Action Agency Response to Comments on the Summer Spill Proposal

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Impacts Analysis

Two broad themes emerged in comments about the estimates of impacts of reduced spill options on juvenile and adult salmon. The first common concern was that the SIMPAS (Simulated Passage) model is not an appropriate tool for assessing the impacts of the proposed operational changes. The second significant concern expressed by commenters was that the analysis would gravely underestimate the impacts of operational changes. (Note: SIMPAS only provided one part of the overall impacts analysis. The full analysis consists of SIMPAS survival rates and estimates of juvenile fish numbers, their migration timing, and adult return rates.)

Appropriate Use of the Model

The Action Agencies' response to statements regarding the appropriate use of the SIMPAS model to estimate impacts is that other models can estimate relative survival and adult return rates, but every model is going to have uncertainties so long as the data continue to show uncertainties. There has always been uncertainty regarding passage survival rates, rates of delayed mortality after transportation, rates of delayed mortality after bypass system passage, effects of operations on pool or reach survival, etc. While undertaking our analysis has not eliminated these uncertainties, we believe our analysis reflects the same level of uncertainty found in other fish management decision-making and research processes within the region.

SIMPAS is a relatively simple spreadsheet of numerous calculations that can be used for relative survival analyses based on the best available data. The model itself does not include a risk or uncertainty analysis feature. However, the user can address risk and uncertainty in the model input or by applying the results in a risk-averse manner. In the summer spill impact analysis, the SIMPAS results were applied to a range of adult return rates including a high but unlikely potential adult return rate. By overestimating the adult return rates, we overestimated the expected adult impacts. In so doing, some of the risk and uncertainty associated with the operations under consideration are taken into account. Smolt-to-adult return (SAR) rates represent "cradle to grave" performance of salmonids. The broad SAR range used in the analysis therefore captures potential uncertainty even if ranges for individual parameters are not explicitly addressed.

Risk and uncertainty can be addressed further by erring on the side of conserving fish in the offset calculations and in the extent of biological offsets that are implemented. For instance, implementing offsets that are estimated to increase survival by 10,000 adult returns could reduce the risk of uncertainty surrounding implementation of an operation that is estimated to decrease survival by 5,000 adult returns. Alternatively, the offset benefits can be estimated very conservatively and implemented sufficiently to counter very conservative (in this case meaning erring on the high side) estimates of the potential impacts. For a more detailed discussion of the expected benefits of the NPMP, please see our response to the Pike Minnow Management Program.

NOAA Fisheries now accepts that in a comparative analysis applying SIMPAS results to the estimated number of juvenile migrants along with a range of adult return rates is a reasonable means of estimating relative effects of operational alternatives on adult returns, especially when using a range of adult return rates that is wide enough to encompass the uncertainties that are not addressed by SIMPAS, so long as the uncertainties are explained to and understood by the end-user of the analysis. (Personal communication with NOAA staff March 2004) The federal executives, who will consider this analysis along with other information in making a decision about summer spill, are fully aware of the issues of uncertainty.

Underestimation of Impact
In order to ensure that our estimates of impacts are reasonable, we crosschecked our analysis in different ways. The inputs into the model for reservoir survival were based on best available empirical data, (including pit and radio tags, hydro-acoustics and net sampling: also see http://www.nwd-wc.usace.army.mil/tmt/agendas/2004/0204.html), and estimates of reach survival. See Appendix D of the BiOp. To ensure the reliability of our modeling, we compared the historical estimates of survival found in Appendix D of the BiOp to the SIMPAS modeled estimates, and found them to be relatively similar. We applied a broad range of smolt-to-adult return rates to the estimated number of surviving juveniles. By applying the "cradle to grave" SARs to the estimated number of juveniles surviving, and using a broad range that reflects the full range of expected SARs based on historic data, we believe we have largely accounted for uncertainty and the potential range associated with the input assumptions to the SIMPAS-analysis. We initially used a low end of 0.5% in our analysis, but received comments that in some cases SARs may be lower yet (e.g. Hanford Reach) and changed our analysis input to 0.2% for the Hanford Reach stock. We also compared the actual numbers of adults returning on a stock by stock basis to our analysis of estimated number of adults associated with current operations – the numbers of adults were generally similar More information regarding this analysis will be made available on our website in the near future. Additionally, we also performed a similar analysis using the Columbia River Salmon Passage (CRiSP) model and found similar results (for detail please see the Word document CRiSPvSimPas.doc posted on www.salmonrecovery.gov). Based on these assessments and comparisons, we conclude that our analysis of spill alternatives represents a reasonable assessment that is consistent with best available empirical information.

While we agree that spill is generally the safest passage route, survival through the other passage routes is nearly as high in most cases. For instance, based on best available information, spill survival at Bonneville Dam is assumed at 98 percent, bypass survival is estimated at 95 to 98 percent, and turbine survival is estimated at 90 to 94 percent. There are some lower-survival routes of concern, also based on available information, like the 72 percent turbine survival estimate at John Day, the 82 percent turbine survival estimate at McNary, and the 84 percent turbine survival estimate at The Dalles. The survival estimates referenced above are included in the analysis of our spill proposal. We included these low survival estimates as input assumptions for the SIMPAS analysis; the effect of these parameters is reflected in the estimated overall passage survival estimates for the various spill alternatives. That is, we used the best available information on passage and survival as input assumptions to the SIMPAS analysis

Offsets

Hanford Reach Anti-Stranding

BPA has proposed an expanded Hanford Reach Anti-Stranding operation to benefit Hanford Reach fall chinook as mitigation for impacts to the stock of a summer spill reduction. The initial estimate of additional adults returning to the reach, resulting from the new anti-stranding efforts ranged from 8,720 (0.5% SAR) to 66,163 (4% SAR). That analysis is posted on the TMT Website at: http://www.nwd-wc.usace.army.mil/tmt/agendas/2004/0204.html. During the public comment period, a number of entities recommended changes to the assumptions used in the analysis of program benefits and raised questions about the action in general.

