6.0 EFFECTS OF THE PROPOSED ACTION

6.1 INTRODUCTION AND METHODS

Effects of the action are defined as "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline" (50 CFR § 402.02). When project operations directly or immediately injure or kill fish or damage habitat at or near the project site, those are considered direct effects of the project. Indirect effects are defined in 50 CFR § 402.02 as "those that are caused by the proposed action and are later in time, but still are reasonably certain to occur." They include the effects on listed species of future activities that are induced by the proposed action and that occur after the action is completed. "Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR § 402.02).

The approach to evaluating effects of the proposed action is summarized in Section 1.2.3 and detailed in Appendix D. The approach involved approximating the effect of the proposed hydro action as the difference between the effects of the proposed action and the "reference operation" that was described in Section 5.0. Then NOAA Fisheries quantitatively evaluated the effects of actions proposed to reduce or minimize those effects or to mitigate for them through non-hydro actions designed to improve habitat conditions and survival. Finally, NOAA Fisheries qualitatively evaluated the net combined effects of FCRPS operations and non-hydro improvements.

NOAA Fisheries then conducted two related analyses — one to inform the jeopardy determination and one to inform the critical habitat determination.

For the jeopardy analysis, as discussed in Section 1.0, NOAA Fisheries first determines whether the proposed action is likely to reduce the abundance, productivity, or distribution of a listed ESU. This analysis is conducted using both an evaluation of survival changes and, where survival data are lacking, a habitat proxy approach, as described in Section 6.1.1. If, in the jeopardy analysis, NOAA Fisheries determines that the proposed action is likely to reduce the abundance, productivity, or distribution of a listed ESU, then NOAA Fisheries must determine if that reduction constitutes an "appreciable reduction in the likelihood of both survival and recovery" and therefore is likely to jeopardize the continued existence of the ESU.

For the critical habitat analysis, NOAA Fisheries evaluates the effect of the proposed action on component areas of designated critical habitat and, in particular, on the essential features of that critical habitat and then determines whether the effects include alteration of those essential features.

For this consultation, the effects of the proposed action on each ESU and on critical habitat are discussed in Section 6.0, while Section 8.0 presents NOAA Fisheries' determinations on whether the ESU effects constitute an appreciable reduction in the likelihood of both survival and

recovery and the habitat alterations constitute destruction or adverse modification of critical habitat.

6.1.1 Methods for Evaluating Proposed Hydropower Operations and Configuration Changes

The effects of proposed FCRPS operations and configuration changes are first evaluated as differences in habitat conditions between the proposed operation and the "reference operation" described in Chapter 5 as a proxy for determining whether the proposed annual hydro operation results in less survival of listed fish. Habitat conditions that support a sufficient number and distribution of viable populations (i.e., populations with adequate abundance, productivity, spatial structure, and diversity) serve as a valuable proxy for a quantitative survival analysis. There is a strong causal link between habitat modification and the response of salmonid populations. Any differences in habitat condition (positive or negative) relative to the "reference operations" represent the effects of the proposed action. This evaluation of habitat effects supports the jeopardy analysis for all ESUs. Additionally, evaluation of the change in essential elements of critical habitat, as described in Chapter 1 and Chapter 5, support the analysis of adverse modification of critical habitat for the three Snake River ESUs with designated critical habitat.

One or more populations of 11 ESUs travel through one or more mainstem Snake and Columbia river FCRPS hydro projects during their juvenile and adult migrations. For all of these ESUs, NOAA Fisheries is able to estimate the juvenile and adult survival rates[1] associated with the proposed FCRPS operations and configuration changes at each or a series of these projects, using the "survival approach" applied in the analysis of the reference operation (see Appendix D). For several ESUs where empirical data are sparse or lacking, these survival estimates are inferred from data available for similar species (e.g., Snake River sockeye survival rates are inferred from SR spring/summer chinook and SR steelhead). This survival rate correlates to the aggregate of most of the known habitat effects occurring within the same reach, so this analysis provides an alternate evaluation to that performed using the habitat proxy approach.

NOAA Fisheries approximates the effect of proposed annual near-term (2004) and long-term (2010-2014) hydro operations on fish survival during their migration through the FCRPS by determining the difference in the survival rates between both the near-term and long-term proposed hydro operation and the "reference operation" described in Section 5.0. Where juvenile fish are transported in barges or trucks around FCRPS projects, NOAA Fisheries' estimate of their survival rates include the observed rate of survival to the point of release back to the river below Bonneville Dam. It also includes the effects of passage through the FCRPS beyond those effects experienced by non-transported juveniles that are delayed and therefore not expressed until after the fish are released downstream of Bonneville Dam (referred to elsewhere as the "D" value). Survival rates were estimated both as absolute differences between the proposed and reference operations and as relative (i.e., proportional) difference. Proportional survival

[1] "Survival" estimates referred to in Chapter 6 are quantitative measurements of the number of fish surviving passage past a project (reservoir and dam). Juvenile survival estimates at the dam can be specific to a route such as turbine, juvenile bypass system, or spillway.

differences were of primary interest, because these are most relevant for comparing with off-site measures that affect survival rates in other life stages. (See example in Section 6.1.3).

Finally, for purposes of the jeopardy analysis, the combination of survival and habitat effects is summarized as a categorical qualitative impact (e.g., Very Low, Low, Medium, High) on one or more VSP characteristics, according to criteria discussed in Appendix A. For purposes of the adverse modification analysis, the habitat effects are summarized and expressed as changes to the essential features of designated critical habitat.

