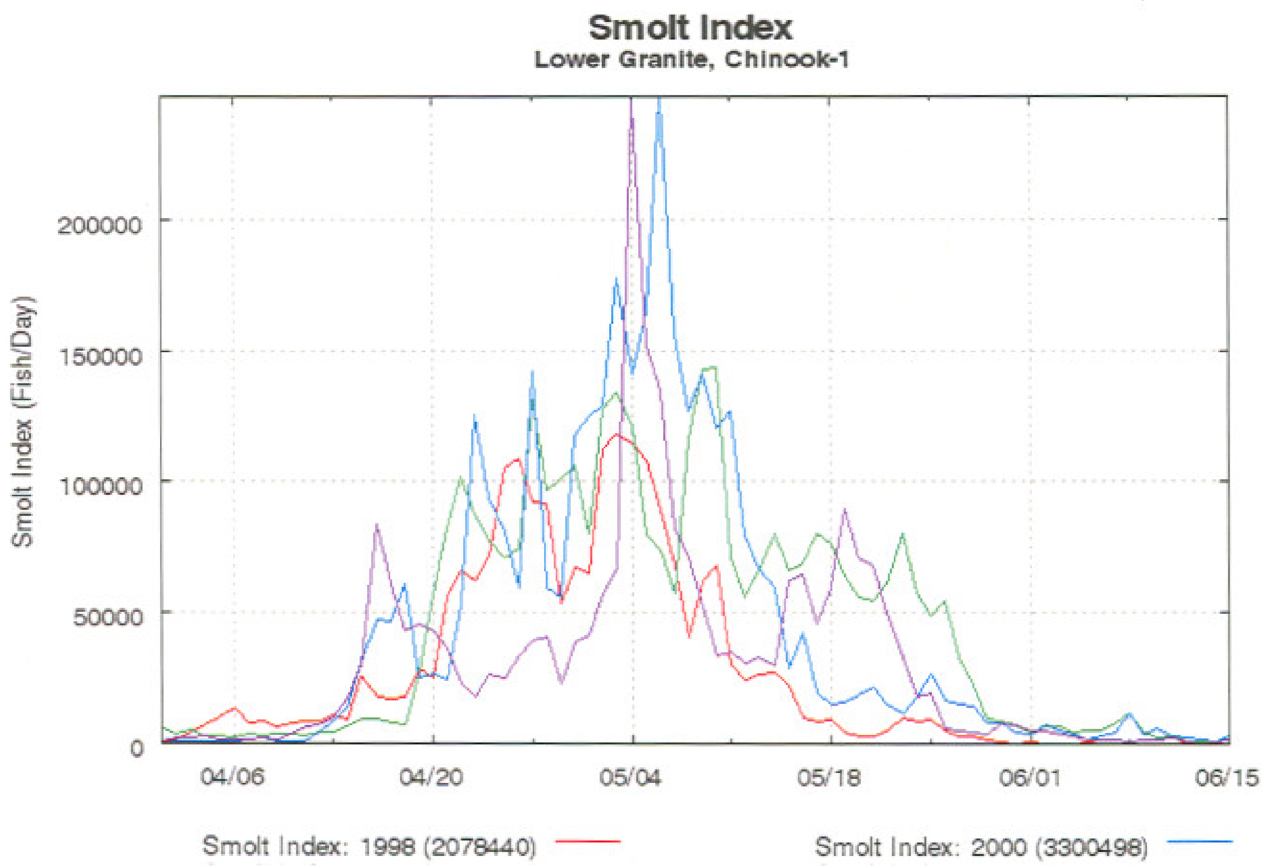

Figure 5. Index of combined wild and hatchery yearling Chinook salmon passing Lower Granite Dam for the years 1998-2000 and 2002.

annually follows a similar trend over the season with fewer juvenile fish migrating in late March and early April when the transport to inriver SAR ratio favors in-river migration the most, while the bulk of the Chinook juveniles migrate in May, in a typical year.