Examples of suggested changes to the analysis include: the use of 0.2% as an SAR, removal of the influence of different sampling methods in the two time periods (prior to and post flow fluctuation limits), and a doubling of fry mortality estimates to expand the analysis to the entire reach rearing area rather than smaller study areas. Suggested changes are: the use of different fry density assumptions, the use of a different "baseline" year than 1998, and revised assumptions about egg-to-fry and fry-to-smolt mortality.
We have adopted these suggested comments and used them to revise our original estimate of offsetting benefits. We now expect additional adult returns from BPA's participation in the new anti-stranding operation to range from 3,941 (0.2% SAR) on the low end to 80,662 (4% SAR) on the high end. The new analysis in the Excel file HRFry_est_Apr2.xls it is posted at www.salmonrecovery.gov

In addition to technical remarks about the analysis, other commenters questioned the use of the proposed anti-stranding program (which BPA has been voluntarily providing in past years) as a mitigating action. Commenters suggested that the program should not count as an offset because it is an already established practice, is already required contractually, is in Grant County Public Utility District (PUD) 's hydropower license, or would be double counting the same benefits for Grant and BPA.

As background, it is important to understand the relationship of the new proposal with the Vernita Bar Settlement Agreement (VBSA), finalized in 1988, which resolved issues raised before the Federal Energy Regulatory Commission (FERC) about the impacts of the operation of non-federal Mid-Columbia hydropower projects on salmon. The VBSA required the signatories to maintain certain flow levels to ensure that redds remained covered during spawning and emergence of salmon (roughly October through May). The VBSA was designed to protect fall chinook by limiting the location of their spawning sites to lower water elevations which, in turn, increases the likelihood the redds will stay submerged from the initiation of spawning in the fall when redds are established, to the end of the emergence period in the spring when the fish emerge from the redds and begin to swim freely in the river. Under the VBSA, BPA was asked to cooperate, but was not required, to provide flows from the federal projects upstream to assist Grant County PUD in controlling flows below the Priest Rapids project for spawning in the fall and was required to maintain a minimum flow thereafter through the time when the fish emerge. The VBSA did not provide for any protection from stranding after the fish emerged (the rearing period).

Since 1999, Grant County PUD has voluntarily agreed to limit the degree of flow fluctuations from their Priest Rapids project during the rearing period in the spring. BPA and the Action Agencies and the other Mid-Columbia operators have voluntarily helped Grant achieve this limitation on fluctuation levels (1999-2003) by coordinating federal dam operations with the PUDs' operations, to the extent feasible.

Grant originally sought to include the proposed Hanford Reach agreement in its application to FERC to renew its license, but did not include the agreement in its license application, as the negotiated terms had not been finally settled by the time Grant needed to submit their application. Grant did include in their application a description of the criteria under which they had operated in the spring of 2003 and stated that future implementation would be contingent upon being "…successful in gaining continued support from the mid-Columbia operators."

The proposed Hanford Reach Fall Chinook Protection Program agreement (Hanford Agreement) is meant to replace the VBSA. The Hanford Agreement also creates two new specific obligations. In particular, BPA will be obligated to support Priest Rapids dam (PRD) flow fluctuation limits with flow releases from the federal projects upstream during the fall chinook rearing period (generally starting in March or April), which will lessen the likelihood of stranding fish in the Hanford Reach. BPA will also support provision of minimum flows at PRD on 4 consecutive weekends during the rearing period. These two obligations were not a part of the VBSA and are new commitments, (even though the flow fluctuation limits at PRD have been voluntarily implemented in recent years). By committing to a long-term agreement, rather than one that is temporary and entirely voluntary, the program should rightfully be considered an offset for a reduction in summer spill. BPA's estimate of the benefits to these fish for offset credit reflects only the two new specific BPA obligations for protection of fish during the rearing period.

BPA's new estimate addresses the concern that both Grant and BPA were claiming the same benefits from the program for different purposes (double-counting). We don't believe that shared responsibility for an operation that may satisfy a number of biological objectives, or more than one statute, is necessarily "double counting." However, to err on the conservative side, the offset benefit BPA is now claiming represents *half* of the overall total estimated biological benefit of the anti-stranding operation. The other half of the benefit from this operation, when combined with Grant County PUD's hatchery program, spill program, and its juvenile bypass systems at Priest Rapids and Wanapum Dams, is intended to mitigate for the existence and operation of Grant's projects. We believe such crediting is justifiable since Grant has indicated that they would not operate their dams in this manner without the upriver federal dams' contributions.

Pikeminnow Predation Mortality and Management

Increased Predation Concerns
Several commenters expressed concern that reduced spill might actually increase smolt predation at the dams and others questioned the effectiveness of expanding the scope (heavy-up) of the Northern Pikeminnow Management Program (NPMP) as an offset for a spill reduction.

Predation appears to be a major factor affecting survival of juveniles in tailraces of Lower Columbia River Projects. Predation appears to be most severe in areas immediately below the dams (Petersen et al. 1990; Poe et al. 1991, and Rieman et al. 1991) and is probably due to concentrating the juvenile at the bypass outfalls and from reduced ability of juveniles to avoid predators following release from the bypass system. Because of this finding, considerable effort was initiated at COE Lower Columbia River Projects to better assess how to minimize predation at the juvenile bypass outfalls and other routes of passage through both configuration and operation changes.

Bonneville Dam
At the Bonneville second powerhouse, a new bypass system was completed in 1999. This included a bypass outfall located approximately 2 miles downstream of the dam. The location of the juvenile release site was in direct response to regional agencies desire to locate the outfall well beyond the influence of the three separate channels of the project (Bonneville first, spillway, and Bonneville second powerhouse). Prior to selecting a new outfall site, considerable effort was initiated to evaluate northern pike minnow capabilities to respond to flow and predation efficiency. Shively et al. (1996) suggested that bypass outfalls should be located in areas of high water velocity (> 100cm/s), at least 75 m from shore or eddies, and in water depths >10 m). In addition, consideration should be given for areas downstream from the release sites that provide protection for juveniles until they recover from the rigors of passage through the bypass system. Design of the Bonneville 2 outfall site, incorporated all of these criteria. The release site is well downstream of any influence of the spillway and results in similar velocities at the outfall regardless if there is spill or not.