6.1.2 Methods for Evaluating Proposed Non-hydro Actions

Methods for evaluating the effects of non-hydro tributary and estuary habitat improvements, reduction of avian predation, and effects of monitoring are detailed in Appendix E. Briefly, staff compared current population status (abundance [number of fish or redds] and productivity [survival rate through one or more life stages, e.g., recruits per spawner]) against estimates of historical population status as an indication of the capacity of the population to increase. Then, using available assessments of historical and current tributary habitat conditions, staff evaluated whether tributary habitat processes within the geographic area currently occupied by the population had been degraded or impaired. Based on assessments of tributary habitat, staff then identified those tributary habitat factors which, as a result of degradation or impairment, were considered most likely limiting to the anadromous salmonid population's abundance, productivity, distribution, or diversity. Finally, the first three steps were integrated to derive an estimate of the capacity of the population to respond to improvements in habitat condition. As a first cut, NOAA Fisheries ascribed qualitative rankings (Very High, High, Medium, Low, and Very Low) to population and habitat parameters, based on the magnitude of the observed or potential difference (see Table 6.1).

Table 6.1. Qualitative Categories for Potential Improvements in VSP Characteristics

Ranking	Description
"**Very Low**"	Little or no potential for improvement; very high risk that these activities would not result in any beneficial effects.
"**Low**"	Small potential for improvement, possibly on the order of a percentage or two relative change in survival rate or abundance (i.e., possibly up to 1.01-1.02 times the current survival rate or abundance level).
"**Medium**"	Significant potential for improvement in population status, perhaps as high as a 24% improvement in survival rate or abundance (i.e., up to 1.24 times current survival rate or abundance level).
"**High**"	Potential for improvement is high, possibly resulting in a doubling of survival rate or abundance (i.e., up to 2 times current survival rate or abundance level).
"**Very High**"	Potential for improvement is very high, possibly resulting in more than a doubling of the current survival rate or abundance level.

In order to evaluate the effect of the Action Agencies' proposed non-hydro program, NOAA Fisheries considered the commitment to implement proposed projects or achieve proposed metric goals and the likelihood that the implemented actions or obtained metric goals would effectively

improve the viability of salmonid populations within the action area. In evaluating the Action Agencies' commitment to implement non-hydro actions, NOAA Fisheries considered whether they had the requisite authorities and resources to ensure prompt and efficient implementation.

NOAA Fisheries evaluated the likely biological effectiveness of the Action Agencies' tributary habitat enhancement actions (identified in the proposed action either by project or proposed performance measures) in relation to factors identified as limiting listed salmonids within those subbasins. NOAA Fisheries also considered the effect of tributary actions implemented by the Action Agencies within the action area since 2000 when reviewing the degree to which the proposed action addressed the limiting factors identified in Appendix E and Fresh *et al.* 2004, the alternative analyses provided by the Action Agencies in their Updated Proposed Action, and other information, such as the Northwest Power and Conservation Council's subbasin plans. In evaluating short- and long-term benefits, NOAA Fisheries considered whether the action was already being implemented or was initially proposed in the Updated Proposed Action, and any anticipated lag between project completion and environmental response.

NOAA Fisheries also characterized the probable temporal lag between project implementation and biological benefit, depending on whether the action provided immediate benefits (e.g., entrainment) or benefits over a longer term (e.g., riparian revegetation). After considering the Action Agencies' commitment to implement non-hydro actions and the potential benefit of those actions to the magnitude and scope of significant limiting factors, NOAA Fisheries made qualitative conclusions on the likely benefit of the proposed actions on the viability of targeted populations.

The potential for artificial propagation to mitigate for FCRPS operations is discussed in Appendix F. The Action Agencies have proposed to continue funding safety-net projects for a number of ESUs "…as long as they are determined by NOAA Fisheries to be effective in reducing the short-term risk of extinction." NOAA Fisheries has determined that the safety-net programs proposed for funding by the Action Agencies continue to be effective as described.

6.1.3 Methods for Determining Net Effects of FCRPS and Non-hydro Actions

Some elements of the proposed action (e.g., FCRPS operations) would be more likely than the reference operation to result in reduced numbers, reproduction, or distribution of listed species or alter essential features of critical habitat, while other elements (e.g., off-site actions) would be more likely show better results. It is necessary to determine the net effects of these adverse and beneficial effects for each listed ESU. Professional judgment is required to determine the net effect, because it is not possible to evaluate the effects of all activities quantitatively or in identical units (e.g., quantitative survival estimates for the effects of hydro operations for some ESUs must be compared with qualitative changes in habitat condition for off-site actions). Not all actions will occur over identical time periods, so the timing of effects must also be considered.

6.1.3.1 Net Effects Methods for Jeopardy Analysis

6.1.3.1.1 Proportional Changes. For the jeopardy analysis, the underlying assumption in the net effects determination is that a relative (i.e., proportional) change in a factor relevant to VSP characteristics in one life stage can be offset by a comparable proportional change in another life stage.

This can be demonstrated quantitatively for survival rates, as shown in Tables 6.2a and 6.2b, since cumulative survival through successive life stages is multiplicative. NOAA Fisheries also assumes that it can be applied to qualitative assessments of the benefits of habitat modifications affecting different life stages.