26. The relatively abrupt shift in SAR ratios around the third week of April suggests that it is not necessarily the management technique responsible for greater returns, but, as identified above, there is

a temporal aspect to the return rates. This temporal aspect is commonly referred to as SAR seasonal variability.

B. **Steelhead**

27. SAR studies for Snake River steelhead juveniles, also migrating in the spring with spring/summer chinook juveniles, indicate that, in contrast to chinook SAR trends, under nearly all conditions over all years, steelhead collected and transported to below Bonneville Dam have a higher SAR than those left to migrate through the hydropower system. Looking again at Figure 4 , above in ¶ 24, these wild steelhead juvenile fish collected for transport at Lower Granite Dam in March return as adults at a rate almost three times better than the same fish left to migrate in the river.[8] Although this trend moderates over the season, it never is worse than a two to one ratio and is sometimes more than five times greater than returns from in-river wild steelhead. This trend of in-season SAR variability is based on SAR data for 1999, 2000 and 2002. Exhibit C at p. 41 provides data for 1999 and 2000 for wild steelhead. The 2002 data are new since the publication of Exhibit C. As with Chinook migrants, the total number of steelhead migrating follows a similar annual trends over the season depicted in Figure 6.

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[8] Hatchery Snake River steelhead have not been marked and studied to determine their SAR under transportation or in-river migration.