The COE recently completed construction of the Bonneville 2 corner collector (2004). The release site was designed to meet the above-mentioned criteria under most river flow conditions. This system in combination with the juvenile bypass system should provide very high fish passage efficiency at the Bonneville Project. In addition, the Bonneville second powerhouse is being operated as the priority project since 2002. The juvenile release site for the corner collector, similar to the JBS outfalls, was extensively evaluated in the physical models at the COE's hydraulic Laboratory (ERDC). The agreed to location for the release site is approximately 2100 feet downstream of the second powerhouse, off the Western tip of the Cascade Island. Physical model data suggest the release site meets most of the criteria established for low flow outfalls. However, without spill, a small amount of dye moves towards Bradford Island and may get caught in the eddy. It is uncertain whether and how many fish will follow this pattern. The regional agencies and Tribes suggest that operating the spillway at 50 KCFS will move the dye and presumable fish downstream. Hydraulic modeling has been and continues to be a valuable tool for establishing juvenile release sites. Based on biological results from The Dalles and John Day studies where we have matched fish behavior, drogue information, and physical modeling data, they have correlated very well with fish following the flow paths consistent with the physical models. Based on this premise, in a no spill condition, we would not expect many fish to enter the eddy condition near Bradford Island. However, this is an uncertainty that needs further evaluation.

Survival testing has been conducted at Bonneville Dam from 2000 through 2002. The technique used for survival evaluation has been radio-tracking methods using both the route specific and paired release models (Skalski). The route specific model has been primarily used except at the Bonneville first powerhouse, as too few fish were available from upstream releases. The route specific model relies on fish released upstream of the project and pairs these fish with fish released downstream (reference release). In the case of Bonneville the downstream reference release is immediately downstream of the new Bonneville 2 juvenile bypass release site. This allows for assessment of the different routes of passage and the losses in the tailrace zone to the reference release site, thus it incorporates predation lost in the tailrace zone.

Results from post construction studies indicate that survival in 2000 was 98% for spring chinook at both the spillway and through the Bonneville 2 juvenile bypass release. (Counihan et al. 2002). Subyearling survival estimates were not available for this year through the bypass system.

In 2001, survival was again evaluated, however, flow conditions were extremely low and information is probably not representative of more normal flow conditions. The 2001 information does, however, provide a look at "with spill" and "without spill" conditions (Counihan et al. 2002 draft report). Project survival for yearling chinook was 92.8% during the period of no spill and 94.6% during the 50 KCFS spill condition. This survival rate included all routes of passage and was not statistically significant. The Bonneville 2 juvenile bypass route survival was 96% during the spring during the study. The authors also evaluated the difference in turbine and non-turbine passage during the spring study. They suggested that the non-turbine passed fish had a lower survival without spill as compared to the spill condition (96% versus 91%). The causative factors are not clear as the Bonneville 2 juvenile release site is well downstream of the influence of spill. A part of the difference may be partially in response to the non-turbine fish would include fish passed through the first powerhouse juvenile bypass system which is noted to have lower survival than other passage routes (Ledgerwood et al. 1994). They also noted that the turbine passed fish under spill and no spill conditions, the turbine passed fish had higher survival without spill (95.4% versus 90%). They suggested this increase in survival through turbines was primarily in response to higher flows through turbines and in the tailrace in the no spill condition. The authors noted that the opposite trends in survival between the two groups (turbine and non-turbine in relation to spill and no spill) suggested insignificant differences in the project survival of fish passing all routes at Bonneville Dam.

Subyearling survival was also evaluated in 2001 (Counihan et al. 2002 draft report), however, they were not able to evaluate the difference between spill and no spill conditions. The average project survival for subyearlings was 90.2% for total project survival and 90% through the second powerhouse juvenile bypass system. Summer spill in 2001 was initiated after the summer test had been completed.

Survival studies were conducted again in 2002 (Counihan et al. 2003 draft report). The survival through the spillway was estimated at 97.7% while passage through the second powerhouse 2 (bypass and turbines) was 99.3%. With and without spill conditions for subyearling fish were evaluated in 2002. The Bonneville first powerhouse routes of passage were evaluated in 2002 (Counihan et al. 2003 draft report). The routes of passage included the minimum gap runner (MGR, main unit 6) and the juvenile bypass system. Results suggest that survival through the first powerhouse juvenile bypass survival was 91% and 100% through the MGR. The first powerhouse juvenile bypass system survival was suspected of being lower than turbine survival for summer given the outfall location, but was unknown for spring fish (Ledgerwood et al. 1994). The juvenile bypass outfall is located along the north shore of Bradford Island and does not currently meet the outfall criteria described by Shively et al. (1996).

Based on the results of the above mentioned studies, the site characteristics of the Bonneville Project (3 separate channels), operating priority for the second powerhouse, and the location of the Bonneville 2 juvenile release site (beyond the hydraulic influence of the three channels), this does not support the contention that spill may reduce predation in tailraces. In fact, in 2001, the results of the Bonneville 2 turbine passed fish indicated a significant improvement in survival in the without spill condition compared to the with spill condition. The non-turbine passed fish showed a decrease in survival; however, this may have been due to overall poor survival in the first powerhouse juvenile bypass system, which will be taken out of service in 2004. The studies to date have provided some information on the relative difference in survival with and without spill. The increased risk to predation appears to be accounted for in the route specific survival rates. There is still some uncertainty on how well the Bonneville 2 corner collector will perform with or without spill in 2004. This will be the first year of corner collector operation and the COE recommended testing survival with and without spill in 2004, however, regional input did not support this test.

The Dalles Dam

The effect of spill on fish distribution

Passage distribution data for 1999 through 2003 are presented in Table 1. Spill operations in 2000 and 2003 were the only two years that followed current Fish Passage Plan guidelines. There was a test of two spill levels in 1999: 30% vs. 64%. Data presented below are for the 30% treatment only. In 2002, powerhouse unit operating priority was shifted to west units to accommodate a test of turbine intake occlusion devices. This shift in priority is thought to have reduced spill efficiency. In 2001, there was no spill after 21 June due to a drought and power emergency. Data presented in Table 1 for 2001 is from 21 June – 18 July.

Table 1. Table 1. Spill passage efficiency (SPE), sluice passage efficiency (SLPE) and turbine passage for subyearling chinook at TDA, 1999-2003.