Effects of most proposed FCRPS operations can be described as expected changes (generally negative) in juvenile and adult survival rates, and these expected changes can be expressed as relative (*i.e.,* proportional) changes in survival rates. To illustrate, if smolt survival under the reference operation is 50% and smolt survival under the proposed action is 45%, the absolute change is -5%, but the proportional change is -10% ([proposed - reference] ÷ reference). To mathematically balance the 10% proportional reduction in smolt survival through the FCRPS, off-site actions would have to result in the equivalent of a 10% proportional survival increase in another life stage. That is, the current survival rate in another life stage would have to increase by a multiplier of 1.10 to balance. If NOAA Fisheries could quantify the egg-to-smolt survival rate in relevant tributaries, and if the baseline survival rate were 3%, proposed off-site actions would have to increase the egg-to-smolt survival rate to at least 3.3% for the combination of both actions to result in no net effect (0.03 x 1.10 = 0.033).

Table 6.2a. Hypothetical example: comparing proportional changes in different life stages.

	Absolute Change in survival	Proportional or Relative Change	Comments
Survival gap due to FCRPS operation:	45% - 50% = -5%	$\frac{45\% - 50\%}{50\%}$ = - 10%	An absolute change of -5% in the FCRPS corresponds to a relative change of - 10%
Increased # of smolts entering FCRPS to "fill the gap"	3.3 - 3% = +0.33%	$\frac{3.33-3\%}{3.33\%}$ = +10%	A 0.33% change in absolute survival upstream of the FCRPS (from 3% to 3.33%) corresponds to a +10% relative change that could be used to offset the reduction in survival.

Multiplying the number of eggs by the survival rates in the different life stages provides the number of surviving smolts. This is shown in Table 6.2b.

Table 6.2b. The multiplicative effect of salmonid survival through different life stages.

# eggs x	egg-smolt survival x	survival in FCRPS =	# smolts exiting FCRPS
5000	0.03	0.50	75
5000	0.03	0.45	67
5000	0.0333	0.45	75

6.1.3.1.2 Timing of Effects. Timing of effects is also an important consideration. Mortality associated with proposed FCRPS operations begins immediately and continues for at least the life of this Opinion. If mortality in all other life stages stays constant, this would result in a cumulative reduction in spawner abundance over time. For example, a 2% mortality rate would result in only 98% as many adults returning at the end of the first year; 96% (0.98*0.98) at the end of the second year; and 89% (0.98^6) at the end of six years. This cumulative reduction in abundance could be offset by an equivalent increase in survival of another life stage if that improvement also began in the first year. If the offsetting survival improvement was delayed, either because of a lag in implementation or in realizing benefits to fish (e.g., long-term habitat restoration projects), the needed survival improvement would have to be greater than the annual FCRPS mortality to provide an equivalent offset. The longer the delay, the greater the survival improvement would have to be. Alternatively, additional short-term actions could be implemented to offset the ongoing hydro mortality.

6.1.3.1.3 Consistency of Qualitative Evaluations of Effects. As described in section 6.1.2 and in Appendix A, an attempt was made to standardize qualitative characterizations of effects (i.e., Very Low, Low, Medium, High, or Very High increases or reductions in one or more VSP characteristics) across activities. NOAA Fisheries addressed this concern by assembling the qualitative evaluators to compare the procedures and values that each applied and to adjust those factors between evaluators until consistency had been achieved.

6.1.3.1.4 Population-level Net Effects: Two-Step Approach. For tributary habitat and artificial propagation programs, NOAA Fisheries first evaluated the net effects of the mitigative action at the population level, the appropriate scale of impact for important components of the proposed action. NOAA Fisheries performed this evaluation by applying the following two-step process. The first step was a "coarse screen" that evaluated whether the qualitative category or rank (very low to very high) describing the hydropower effect was offset by activities ranked at this level or higher. For example, a Medium hydropower gap could be mitigated by non-hydro projects that were ranked Medium (or higher) for mitigation potential, considering any of the four VSP attributes. This approach is transparent and can be applied consistently, but gives the impression of "knife edge" precision in delineating the bounds of each qualitative category (e.g., less than two versus 2 to 24%). In fact, there is a great deal of uncertainty in estimating non-hydro potential. Therefore, a second step was also applied. The capacity to mitigate a hydropower effect was further evaluated by looking more closely at the placement of the benefits of a specific project within the qualitative range. For example, a 3% hydro effect (ranked as Medium: 2 – 24%) might be adequately offset by two habitat actions ranked as having Low (greater than 0 to less than 2%) non-hydro potential. Alternatively, a beneficial action at the low end of the Medium category might be judged incorrectly to offset a hydro action producing an effect closer to the top of the Medium range, even though it passed the coarse screen. This approach considers

the unique attributes of any non-hydro project and acknowledges that the qualitative characterization of habitat improvement activities, expressed as a change in survival rate, is unlikely to be accurate to within a few percentage points. This second step requires a more detailed explanation for NOAA Fisheries' determination that the effects of certain activities are at one end of the qualitative category or another.

The result of the population-level net effects analysis, after considering the potential of all non-hydro actions to offset proposed FCRPS operations and considering the relative timing of effects, was a determination that there is likely to be a "net improvement," "no change," or a "net reduction" in the VSP characteristics of each population. If the action was determined likely to cause a net reduction, the relative magnitude of the reduction was indicated, for use in both the jeopardy and adverse modification analyses.