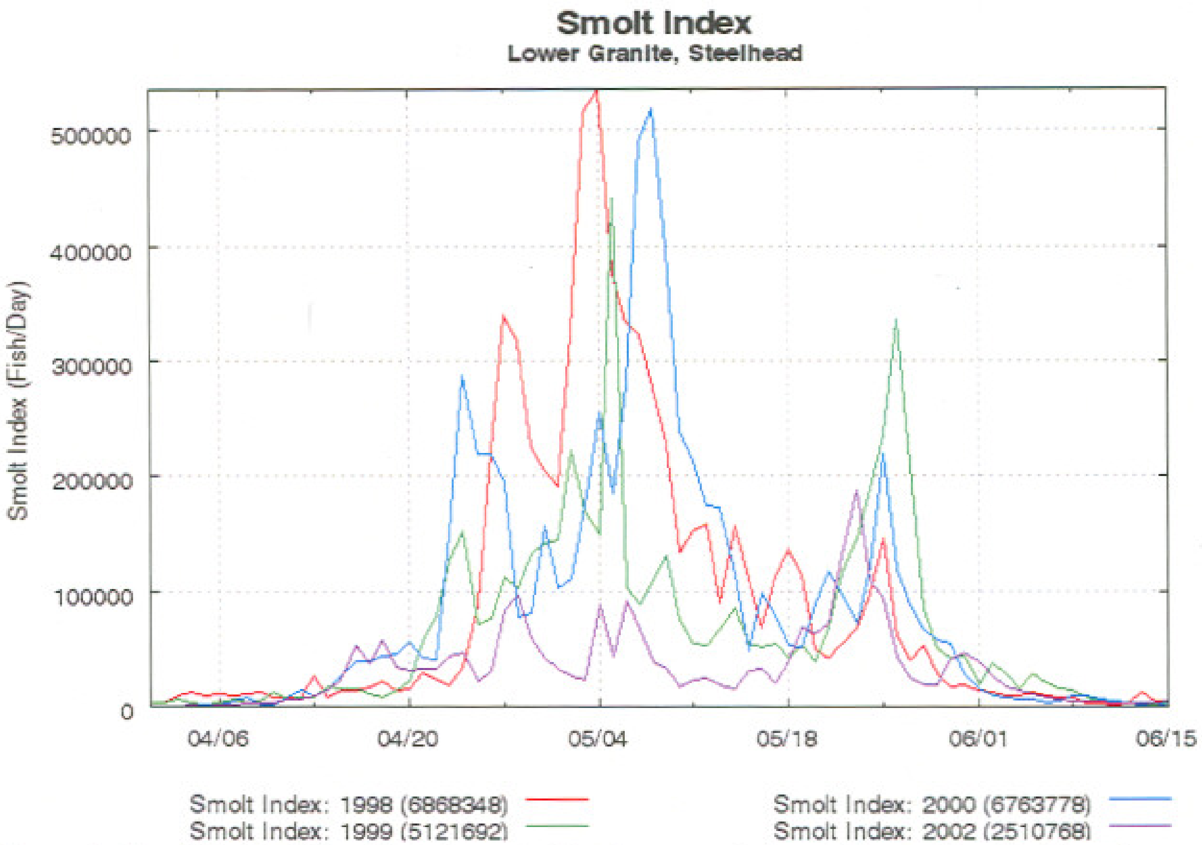

Figure 6. Combined wild and hatchery steelhead passage index at Lower Granite Dam for migration years 1998, 1999, 2000, and 2002. Data from Fish Passage Center.

This means that there are fewer steelhead migrating in March and early April when the Chinook transport to in-river SAR ratio favors in-river migration, while the bulk of the steelhead migrate in late April through May, in a typical year.

28. The seasonal variability of SARs is important when considering management strategies to provide the highest total adult returns for an ESU or collection of ESUs whose migrations overlap. As shown above for spring/summer Chinook and steelhead in the Snake River, juveniles with different passage histories (early migrants, late migrants, transported fish, non-transported fish) have SARs that vary depending on the time of year and mode by which they passed through or around the hydropower system. Further, the number of fish migrating varies throughout the season such that there are increasing numbers of fish reaching a peak mid-season followed by diminishing numbers.

See, again Figures 5 and 6 above. Just as their success at returning as adults varies with the date they begin their migration, the percentage of the total population experiencing a particular rate of adult return varies according to the number of migrating fish

C. Corresponding Management Options with SAR Seasonal Variability

29. Tailoring the river operation to take advantage of the seasonal variation in SARs provides an opportunity to improve the average SAR of the listed population. Figure 7 below illustrates this point. The analyses for this graph uses the spill proposed by the Plaintiffs. The analyses then compares ratios of SARs of transported fish versus non-transported fish (not detected fish because they pass mainly through spill - but some through turbines) based on the Plaintiffs proposal to the