Year	Method	Spill Level	SPE (%)	SLPE (%)	Turbines (%)
1999	HA	30%	54	10	36
2000	RT	40%	77	11	12
	HA	40%	74	7	19
2001	RT	0%	NA	35	65
2002	RT	40%	56	8	36
	HA	40%	38	11	51
2003	RT	40%	77	12	11

In general, the spillway at The Dalles Dam passes downstream-migrating smolts in a near 2:1 percent fish to percent spill ratio. Sluiceway passage is consistently near 10% at the 30% and 40% spill levels, however with no spill in 2001, sluiceway passage increased to 35%. This comports well with previous sluiceway studies that estimated its passage efficiency at approximately 40% under a no spill condition.

Route-specific survival rates

Table 2 summarizes juvenile salmonid survival rates at The Dalles Dam that were estimated by NMFS from 1997-2000 (Absolon et al. 2002) and USGS in 2001 (Counihan et al. 2002). Of particular interest is the sluiceway survival estimate from 2001: under the zero spill condition and low river flow it was similar to 2000, when there was 40% spill and normal river flow.

Table 2. Relative passage survival of subyearling chinook @ TDA spillway and ice and trash sluiceway, 1997-2000 (data from Absolon et al. 2002 and Counihan et al. 2002).

River Flow (kcfs)			Means and (95% CI)		
			64% Spill	30-40% Spill	
Year	**Median**	**Range**	**Spillway**	**Spillway**	**Sluiceway**
1997	301	242-529	92 (86-99)		
1998	212	167-275	75 (68-83)	89 (80-99)	89 (81-98)
1999	300	221-352	96 (92-100)	100 (96-104)	
2000	179	156-231		92 (84-102)	96 (90-104)
2001	**- - - - No Spill- - - - -**				96 (± 5.6)

In 2000, NOAA Fisheries estimated the survival of yearling and subyearling Chinook that pass through The Dalles turbine units. Survival was much lower than what has been observed at other similar turbine units. NOAA Fisheries estimated turbine passage survival to be 84% (95% CI 76-92%) for subyearling Chinook (Absolon et al. 2002). Under a no-spill condition, the information available suggests that sluiceway survival would be 96% and turbine survival would be 84%. Using 2001 passage distribution data, dam passage survival for subyearling Chinook salmon at The Dalles

Dam under a no spill condition should be approximately 88% [(35% sluice passage x 96% survival)+(65% turbine passage x 84% survival) = 88.2%].

Predator distribution and movement

Northern pikeminnow distribution and movement in The Dalles dam tailrace was evaluated in 1993, 1994 and 2002. In addition, smallmouth bass was evaluated in 2002. In all three years, few pikeminnow or smallmouth bass were found in areas that fell outside of the bypass criteria: water velocity ≥ 100 cm/s; water depth ≥ 10 m; distance from structures in water ≥ 75 m. Areas identified as having the greatest risk of predation by either species included the basin islands and the BRZ Island. This was based on where northern pikeminnow and smallmouth bass were most commonly located. In addition, smallmouth bass were found frequently in the powerhouse channel and along the Washington shore downstream of the navigation lock. In 1993, spill occurred only at night and sluiceway operation was only during the daytime. Northern pikeminnow movement patterns also changed from day to night. The south side of the spillway shelf area was used by northern pikeminnow during the day, when spill ceased. This might be explained by a large, slow eddy that forms on the spillway shelf under a no spill condition, lower velocities for predators to hold in, and the proximity to the river's thalweg where the bulk of powerhouse flow, and presumably juvenile salmonids were passing. Northern pikeminnow use of the sluiceway outfall area was relatively higher during the daytime when the sluiceway was operating. This is likely explained by the availability of prey when the sluiceway is open versus when it is closed. The same relationship was observed at the John Day Dam bypass system outfall, where fewer pikeminnow used the outfall area during the daytime compared to nighttime. Smolt passage through that bypass system is much higher at night. In summary, the available data on predator distribution and movement at The Dalles Dam suggest that northern pikeminnow and smallmouth bass concentrate near major fish passage routes in areas of low water velocities, shallow depth, and near structures.

Tailrace egress

Tailrace egress, the travel paths and transit times of smolts in the tailrace, has been assessed at The Dalles since 1992. Egress studies conducted by USGS in 1999-2002 used consistent methods and therefore provide the best comparison among years and conditions. In 1999, egress of fish passing through the spillway was evaluated under two spill levels: 30% and 64%. In 2000, egress was evaluated for spill (40%), sluiceway, and turbine passed fish. In 2001, only sluiceway-passed fish were evaluated, and in the summer there was no spill at the project. Table 3 summarizes tailrace egress times from 1999 – 2002 studies for subyearling Chinook at The Dalles Dam.

Table 3. Mean tailrace migration time from passage to an exit point 1.7 km downstream of The Dalles Dam for radio-tagged subyearling Chinook salmon released through spill, sluiceway, turbine and the proposed JBS outfall site.

Year/Condition	N-Spill	S-Spill	Sluiceway	Turbine	Control
1999 / 30% spill	0.4	0.5	NA	NA	0.1
1999 / 64% spill	0.4	1.1	NA	NA	0.2
2000 / 40% day spill	1.7	2.4	4.3	3.8	1.4

2000 / 40% night spill	1.7	3.3	4.0	3.4	2.2
2001 / day no spill	NA	NA	1.78	NA	NA
2001 / night no spill	NA	NA	2.18	NA	NA
2002 / 40% spill	NA	NA	1.61	NA	NA

Subyearling Chinook passing turbine units and the sluiceway generally followed one of two paths after encountering the BRZ island: north around the Bridge Island, or south along the Oregon shore. The Bridge Island path follows the original river thalweg, and the south shore path typically results in entrainment in an eddy, followed by travel through or near the Basin Islands. North spillway fish typically stayed in the river thalweg or along the Washington shore. South spill fish passed either along the thalweg or through the south channel along the Oregon shore. Drogues released during tailrace egress studies show the same general travel paths for the various routes. Both fish and drogue results from the tailrace egress studies show good agreement with observations of dye and confetti egress in the 1:80 physical hydraulic model.

USGS also reported suspected predation events on test fish. In 1999, the majority of predation events involved south-spill fish during 64% spill. No predation events were detected during the 30% spill treatment. In 2000, USGS estimated that 10 spillway fish, 1 sluiceway fish, and 2 control fish were preyed upon. In 2001, there were 9 tailrace predation events estimated to have occurred for subyearling Chinook released into the sluiceway.