6.1.3.1.5 Net Effects for Populations, Major Population Groups, and ESUs. In the 2000 FCRPS Biological Opinion, NOAA Fisheries' analysis for most ESUs assumed that every component population needed to achieve a certain level of improvement to meet or exceed the defined survival and recovery metrics. These needed levels of improvement were set as performance standards. Since then, the Interior and Willamette/Lower Columbia TRTs have drafted descriptions of the population structure of each Columbia basin ESU. Populations in close geographic proximity and with similar genetic characteristics were termed "major population groups" by the Interior TRT (the W/LC TRT used the term "strata," which for the purposes of this analysis, is the same concept). The major population groups for each ESU are identified in Section 4.0.

NOAA Fisheries determined if, on balance, each major population group experienced no change or an increase or decrease in VSP criteria, although the net effects for specific populations within a given major population group could be a mixture of "net improvement," "no change," or a "net reduction" in status of the VSP characteristics. Where such a mixture was difficult to interpret, NOAA Fisheries weighted the relative contribution of each population within each MAJOR POPULATION GROUP by its relative abundance and productivity (currently and historically) and any unique traits of the population (e.g., the only summer-run population in a major population group) per Appendix A. If a population was historically small relative to other populations within the ESU and the population had no especially unique characteristics, it would have less weight in making a determination for the major population group than would a population that was a significant source of the ESU's abundance and/or had unique characteristics (e.g., the only summer-run population).

Once a determination was reached for each major population group, NOAA Fisheries determined whether the ESU as a whole experienced no change or an increase or decrease in VSP criteria. If the net effect of the proposed action was to reduce the VSP characteristics of any major population group, then NOAA Fisheries determined that the abundance, productivity, or distribution of the ESU was reduced by the proposed action. The magnitude of any such reduction was noted. In Section 8.0, NOAA Fisheries determined if this represented an "appreciable reduction" in the likelihood of both survival and recovery of the ESU in the wild. The specific major population group(s) affected within an ESU was relevant to this determination.

Only one major population group exists for four ESUs: UCR spring chinook, UCR steelhead, SR sockeye, and SR fall chinook. The two UCR ESUs have only three or four populations each, and, with so few, a reduction in numbers, reproduction, or distribution of any one population is likely to represent a reduction for the major population group as a whole. Because there is only one major population group, the same effect is experienced by the ESU. The case is even more dramatic with SR sockeye and SR fall chinook, ESUs for which there is only one population, so the population, the major population group, and the ESU are equivalent.

6.1.3.2 Net Effects Methods for Critical Habitat Determination

As described in sections 6.1.1 and 6.1.2, NOAA Fisheries evaluates the effects of hydro actions and non-hydro actions on component areas of designated critical habitat and, in particular, on the essential features of that critical habitat. To determine net effects, positive and negative actions affecting the same component areas and essential features were compared to determine if, on balance, there was no change, an alteration, or an enhancement of critical habitat function. In most cases, this analysis relied upon habitat information that was also considered in the jeopardy analysis. If there were a net alteration of habitat function, NOAA Fisheries determined in Section 8.0 whether that constituted a destruction or adverse modification of critical habitat.

6.2 RESULTS COMMON TO MULTIPLE ESUS

6.2.1 Effect of Proposed Hydro Operations on Mainstem Habitat Conditions, Including in the Estuary and Plume

The main differences between the proposed hydro operation and the reference operation are seasonal differences in flow through the Snake and lower Columbia rivers, differences in spill at FCRPS mainstem dams, and a change in the John Day reservoir elevation.

6.2.1.1 Flow

Flow influences water velocity and water quantity, the amount of spawning habitat and shallow-water rearing habitat below Bonneville Dam for some ESUs, as well as the size and physical characteristics of the near-ocean plume at the mouth of the Columbia River. There is essentially no net difference in seasonal average spring flows in the Snake River between the proposed action and reference operation, when SR sockeye salmon, SR spring/summer chinook salmon, and SR steelhead are migrating through the action area (Table 6.3). Compared to the reference operation, the proposed hydro operation has slightly reduced lower Columbia River flows (-1.5%) during the spring, when SR sockeye salmon; SR spring/summer chinook salmon; SR,UCR, MCR, LCR, and UWR steelhead; UCR spring chinook; some populations of LCR chinook; CR chum salmon; and UWR chinook are migrating through the action area (Table 6.3). CR chum salmon may also be rearing in the action area during the early part of this period. Because the difference in spring flow is minimal, the proposed action is not likely to have more than a minimal effect on the functioning of either the migration corridor or juvenile rearing habitat during the spring.

Compared to the reference operation, flows resulting from the proposed hydro operation are significantly lower during the summer, when SR fall chinook, CR chum salmon (chum salmon migrate out in April peak - see http://www.nwfsc.noaa.gov/publications/techmemos/tm32/Tables/table9.htm), and some populations of LCR chinook are migrating through and rearing in the action area. Quantitative estimates of the associated difference in shallow-water rearing habitat below Bonneville Dam (including the estuary) are not available, but the 20% difference in flow is likely to significantly reduce the availability of shallow-water rearing habitat during the summer. Fall and winter flows associated with the proposed hydro operation are somewhat higher compared to the reference operation, which would result in a greater quantity of spawning and incubating habitat for at least one population of CR chum salmon. It is unlikely that these higher flows higher flows would have a significant effect on mainstem spawning of SR fall chinook salmon, which generally takes place in relatively deep water downstream of dam tailraces, but, to the extent that there is an effect, it would likely be beneficial.