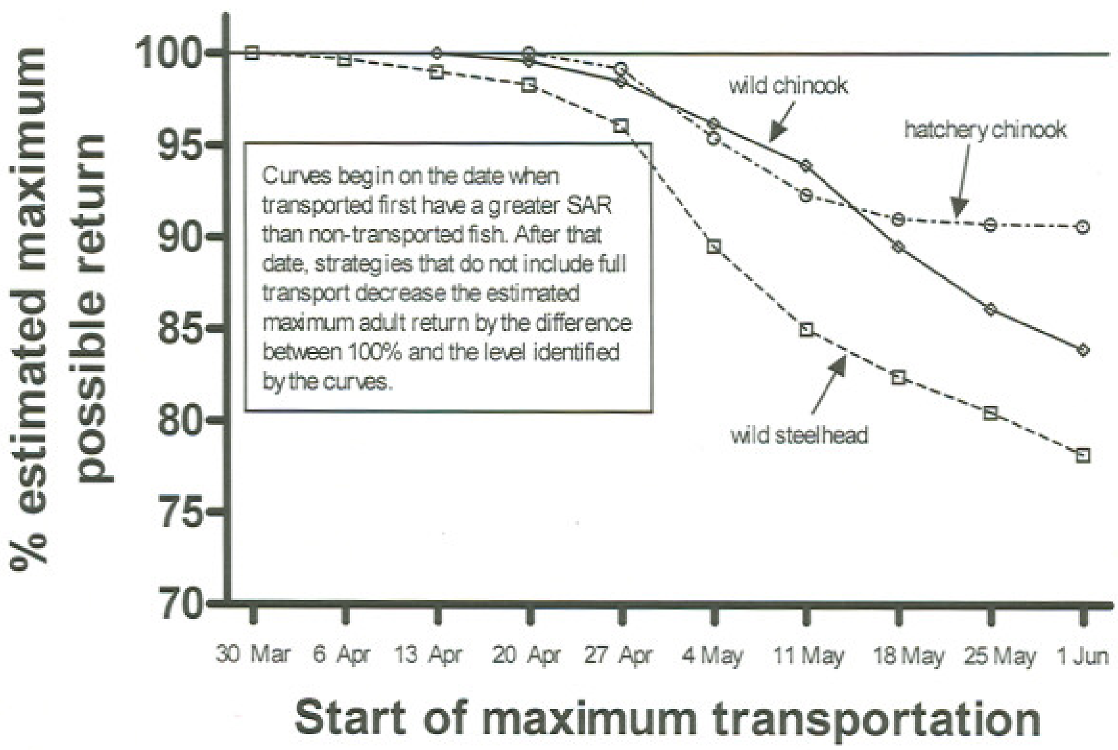

Figure 7. Curves estimating the point at which switching from a spill scenario to maximum transportation would maximize the number of potential adult returns.

COE's proposal of no spill and transporting all fish collected after April 20th. This figure shows two main points: 1) the date at which a switch to a maximum transportation strategy (no spill at Lower Granite, Little Goose, and Lower Monumental Dams) from a spill strategy would result in the highest number of adult returns – this point is represented at the top of the graph where the lines meet the 100% level; and 2) the estimated percentage of the maximum adult return that would result from not implementing a full transportation policy – the lines for each category of fish decrease throughout the season as a result of later switches to full transportation. For steelhead, the maximum adult return would require full transportation from the beginning of the season. For Chinook salmon, between the third and fourth week of April, spill and no transportation would provide more adult returns up until those dates. The consequence of not implementing a full transportation program for each of the stock groupings at the point where maximum transportation would provide the highest numbers of adults would lead to decreases of the potential return of hatchery Chinook salmon of 10%, wild Chinook salmon of 15%, and wild steelhead of 22%. Based on an average of adult returns over the last 5 years at Lower Granite Dam, the proposed operation to provide 24-hour spill and not implement a full-transportation operation would result in lower adult returns to Lower Granite Dam of approximately 9,200 hatchery Chinook salmon, 4,300 wild Chinook salmon, and 12,600 wild steelhead. If hatchery steelhead had the same performance as wild steelhead (we do not have sufficient data to evaluate this), approximately 38,000 fewer hatchery steelhead would arrive at Lower Granite Dam. In other words, a spill operation, as proposed by the Plaintiffs in comparison to the COE proposal to begin full transport after April 20th, would result in approximately 64,100 fewer fish returning as adults. These are numbers of adults to Lower Granite Dam, and do not include additional fish that would get captured in lower river fisheries.

30. This graph indicates that Snake River spring/summer Chinook and steelhead do not respond equally to a single transportation strategy. Steelhead returns are maximized when transportation begins at the first of the season under a no-spill strategy. In contrast, Chinook collected and transported up until approximately the period between the 2nd and 4th week of April generally return at lower rates than fish not transported. The question facing hydropower system managers is how to best balance these competing interests in order to obtain the highest adult returns *for both species.* Based on the graph above, and considering listed wild Chinook salmon, an operation that uses in-river migration through spill up until approximately the last week of April (when Chinook migration is at its highest), then a reduction in spill to collect more fish for transportation would provide the highest Chinook salmon returns. Transportation would begin when the steelhead migration is at its highest and Chinook experience higher SAR's from transportation. It would provide less than the maximum possible steelhead returns. Such an operation has a threefold strategy. First, early Chinook juveniles would be encouraged to migrate in river which means they have a higher likelihood of reaching the estuary at the optimal time thus increasing SARs. Second, late arriving Chinook would be transported, beginning near the last week of April, ensuring arrival at the optimal time. Finally, although steelhead would experience a slight decrease in SAR's from an early spill operation, because collection and transportation is increased during the height of their migration, returns would also be maximized to the greatest extent possible.