Uncertainty

Turbine Passage – There is only one year of turbine survival data (2000) with no survival data under zero spill and no indication of year-to-year variability. Perhaps more importantly, the cause of turbine mortality (direct versus indirect effects) is not known. Many of the salmon managers believe that low turbine survival at The Dalles is due to predation in the tailrace, but the data do not support this. In 2000, egress times and paths of turbine passed fish were very similar to those of the sluiceway-passed fish, however, sluiceway survival was more than 10% higher than turbine survival. Additionally, there were no predation events observed for subyearlings passing the turbines, even though events were observed for fish passing the spillway and sluiceway.

Passage Conditions Under Zero Spill – there is only one year of survival and egress information under a no spill condition, and that was a very low flow year and the information is only for fish passing via the sluiceway.

Predation Events – we don't know where smolts are being captured by predators, only where predators spend most of their time.

Spillway Survival – we suspect that there was significant direct mortality and injury for spillway-passed fish under the juvenile spill pattern. This may have influenced predator habitat preference and the predation events observed by USGS. There will be a new spillway configuration in place in 2004, which should improve the direct effects of spillway passage, as well as spillway egress. It is not known how this will affect predation in the tailrace.

Conclusion
The available information for The Dalles Dam does not support the Joint Technical Staff's suggestion that spill may reduce predation in tailraces by at least 50%. The one year of survival data available indicates that sluiceway survival is similar under zero spill and 40% spill conditions for subyearling Chinook. The effect of a zero spill condition on turbine survival is unknown. Predation events on radio-tagged subyearling Chinook were highest for spillway-passed fish during 2000, the only year when all routes of passage were examined. That same year, there were no observed tailrace predation events on subyearling Chinook that passed through the turbines. Based on predator distribution data and tailrace egress studies, smolts passing via the sluiceway and turbines are at higher risk to predation than smolts passing via spill. However, that increased risk to predation appears to be reflected in the existing route-specific survival rates, which, at least for the sluiceway, do not increase when spill is not provided.

John Day Dam

Introduction
Relatively high concentrations of northern pikeminnow and high predation rates by pikeminnow have been documented for the boating restricted zone (BRZ) of John Day Dam's tailrace. Research has shown that changing spill operations at the dam influences passage distribution, dam survival, and tailrace egress for subyearling chinook salmon. Changing spill operation also likely changes predator distribution and behavior near the dam. This section discusses the potential effect of a no-spill condition on predation rates at John Day Dam.

Subyearling Chinook passage distribution when there is no spill
Under a no spill condition at John Day Dam, there are only two routes available for smolts to pass: turbines and the juvenile bypass system. The proportion of fish intercepted by the juvenile bypass (FGE) appears to be dependent on spill level and time of day. However, measurement of this relationship has been confounded because during most studies, spill occurred only at night. Under a 24-hour spill condition (30% day/30% night) in 2002, Moursund et al. (2003) found that FGE remained relatively constant for day and night. That same study noted a dramatic difference in day FGE versus nighttime FGE during the 0 day / 60% night spill treatments. Radio-telemetry results from Hansel et al. (2000) and Beeman et al. (2003) confirmed this relationship. Based on this information, it is likely that that fyke net FGE studies conducted at John Day (Krcma et al. 1986; Brege et al. 1987) underestimated overall FGE of the submerged traveling screens because those studies were conducted during nighttime spill. The range of subyearling Chinook fyke net FGE estimates that have been commonly used is 13%-55%. Based on the influence of spill on FGE discussed above, the high end of this range is more likely to occur during a zero spill condition. Moursund et al. (2003) estimated that the overall FGE of subyearling Chinook was 66% at John Day Dam in 2002.

The effect of spill on tailrace egress
Spill influences the egress of fish that pass via the JBS outfall. The effect of increasing spill level at John Day Dam is to reduce velocities at the JBS outfall and draw flow from

the powerhouse and JBS outfall northward, toward spill. Sub-yearling Chinook released through the juvenile bypass system had median travel times to an exit station, located 1.9 km downstream, that were about twice as long under 60% spill, than during 30 or 45% spill. Travel paths of fish exiting the bypass system during 60% spill were predominantly northward across the river toward the spillway. Many of these fish spent time in a large eddy that forms between the spillway and the powerhouse. At the same time, the estimated survival for sub-yearling Chinook were lower under the 60% spill than during 30% spill, suggesting that the delay or different route subjected these fish to increased predation opportunities. No egress studies on fish passing via turbines have been conducted, however observations of dye in the 1:80 physical model at ERDC show turbine-passed dye is pulled toward the spillway and entrained into the skeleton bay eddy when the spillway is operating.

Predator distribution
Northern pikeminnow distribution and behavior were evaluated in 1993 in the tailrace of John Day Dam. After spill and river flows diminished in July and August, northern pikeminnow moved to areas below the spillway and powerhouse. Like other sites evaluated, northern pikeminnow were located in areas of lower velocity near major fish passage routes. More fish were contacted at night than during the day and this is believed to be due to higher subyearling passage through the dam at night.

Route Specific Survival
Subyearling Chinook salmon survival estimates for John Day Dam are presented in Table 1. In 2002 and 2003, survival was highest for spill followed by powerhouse (2002) and JBS (2003). Turbine survival was lowest. The lowest JBS survival rate observed was from 2001, which was a low flow year with no spill. As stated in the tailrace egress section, JBS and powerhouse survival decreased with increasing spill percentages.

Table 1. Project (dam) spillway, and powerhouse (turbines and JBS) or JBS survival estimates for radio-tagged subyearling Chinook salmon at The Dalles Dam, 2001- 2003. In 2001, there was no spill during the subyearling run.