Table 6.3. Simulated average seasonal flows (and flow ranges) in thousand cubic feet per second (kcfs) for reference and proposed action operations during spring and summer time periods relevant to migrating listed juvenile salmon and steelhead for the years 1994 through 2003.
Source: BPA "HYDSIM" model studies 03SN6704S1 and 03FSH05D9, August 2004.

Reach and Season	Reference Operation	Proposed Action Operation	Absolute Difference (Proposed - Reference)	Percent Difference (Absolute Difference ÷ Reference)
Snake River Spring (4/3 - 6/20)	93.0 (47.9 to 148.1)	93.1 (54.0 to 145.4)	+0.1 (-2.7 to +6.1)	+0.1% (-2.1 to +12.7%)
Snake River Summer (6/21 - 9/30)	45.0 (26.9 to 64.8)	41.6 (27.3 to 59.7)	-3.3 (-6.6 to +0.4)	-7.4% (-12.1 to +1.6%)
Lower Columbia Spring (4/10 - 6/30)	258.4 (143.5 to 424.8)	254.6 (156.1 to 401.8)	-3.8 (-23.1 to +12.6)	-1.5% (-5.4 to +8.8%)
Lower Columbia Summer (7/1 - 9/30)	189.2 (166.0 to 220.0)	150.9 (115.2 to 196.3)	-38.3 (-50.8 to -23.7)	-20.2% (-30.6 to -10.8%)
Lower Columbia Fall and Winter (11/1 - 4/15)	162.4 (118.8 to 212.4)	174.1 (121.0 to 237.0)	+11.7 (-0.7 to +24.7)	+7.2% (-0.6 to +11.%)

Some water quality conditions associated with the proposed hydro operation could decline with lower reduction in flows during summer months, compared to the reference operation. Higher temperatures during the summer would most likely affect migrating juvenile SR fall chinook salmon and some populations of rearing CR chum salmon and LCR chinook salmon. Additionally, warmer summer temperatures may affect migrating adult SR and LCR fall chinook salmon and winter-run populations of several steelhead ESUs. It is unlikely that other water quality factors such as total dissolved gas levels would be higher for the proposed hydro operations relative to the reference operation, since voluntary spill for fish passage should not exceed total dissolved gas caps based on state water quality standards in either the reference or proposed operation, and involuntary spill is similar in the two operations.

6.2.1.2 John Day Reservoir Elevation

The proposed action will raise the elevation of the John Day pool from minimum operating pool (MOP) to the minimum elevation required for irrigation withdrawals. This operation results in roughly a 15% reduction in water particle travel time through the reservoir and a decrease of approximately 6300 acres in available shallow-water rearing habitat within the John Day Reservoir (Corps April 1994). Since ocean-type SR fall chinook rear primarily in Lower Snake River reservoirs, particularly Lower Granite pool, and these fish have migration rates similar to spring migrants through the lower Columbia River during the summer months, this reduction in shallow-water habitat is not expected to affect their rearing habitat. Connor *et al.* (2004) state it is unknown presently which mainstem reservoirs are used by reservoir-type SR fall chinook for rearing purposes, the extent of that use, or the passage timing of this life history. Thus, this operation is expected to have a minor impact on the rearing habitat for SR fall juvenile chinook in this area, which has already been significantly modified from riverine conditions by the existence of John Day Dam and Reservoir. Quantitative estimates of the degree to which the increased pool elevation reduces juvenile migration time and survival of ESUs migrating through John Day Reservoir are incorporated into the in-river and system survival estimates for migrating juveniles of several ESUs. These survival estimates are presented in subsequent sections of this chapter.

6.2.1.3 Spill

Compared to the reference operation, the proposed hydro operation would reduce spill at all FCRPS mainstem dams. The reduction in spill is particularly noteworthy during the spring migration period at Little Goose, McNary, and John Day dams, all of which are limited to a 12-hour spill operation for fish passage in the proposed action. Reduced spill primarily affects the ability of juvenile migrants to safely pass dams, which function as partial barriers to migration and can also result in migration delays. Because spill is generally acknowledged as the safest route of dam passage (Ferguson *et al.* 2004), reducing spill would decrease the functioning of migration corridor habitat. The degree to which this affects safe passage is informed by quantitative survival estimates presented later in this section. However, increases in spill efficiency through the installation and use of forebay guidance devices or removable spillway weirs, as indicated in the long-term hydro operation, would be expected to diminish the overall impacts of reducing spill from the reference operation.

6.2.1.4 Juvenile Fish Transportation Operations

The proposed action differs from the reference operation in several ways. One of the main changes in the transport operations of the proposed action is to delay the date when fish are collected and transported from late March to approximately April 15. Prior to that date, all fish collected would be returned to the river. This change is consistent with recent empirical information which indicates there is typically no benefit provided from transportation during late March and early April (Williams *et al.* 2004). In contrast, the reference operation delayed transportation through the entire month of April, and provided spill during April in some lower flow years than the proposed action operation. For example, the proposed hydro operation provides spill only when the seasonal average flow is forecasted to exceed 85 kcfs, whereas the

reference operation provided spill during the month of April when seasonal flows were forecasted to exceed 70 kcfs. The reference operation places more emphasis on keeping fish in-river during a time of year when transportation appears generally to provide little if any benefit. Yet this is not always true. In 1999, the only wild steelhead to come back in any numbers were those that were transported in April. Thus, the reference operation may understate the value of transport for some stocks at some times.