31. Based on the Declaration of Col. Martin, I understand that the Corps of Engineers proposes to end spill and maximize transportation for spring migrants on April 21st at Lower Granite, Little Goose and Lower Monumental dams. Based on our analysis displayed in Figure 7, (see ¶ 29 above), and the SAR studies, it appears this operation would produce the highest adult returns of wild and

hatchery Chinook salmon, while limiting a decrease in the maximum possible steelhead returns to no more than 5%.

D. <u>Plaintiffs' Spring Proposal</u>

32. The Plaintiffs' declarant Robert Heinith states, in paragraph 25 of his declaration,"[r]ecent analysis of smolt-to-adult returns (SARs) for Snake River wild spring and summer chinook indicates that transportation at this level [70% to 85%] is not supported by the data that compares transportation to in-river performance, except under extremely poor in-river conditions such as those in 2001." However, the Plaintiffs' declarant is relying on seasonal <u>average</u> SARs over nine migration years. "The nine year geometric mean SAR ratio of transported to in-river migrants (T/C ratio) was 0.99, indicating that transportation was no better than in-river migration." Id. Such analysis ignores the temporal variability of SARs within a season, the importance of which is demonstrated above. Again, this in-season variability is likely best explained by the timing at which the smolts reach the estuary for successful entry into seawater. The data we present here is not the first time this seasonal variability has been demonstrated. The Plaintiff's declarant could have reviewed the extensive discussions about this in-season variability not only in Williams et al. 2005 (Exhibit C), but also in the report from the Comparative Survival Study (CSS) Workshop held in 2004. Marmorek et al. 2004. The participants at the workshop evaluated the CSS hatchery fish from outmigration years 1998-2000 and found that fish arriving in the estuary prior to late April (transported fish) or after the end of June (non-transported fish) had lower adult return rates. The highest return rates came from fish arriving between these two periods and the participants defined this period as a "window of opportunity" for spring/summer Chinook smolts to enter the estuary. The conclusions expressed by the Plaintiffs' declarant are thus out of step with analyses available over the nearly the last 2 years showing temporal variability in SARs.

33. In contrast, to the Snake River spring/summer Chinook SAR data, however, later migrating Snake River steelhead do not appear to have the same exact "window of opportunity." In several recent years, no PIT-tagged steelhead leaving Lower Granite Dam (whether transported or not) after the middle part of May returned as adults. Data on wild steelhead indicated that fish transported the earliest from lower Granite Dam had the highest SARs and the SARs of fish subsequently transported decreased as the season progressed. See, again Figure 7, ¶ 29. Here, the in-season variations in SARs for wild steelhead consistently favors transportation. In this case, both the average SARs across multiple seasons and the in-season variation in SARs both argue for transportation as the best operation to maximize adult wild steelhead returns.

IV. SUMMER MIGRATION: SNAKE RIVER FALL CHINOOK

34. SAR studies for summer migrating Snake River Fall Chinook salmon are based on very little data because studies designed to determine effects of transportation did not begin until 2001 and complete adult returns from even that study year have not yet occurred. However, based on incidental transportation of PIT-tagged fish for studies designed to measure juvenile survival, it does not appear that transportation has led to either increased or decreased SARs compared to fish that migrated through the hydropower system (Williams et al. 2005). More SAR studies to compare the relative performance of transported fish compared with non-transported migrants are needed to better guide the appropriate hydropower operation for this species. Based on reading the fish scales taken from adults that returned in recent years, we have found that the life history of fall Chinook salmon is quite complicated. It has complicated the ability to develop strategies to increase adult returns of these fish. As discussed in my previous declaration about the juvenile migration of Snake River fall Chinook salmon there are problems with determining the optimum strategy for increasing adult returns.