YEAR	SPECIES	ROUTE	% SPILL (day/night)	SURVIVAL (95% CI)
2001	Subyearling Chinook	JBS	0/0	86.8% (± 8.4)
2002	Subyearling Chinook	Project	0/54	92.8% (± 4.3)
			30/30	99.2% (± 5.1)
		Spillway	0/54	98.5% (93.4-102.3)
			30/30	100.3% (98.3-107.8)
		Powerhouse	0/54	86.6 (79.5-92.8)
			30/30	96.6 (88.5-103.1)
2003	Subyearling Chinook	Project	0/60	84.5 (± 3.1)
			30/30	88.6 (± 3.0)
		Spillway	0/60	90.1 (87.7 – 92.2)
			30/30	95.5 (93.8 – 97.0)
		JBS	0/60	89.2 (85.5 – 92.4)
			30/30	92.1 (87.7 – 91.6)

		Turbines	0/60	71.9 (67.1 – 76.4)
			30/30	72.2 (67.3 – 76.7)

Conclusion
Based on available information, there is no indication that zero spill will decrease JBS or turbine survival rates below what has been observed in Table 1. While the spillway provides the best survival of all routes at the dam, the use of spill compromises the egress conditions at the other two routes. Therefore, under a no-spill condition, egress conditions for fish exiting the JBS and turbines should improve. Improved egress has resulted in improved survival for fish passing John Day's JBS.

Ice Harbor Dam
In 2003, comparative survival was measured at Ice Harbor for subyearling fall Chinook salmon using PIT tag methodology. Control fish were released downstream of Ice Harbor near Goose Island and treatment fish were released into the corresponding passage route. These values therefore, would also include tailrace predation.

While spill was occurring, turbine survival was measured at 91% as compared to 89% when spill was shut off. In addition, the with spill condition for bypass indicated 99% while the without spill condition measured 100%. Survival through spill was measured at 96%. All values for survival are reported in weighted geometric means.

Based on the information from 1993, it suggests that zero spill will not decrease survival through the other passage routes in the immediate tailrace zones due to predation.

(Preliminary unpublished data - Personal communication between Randy Absolon NOAA-F and Paul Ocker USACE-Walla Walla on March 17, 2004)

	With Spill	95% C.I.	Without Spill	95% C.I.
Turbine Survival	91%	(85-97)	89%	(80-98)
Bypass Survival	99%	(90-110)	100%	(95-105)
Spillway Survival	96%	(91-103)	-	-

Proposed Pikeminnow Offset

BPA received many comments regarding increasing catch and resultant pikeminnow exploitation rate utilizing the existing infrastructure of the Northern Pikeminnow Management Program (NPMP). Most of the comments were technical and repeated by several authors or the same authors under different group representation. We present here an updated version of the NPMP heavy up proposal in response to the comments received.

Comments from the Salmon Managers suggest that while there may be benefit from increased removal of northern pikeminnow, those effects would not be discernable. We agree that that may be the case. First, potential changes in the annual exploitation rate may be small and within the noise of any estimation of annual exploitation rate. However, we are quick to note that one of the weaknesses in the existing biological evaluation is the limited statistical precision of the estimated exploitation rate. In response, we are proposing to more aggressively implement the NPMP to achieve exploitation rates that are in the higher end of the target range, and which in the long-term may be more significant relative to measurements. We are also proposing that the mark-recapture effort, which is the basis for the NPMP evaluation, receive additional statistical review, as recommended by Hankin and Richards (2000). But even lacking such precision, we reiterate that unless there is either inter- or intra-specific compensation, increased removal has the effect of reduced consumption on smolts, a positive outcome that can be assessed analytically.

Description of Proposed Action

One of the primary non-operational actions available to improve in-river survival of fall chinook is the management of predatory fishes. The Northern Pikeminnow Management Program is a multi year effort to reduce pisciverous predation on juvenile salmon primarily through public angler-driven system-wide removals of predator-sized northern pikeminnow *Ptychocheilus oregonensis*.

BPA funds the NPMP. Since program inception, over 2 million northern pikeminnow have been removed throughout the system with an estimated benefit of reducing predation mortality by 25% (Friesen and Ward 1999). This equates to over 4 million juvenile fish not eaten by pikeminnow each year. This has been achieved through annual harvest of northern pikeminnow since 1990. Currently, multi-year annual average harvest is approximately 12 percent, with the annual harvest rate ranging between approximately 8 and 16 percent. While the benefit of annual removals accrue over time, removals within a year can also have significant immediate benefits to fish survival within the same year. An increase in the annual harvest rate can also have the effect of increasing the average annual harvest rate in the longer-term.

More aggressive and focused removals could provide substantial survival benefit to reduce the impact of the conditions that inriver outmigrants face in 2004 and beyond. The NPMP is now a turnkey operation with demonstrated success in adaptively managing to changed conditions and responding to special circumstances. The NPMP performance in 2001 is a case-in-point. The highest observed annual harvest rate of 16 percent harvest was achieved in 2001, and was at least in part due to the "heavy-up" that was implemented during the drought/power emergency.

a. Location

The NPMP is a system-wide predator control program in the Columbia Basin. Open waters include the mainstem lower Columbia River up to Priest Rapids Dam in Washington and the Snake River up to Hells Canyon Dam in Idaho. Also open within this reach are backwaters, sloughs and up to 400 feet into tributaries on the Columbia and Snake rivers.

The scope of the 2004 Heavy up would include a general increase in the reward structure in the Sport-Reward Fishery similar to that of 2001,to provide system-wide enhancement and benefit to all stocks (see further description, below). In addition, increased emphasis in the Sport Reward Fishery in Little Goose and Lower Granite reservoirs to benefit the listed fish [and below Bonneville dams would occur through other enhancements to the reward structure, special localized events to increase effort and catch. The purpose of this additional focus is to address listed fall Chinook smolts.

Additionally, in response to the comments received concerning potential increases in predation resulting from spill operation modifications, we are proposing the addition of focused removals at Bonneville, The Dalles and John Day dams' forebay and tailrace boat restricted zones. The purpose of this action would be to take advantage of any potential vulnerability of northern pikeminnow to catch based on redistribution under no-spill conditions. The NPMP employed contracted removals at dams and other site-specific locations from 1991 through 2001. Contributions toward total catch in those fisheries were significant in the early years of the NPMP but decreased considerably after 1995. Accordingly, these fisheries were terminated in 2001. An increase in spill at FCRPS projects resulting from the 1995 Biological Opinion may have dispersed predators below dams to partially explain the decline in catches observed from 1995 forward. If northern pikeminnow re-disperse to locations nearer the dams under proposed spill modifications, then implementation of a new site-specific fishery at these projects should provide opportunity to achieve catches similar to early years and thereby reduce the risk of potential increases in predation mortality at the projects.