The Action Agencies also proposed improving transport operations by adding more barges. The theoretical value of increasing the number of barges results from lower holding densities during transport operations and the potential for added flexibility in the barging schedule, which would facilitate the release of fish in areas where they could be less prone to predation. Furthermore, new barges could theoretically improve the survival of barged fish and increase the value of "D" by several percentage points. Research is planned to evaluate any potential operational or survival benefits that new barges may provide.

6.2.2 Effect of Proposed Hydro Operations on Juvenile and Adult Mainstem Reach Survival

6.2.2.1 Modeling Results

NOAA Fisheries' modeling results indicate that proposed near-term (2004-2010) hydro operation is estimated to reduce in-river and system survival for several ESUs, compared to survival estimated to occur under the reference operation (Table 6.7; Appendix D). For other ESUs, there is not a significant difference in survival between the proposed 2004 hydro operation and the reference operation. However, modeling results also indicate that the proposed long-term (2010-2014) hydro operation, with expected survival improvements, is estimated to either reduce or close the survival gaps for several ESUs when compared to survival estimated under the reference operation. As described in Appendix D, the range of estimated survival results reflects variation in eight recent years (for SR fall chinook) or 10 recent years of study (for spring chinook and steelhead ESUs). That variation is caused both by environmental variability (extreme low runoff in 1994 and 2001, compared with moderate to high runoff in other years) and the differential survival of fish under similar runoff conditions in different years, as determined by empirical survival estimates (Williams *et al.* 2004).

6.2.2.2 Effects of the Proposed Hydro Operation on Adult Salmon and Steelhead

Adult salmon and steelhead must pass up to eight mainstem dams and reservoirs to reach their natal spawning streams and river reaches. Each FCRPS project within currently occupied habitats imposes stresses on migrating adults. Those project-induced effects most likely to adversely affect adult survival are: delay and delay-induced predation, water quality changes (e.g., total dissolved gas concentrations and water temperatures), and fallback and volitional downstream passage (e.g., kelts).

NOAA Fisheries has estimated the recent survival rates of adult anadromous fish passing through the FCRPS (Table 6.4).[2] System passage survival estimates shown in Table 6.4 include

[2] A discussion of the data and methods used to make these estimates is provided in Appendix D.

all unknown causes of adult mortality. Efforts have been made to exclude fish mortalities for reasons not associated with the FCRPS. Fish that turn off into tributaries or are captured in a fishery are not included in the estimate. However, fish injured or infected prior to entering the FCRPS are included. Also, the sampling technique itself, including anesthesia and the insertion of radio-telemetry gear into body cavities, may also cause mortalities that occur following passage of Bonneville Dam. Those mortalities would be incorrectly attributed to dam passage in Table 6.46, but given the high rate of adult survival, non-dam-caused mortality does not appear to be a significant component of the calculation. To determine the likely effect of the proposed action, we investigated those differences in conditions between the reference operation and the proposed hydro operation that might affect adult survival.

Table 6.4. Estimated minimum adult survival and unaccounted loss from 2000 through 2002 through the FCRPS (Bonneville Dam tailrace through John Day, Lower Granite, Priest Rapids dams). Source: Ruff et al. 2004 (Appendix D)

ESU	Mean Unaccounted Loss	Minimum Mean Survival	Number of Dams Passed	Per Project Survival
Chinook Salmon				
SR spring/summer chinook	0.138	0.861	8	0.982
SR fall chinook	0.200	0.800	8	0.973
UCR spring chinook	0.099	0.901	5	0.972
LCR spring chinook		0.982	1	0.982
LCR fall chinook		0.973	1	0.973
LCR coho		0.973	1	0.973
Steelhead				
SR steelhead	0.108	0.893	8	0.986
UCR steelhead	0.073	0.928	5	0.985
MCR steelhead		0.959	3	0.986
LCR steelhead		0.986	1	0.986
SR sockeye salmon	0.143	0.857	8	0.981

6.2.2.2.1 Delay and Delay-induced Predation. To pass each dam, adult fish must successfully locate and ascend the project fish ladder(s). The ability to successfully pass each dam has been found to be affected by project configuration and various operating characteristics, principally attraction flow rates, project spill patterns, and powerhouse discharge patterns. However, Bjornn *et al.* (1999) estimated that the median time to transit the lower Snake River in 1993 was the same or less with dams than it would be without dams, suggesting that adult passage timing is relatively unaffected by the FCRPS. This is due to the faster transit times through project reservoirs than would occur in the natural river.

High rates of spill have been found to delay project passage. The spill rates that cause a notable increase in delay are those associated with involuntary spill, an unavoidable consequence of dam existence. It is unlikely that any of the configuration and operation changes considered in the reference operation would substantially reduce adult passage delay. The additional daytime spill considered under the reference operation could result in a slight increase in the delay of

migrating adults. The effect of a small increase in delay on adult survival or spawning success is unknown. Changes in project configuration and operation under the proposed hydro operation would also be unlikely to change adult passage delay. Under the proposed action, any passage delay problems identified by ongoing monitoring and evaluation would be addressed through the Regional Forum.