35. Prior to 2005 no spill was provided for Snake River fall Chinook salmon in the summer and all fish collected were transported. The natural stocks reached a low point with adult returns of 78 fish in

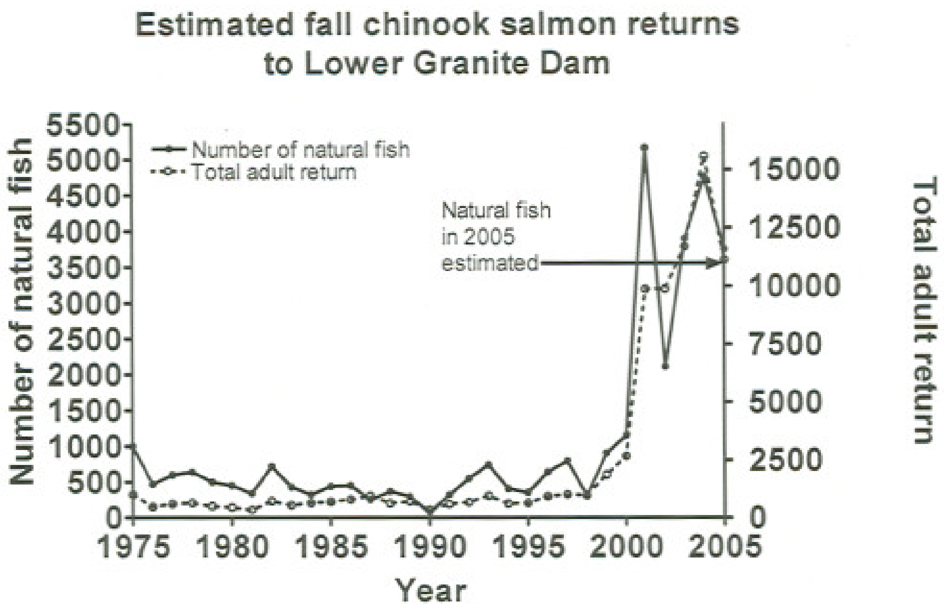

Figure 8. Estimated natural Snake River fall Chinook salmon returns to Lower Granite Dam since its completion in 1975.

1990 (the result of juvenile outmigrations in from 1986 to 1989). Releases of cold water from Dworshak Dam beginning in 1992 have decreased elevated water temperatures faced by all fish in the lower Snake River. The combination of adult returns from fish that were transported, migrated as subyearlings, or were now able to survive during the summer and hold over and migrate as yearlings has led to a substantial increase in adult returns. Based on the management strategies employed for Snake River fall chinook salmon over the decade or more, the following Figure 8 graphs their adult returns and demonstrates that these stocks are clearly not continuing to decrease. In fact, in recent years estimated adult escapements above Lower Granite Dam (not adjusted for any river or ocean fisheries) have exceeded levels of 2,500 natural fish initially identified by NOAA for a recovered ESU of Snake River fall Chinook salmon. See attached Exhibit E at p. 8, D. Robert Lohn, NOAA

Fisheries Service Regional Administrator, Letter to Frank L. Cassidy, Jr., Northwest Power Planning Council, April 4, 2002.

35. In the declaration of Col. Martin, the Corps of Engineers proposes a strategy of "spreading the risk," a position clearly argued by the Plaintiffs as necessary under conditions of uncertainty. Additionally, the proposed operation will provide the ability to conduct research that will evaluate spill and bypass versus transportation to further our understanding in the face of uncertain data. Transportation studies started in 2005 will continue in the summer of 2006 to provide additional data about the relative benefits to Snake River fall Chinook of transportation or in-river migration, and particularly evaluating any in-season variations in resulting SARs that has proven important for spring migrants. In the absence of definitive research necessary to make informed river management decisions, gathering additional data relevant to these management questions will be more beneficial than simply guessing at the appropriate river operation as the plaintiffs propose.

V. OPINION

In my opinion, for the spring migration, the COE's proposed spill at collector dams in the Snake River, followed by a full transport operation will return more adult salmon to the Columbia River than will the Plaintiff's proposal. For the summer migration, because of the complexity of the life history strategies that produced the recent steadily increasing natural adult returns of Snake River fall chinook salmon under management operations that included no spill, a precautionary strategy that "spreads-the-risk" appears most prudent. In my opinion, the COE's proposal comes closet to spreading the risk between transported and non-transported fish. It will not preclude the ability to conduct research.

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I declare under penalty of perjury that the foregoing is true and correct. Executed on November 18, 2005, in Seattle, Washington.

John G. Williams