b. Affected Species

Juvenile salmonids are the major dietary component of northern pikeminnow grater than 250mm fork length. The importance of salmonids in the diet of northern pikeminnow varies seasonally. Research conducted between 1982-88 in John Day reservoir indicates that juvenile salmonids were of greatest importance in the diet during July (82% by wt.) when the run of subyearling Chinook salmon peaked. (Poe 1993). Overall, approximately 80% of northern pikeminnow predation occurs in July and August when water temperatures are warmer and predators most active; this coincide with the peak migration of subyearling fall Chinook.

c. Statement of Feasibility and Certainty of Implementation

Increasing removals due to a program heavy-up is feasible utilizing current program infrastructure. The most effective and logistically feasible approach to increase the fishery performance would be to increase the basic reward structure using the 2001 increase in the NPMP reward structure as a model.

d. Coordination Needs and Additional Requirements

Coordination of activities associated with a NPMP heavy up would occur utilizing existing program coordination and review processes. The NPMP has a separate Biological Opinion and NEPA documentation to cover program activities. A program heavy up is consistent with the existing BiOp for NPMP.

Estimated survival or Productivity increase
Using the 2001 Power Emergency NPMP heavy-up as a model for 2004 and beyond and the implementation of focused removal fisheries in the tailraces of select dams, we conservatively estimate an increase in system-wide catch of 15,000 northern pikeminnow (10,000 Sport-Reward, 5,000 Site-Specific forebay and tailrace). We believe it is reasonable to anticipate the potential for increased catch as high as 40,000 additional northern pikeminnow.

The juvenile salmon survival benefits associated with an increased incentive program can be estimated by modeling the additional removals consistent with the general assumptions and model parameters used in evaluating and estimating the cumulative benefits of the NPMP to date. The general approach employed by NPMP analysts involves applying an appropriate northern pikeminnow consumption rate on juvenile salmonids (temporally and spatially) to the number of additional northern pikeminnow removed (temporally and spatially) to determine "number of smolts" not eaten. This provides an indication of potential incremental benefit of increased removals, assuming no significant inter-or intra-specific compensation.

With respect to Snake River Fall Chinook, the attached analysis provides a more refined estimated benefit of northern pikeminnow management on this stock (projected for first year of increased removal). It accounts for the approximate abundance of listed fish in relation to total abundance of all stocks (to apportion stock-specific benefit), and accounts for the fact that northern pikeminnow are caught over the course of the season (as opposed to instantaneously at the beginning of the season). It is based on a conservative assumption of an increased catch of 10,000 additional northern pikeminnow as well as a higher level of removal of 22,000 northern pikeminnow. Survival benefit is based only on northern pikeminnow removed in Lower Granite and Little Goose reservoirs, and below Bonneville (i.e., excludes most of the mainstem where few SR listed fish are present). For analytical data please see Excel files: SNFAC pred ctrl with timing 03-17-044.xls, NPMPcatchstatsforcast CUMULATIVE 03-16-04.xls posted on www.salmonrecovery.gov

Benefits to other juvenile salmonids from a NPMP heavy-up identified as potentially affected by modified summer spill migrating during the 2004 season are similarly calculated and presented in Table 1 below. The attached analyses provide assumptions, parameters and methodologies used to arrive at the smolt savings described in the table. For analytical data please see Excel files: Hanford-priest NPM redu 04-01-041.xls, below-MCN NPM reduction 04-01-042.xls. posted at www.salmonrecovery.gov

Table 1. Estimated Benefit on SIMPAS identified stocks from NPMP heavy-up

Affected Stock	Number of Juveniles Migrating	Total Saved, 5% (10,000) NPM increase	Total Saved, 11% (22,000) NPM increase
Priest Rapids & Ringold Springs Hatcheries	10,200,000	17,312	37,075
Hanford Reach Natural	25,000,000	42,432	90,869
Yakima River & Marion Drain	1,020,000	1,731	3,707
Listed Wild Snake River	1,051,615	268	590
Unlisted Lyons Ferry Hatchery	3,300,000	841	1,851
Unlisted Nez Perce and Big Canyon Hatcheries	2,050,000	523	1,150
Deschutes River	1,474,000	4,264	9,292
Klickitat River	4,000,000	11,572	25,215
Umatilla River	1,080,000	3,124	6,808
Little White Salmon River	2,000,000	5,786	12,608
SUMMER CHINOOK (Upper Columbia)	2,573,832	4,368	9,355
Total	53,749,447	92,222	198,774

Our goal is to increase absolute catch on an annual basis, with the longer-term effect of increasing the resultant annual average exploitation rate from the lower end of the desired range to the higher end. This would have the effect of increasing the likelihood of showing a statistical increase in actual exploitation in the longer-term.

For illustration, if an increase in the annual harvest of 15,000 to 40,000 northern pikeminnow is achieved over what would otherwise have normally occurred it would result in an additional savings of approximately 1,100,000 - 2,800,000 smolts across the lifespan of the northern pikeminnow caught. Sustaining this increased catch would, over time, result in a similar annual savings in smolts at equilibrium (in approximately 8-10 years). To the extent that most of such improvements in survival would be achieved in the lower Columbia River where northern pikeminnow abundance and predation losses are highest, the survival benefit would be similar to all stocks (proportional to their abundance).

We identified in an earlier version of our NPMP proposed action that based upon the objective of increasing catch by between 10,000-40,000 northern pikeminnow, a within year benefit of between 50,000-200,000 smolts not consumed by pikeminnow would be realized (Beamesderfer 1996). Our updated analysis based on more detailed modeling of both smolt run timing, geographic and temporal predator removals, and progressive removal of pikeminnow over the season, and yields results for identified stocks that is somewhat higher than our earlier general estimate. The detailed analysis increased removal of northern pikeminnow only captures the benefit to stocks potentially affected by summer spill, and does not stocks migrating earlier in the spring and summer nor stocks originating below Bonneville Dam which would be affected positively by the proposed NPMP heavy-up both in 2004 and beyond.