Pinnipeds (seals and sea lions) protected under the Marine Mammal Protection Act of 1972 have been increasing in recent years in the vicinity of Bonneville Dam, feeding primarily on spring chinook salmon. The number of pinnipeds, primarily California sea lions (*Zalophus californianus*), observed each year from 2002-2004 has increased to 30, 106, and 101, respectively. The estimated percentage of the spring chinook run consumed has also increased each year to 0.3%, 1.1%, and 2.0%, respectively (Stansell 2004). NOAA Fisheries and the Action Agencies are concerned about the recent growth in pinniped predation near Bonneville Dam and the potential impact this source of mortality places on species recovery. Under the proposed action, pinniped predation would be monitored and managed as appropriate.

6.2.2.2.2 Water Quality Effects on Adult Passage Survival. Migrating adult salmon require river flows of sufficient quality to reach spawning grounds and spawn successfully. Specific ranges of the water quality components (i.e., water temperature, turbidity, and total dissolved gas) are needed for successful migration. The preferred temperature range for migrating adult salmon is 7 to 14.5˚ C, with upper and lower lethal limits of 0 and 25˚ C (Bell 1991). High concentrations of dissolved solids can irritate or suffocate salmon. Total dissolved gas concentrations (TDG) higher than 125% of saturation concentration due to high spill levels can impair and reduce adult survival (Ferguson *et al.* 2004). Biological requirements are the same for all ESUs migrating in the mainstem Columbia and Snake rivers.

Water temperatures as high as 23˚ C have been noted in localized surface water areas in the FCRPS, but summer surface (depth ≤ 15 feet) water temperatures generally do not exceed 22˚ C (DART, U. Wash.). High water temperatures cause metabolic stress in adult salmon and increase the virulence of disease vectors. Higher spring and summer flow rates that would occur under the reference operation could reduce the maximum water temperatures in the system. The scale of that effect and the associated improvement in adult fish survival and spawning success is unknown. Under the proposed hydro operation, water temperatures would be very similar to those recently observed.

Turbidity extremes that can impair the survival of adult salmon generally do not occur in the mainstem Columbia and lower Snake rivers in the FCRPS.

Under the proposed hydro operation, voluntary spill for juvenile fish passage would continue to be managed to produce less than 120% TDG. At this TDG level, no signs of gas bubble disease have been noted, and the adult anadromous fish survival effects are considered benign.

6.2.2.2.3 Fallback and Volitional Downstream Passage. Fallback refers to adult fish that pass a dam and then are entrained in the spillway or the powerhouse intakes and pass back through the dam. Fallback of adult spring/summer chinook passing dams during spill has been found to reduce the number of fish that passed between tops of ladders at Bonneville Dam and Lower

Granite or Priest Rapids dams (after adjustments for harvest). Fallback (at Bonneville and Ice Harbor dams) of steelhead similarly has been found to reduce escapement (Keefer and Peery 2004). During 1996-2002, escapement, on average, was lower for fallback fish by 6.5% for spring/summer chinook ($P<0.05$), 19.5% for fall chinook ($P<0.005$), and 13.3% for steelhead ($P<0.005$) (Keefer *et al.* 2004). Multiplying the percent of reduction in escapement for fish that fall back times the percent of fish that actually fallback provides an estimate of the reduction in overall system escapement (e.g., steelhead: 13.3% lower escapement for fallback fish * 21.4% fish that fell back = 2.84% reduction in escapement). Accordingly, reductions in overall run escapements were estimated at 1.30% (range=0.46-2.27%), 2.26% (range=1.32-2.91%) and 2.84% (range=1.34-4.02%) for spring/summer chinook, fall chinook, and steelhead, respectively.

However, system-wide information showed no significant difference in spring/summer chinook and steelhead escapement due to fallback during spill (approximately 30-50 kcfs) and no spill periods in 2001 (Keefer and Peery 2004). Escapements of adult steelhead from Bonneville to Lower Granite dam adjusted for harvest in 2000, 2001, and 2002 were very similar (87.6, 85.2 and 85.6%), even though 2001 had very little spill at dams compared with 2000 and 2002. No differences ($P<0.05$) in escapement were found for fallback of spring/summer and fall chinook with and without spill for all years (1996-2002) pooled (Keefer *et al.* 2004). These similar escapements with and without spill may be due to so few fish falling back during non-spill periods.

Because more fish fall back during spill but fish escapement is similar for spill and no spill conditions, it appears total adult survival in the hydrosystem is similar for spill and no spill conditions. Thus, the addition of daytime spill at three dams under the reference operation could result in more fish falling back, but overall adult survival is not expected to decrease. Because the proposed hydro operation would result in voluntary spill conditions very similar to current operations, no change in fallback rates is anticipated.