Estimated Cost, Duration, and Proposed Funding Source

Our approach is two-pronged to provide substantial incentive while simultaneously minimizing potential abuse of the program. The most effective and logistically feasible approach to increase the fishery performance would be to increase the basic reward structure. An additional reward of $500 per tagged northern pikeminnow caught provides substantial incentive to successful anglers and to minimize potential fraud on the program. Additionally, modification across all three tiers provides additional certain reward for those anglers who are most successful. By increasing tier 2 (>100 northern pikeminnow caught) from $5 to $6 per fish, and tier 3 (>400 northern pikeminnow caught) from $6 to $8 per fish, we would substantially increase the monetary incentive to those who have already demonstrated their ability to contribute substantially to the programs' catch. Increasing tier 1 (<100 northern pikeminnow caught) from $4 to $5 per fish would provide additional incentive for less effective anglers to continue to participate and increase fishing effort in order to graduate to the next tier. Additionally, past productive anglers who are not currently fishing in the program may choose to return. In addition, increasing the reward will result in modest additional recruitment of new anglers into the program if the treatment is coupled with information dissemination to make the public aware of Program enhancements.

Total cost: $600,000 to restore geographic scope; ~$600,000 for increased rewards; ~$250,000 for site-specific fishery; ~$250,000 to $1,250,000 for additional aggressive actions, to-be-determined.

The NPMP budget was reduced beginning in 2004 to approximately $2.2 million. The expectation was that similar survival benefits would be achieved at reduced cost. To ensure that the NPMP was staged to more aggressively implement actions associated with the offset and to avoid a protracted discussion about the legitimacy of the NPMP as an offset given the budget reduction, BPA-PBL restored the former funding level in March 2004. More aggressive offset actions, as described above, will be implemented at the beginning of the season following subsequent decisions on the summer spill reductions.

Process for Implementation and Schedule
Logistics associated with modifying the current NPMP to accommodate a program incentive increase would occur during pre-season program and contract discussions. The contract for the 2004 performance period will be modified effective April, 2004; the fisheries typically begin in early May and run through the majority of September in a given year. Further modification to the NPMP contract would be made, as appropriate, based on pending decisions on the summer spill reductions.

Lead Entity: Bonneville Power Administration
The Bonneville Power Administration funds the NPMP. The Pacific States Marine Fisheries Commission and the Washington Department of Fish and Wildlife together have the responsibility for administration and record keeping for the Sport-Reward fishery. The Oregon Department of Fish and Wildlife has responsibility for biological evaluation of program accomplishments in terms of the annual exploitation rate on Northern pikeminnow, responses of northern pikeminnow and other resident fishes to northern pikeminnow management (e.g., inter- or intra-specific compensation), and estimated benefit to juvenile salmonid survival.

We have addressed the substantive comments within our revised proposal through increased effort to ensure increased catch, which increases the likelihood of higher exploitation rates, implementing a site-specific fishery at projects with reduced spill operations, monitoring Sport-Reward fishery compliance in key program areas and possibly increasing our tagging operation to reduce uncertainty in our key programmatic and biological estimates.

Harvest
The purpose of including modifications to harvest as a potential offset for reductions in summer spill is to illustrate that there are opportunities to achieve substantial "fish saving" through relatively small adjustments to harvest, at relatively low cost. We believe this is an important policy discussion that should be engaged, though we recognize there are complex management, logistical, and regulatory issues to be resolved. Our desires to encourage higher-level policy discussions about harvest are based on several important issues including: the combined ocean and in-river harvest rate on fall chinook, which is approximately 50%. The total harvest is comprised of many fisheries, but only a few fisheries combined constitute most of the catch. The exvessel value (the price paid to fishermen directly for their catch) of harvested fish is relatively low, as is the broader value of the fisheries even with a liberal multiplier for secondary and tertiary value. Moreover, small relative changes in specific fisheries could provide a substantial reduction in the number of fish harvested without threatening the viability of those fisheries. Finally, the differential value of the fisheries relative to the costs associated with hydrosystem operations to benefit these stocks is disproportionately small – too small to be ignored at a policy level.

The value and viability of commercial fishing is waning due, in large part, to the huge worldwide production of farmed fish (Knapp 2001); other costs of production are also exerting pressure as well. The impact of farmed fish has a somewhat greater impact on commercially caught fall chinook, particularly in-river fisheries, than spring chinook and coho. This is because fall chinook exvessel value reflects market timing when supplies of other salmon from West Coast fisheries are also abundant and the quality of the product is lower, particularly later in the season with the relatively advanced sexual maturity of fall chinook (advanced sexual maturity generally results in flesh deterioration as fish approach spawning) relative to other stocks. Development of niche markets focusing on a fresh and/or higher quality product is an approach to this problem in order to stay competitive given the changing market conditions. Fall fisheries in the Columbia River currently do not have the market or the fish product to compete well within this model. This has been exemplified recently by the market value of these fish, averaging about $0.50/pound, and in some cases much lower. Another indication of lack of market opportunity is reflected in actual catch in recent years -- in some fisheries the actual catch is far less than what is allowed.

We recognize there are difficult issues surrounding modifications to harvest, particularly when posed as an alternative to different mitigation measures. However, we believe there are creative opportunities -- ranging from conservation easements on a willing buyer/willing seller basis, to regulatory mechanisms including buy-back -- that may be beneficial to all parties. This may be an opportune time to explore alternatives to enable achievement of biological objectives at least cost.

References:

Beamesderfer, R. Ward, D. and Nigro, A. 1996. *Evaluation of the Biological Basis for a Predator Control Program on Northern Squawfish (Ptychocheilus oregonensis) in the Columbia and Snake Rivers*, Volume 53, Number 12, pp 2898-2908.

Friesen T. and Ward, D. 1999. *Management of Northern Pikeminnow and Implications for Juvenile Salmonid Survival in the Lower Columbia and Snake Rivers*, North American Journal of Fisheries Management 19:406-420.

Knapp, G. 2001. *Challenges and Strategies for the Alaska Salmon Industry*. Institute of Social and Economic Research, University of Alaska. 31pp

Hankin, D. and Richards, J. 2000. *The Northern Pikeminnow Management Program: An Independent Review of Program Justification, Performance, and Cost-Effectiveness*.

Poe, T et al. 1993. *System-Wide Significance of Predation of Juvenile Salmonids in Columbia and Snake River Reservoirs*, BPA project 1982-003-00.

Porter, R. et al. 2000, 2001, 2002. *Development of a System-wide Predator Control Program: Stepwise Implementation of a Predation Index, Predator Control Fisheries, and Evaluation Plan in the Columbia River Basin*, Annual Report