6.2.2.2.4 Kelts. Only recently have studies been conducted to identify kelt (post-spawn downstream migrating adult steelhead) numbers and to investigate downstream passage success and route-specific passage at dams. Repeat spawning rates for Snake Basin steelhead average less than 2% (Ferguson *et al.* 2004). Studies conducted since 2000 have shown that over 13,000 kelts pass John Day Dam, and 83% of the kelts observed at Lower Granite Dam were females. For fish tagged and released at Lower Granite Dam, 4.1, 17.0, and 34.0% were detected below Bonneville Dam in 2001, 2002, and 2003, respectively. Migration rates in 2003 were positively correlated with river flow ($P<0.0001$, $R^2 = 0.63$). Conditions that provided the 34% survival to below Bonneville Dam were spill at dams in accordance with the 2000 Biological Opinion and a very large freshet in late May/early June when kelts were migrating. Since kelts chose spill and sluiceway routes to pass dams and are known to migrate faster with higher flows, spill, sluiceway operation, and increased flows appear to substantially improve kelt survival to below Bonneville Dam. With the large number of steelhead kelts and the high percentage of female kelts, the potential for increasing depressed steelhead populations by improving kelt survival is substantial. The increased spill that would be provided under the reference operation would improve kelt survival by an unknown amount.

NOAA Fisheries does not anticipate any difference in adult salmon and steelhead survival rates between the reference operation and the proposed hydro operation. High per-project and system survivals indicate biological requirements of adult salmon and steelhead generally are being met.

6.2.2.2.5 Mainstem Passage Improvements as a Result of 2000 Biological Opinion Implementation during 2001-2004. In addition to the effects of the proposed action, another qualitative consideration is the progress in implementing hydro actions since adoption of the 2000 FCRPS Biological Opinion, which are reviewed below. More detailed Action Agency progress in implementing the Reasonable and Prudent Alternative (RPA) of the 2000 FCRPS Biological Opinion has been summarized in the 2001, 2002, and 2003 annual progress reports as well as within the Action Agencies' 2003 Check-in Report. Progress in achieving the performance goals of the 2000 Biological Opinion has already been achieved. Key achievements since 2000 which are accruing increased juvenile and adult fish survival benefits in the hydro system over time are summarized below.

- Adult passage survival goals exceeded - Adult Snake River Spring / Summer Chinook, Snake River Fall Chinook and Snake River Steelhead have survived passage through the FCRPS at rates exceeding the Biological Opinion goals in 2001-2003 and is equivalent to natural (pre-dam) survival rates. Exceeding the adult survival standard yield will increase juvenile production and thereby contribute to increased juvenile survival in subsequent years. Other than the maintenance of adult passage facilities, no further adult passage improvements appear to be needed.

- VarQ flood control operation and Libby December 31 variable draft operations implemented – VarQ flood control operations at Libby and Hungry Horse Reservoirs have been implemented on an interim basis since 2003, as well as the variable December 31 draft curves at Libby project, which were first utilized in 2004. These operations should increase the probability of achieving refill at Libby and Hungry Horse Reservoirs and thereby improve the ability to meet the spring and summer flow targets.

- The Bureau of Reclamation has augmented summer flows in the Lower Snake River each year since 2000 – The following flow augmentation volumes have been provided since 2000.

2000 Upper Snake Flow Augmentation	340 kaf
2001 Upper Snake Flow Augmentation	90 kaf
2002 Upper Snake Flow Augmentation	289 kaf
2003 Upper Snake Flow Augmentation	273 kaf
2004 Upper Snake Flow Augmentation	300 kaf (estimate)

- Transmission system constraints to Biological Opinion spill remedied – BPA has begun construction on the transmission lines called for in the 2000 Biological Opinion. Spill constraints will cease to be an obstacle in the 2004/2005 timeframe.

- The 2000 Biological Opinion spring and summer spill programs were implemented – The action agencies have implemented the Biological Opinion spill passage provisions each year with the exception of 2001 when a regional power emergency (permitted under the Biological Opinion) was declared.

- Dworkshak Reservoir has been drafted to provide summer cooling water in the Lower Snake – Biological Opinion recommendations for summer drafting at Dworshak have been followed each year since 2000. Heating and filter enhancements at the Dworshak National Fish Hatchery were completed in 2003, which enables continued cool water drafting from Dworshak without adverse effects on hatchery production.

- Substantial progress has been made on the development of surface passage technologies since 2000 - A Removable Spillway Weir (RSW) was built and tested at Lower Granite in 2002-2003. The Lower Granite RSW has been demonstrated to enhance in-river fish survival at reduced operational costs. An RSW will be built at Ice Harbor Dam for use in 2005. Plans for more RSWs at the remaining Snake River dams and McNary Dam are also being developed. In addition, a corner collector was installed at Bonneville Dam Second Powerhouse in 2003. Survival tests were conducted in 2004 and more tests are planned in 2005. Depending on the outcome of these tests the corner collector technology may be applied at other Columbia River dams. A spill wall and bulk spill program was developed and tested at The Dalles Dam, and initial survival tests were encouraging. These efforts have positioned the Action Agencies well to respond to the growing regional interest in increased reliance on RSW/surface passage technologies.

- Chum spawning and rearing flows have been provided (below Bonneville Dam) – Chum spawning operations have been provided each year since 2001 and adult spawning numbers have increased dramatically each year since 2001.

- Project passage research has been heavily funded since 2000 - Action Agency research on juvenile passage survival through the hydro system has been heavily funded. Research funding in 2003 and 2004 has exceeded $30 million. Improved spill operations were developed at Ice Harbor and Lower Monumental dams. At The Dalles Dam, research studies led to the development of the bulk spill/spill wall approach on the northern edge of the spillway. Studies at Bonneville Dam have led to giving generating priority to the Bonneville 2nd Powerhouse, which has also reduced adult fallback at the project. Research at John Day and McNary dams is also expected to reveal methods to improve juvenile passage survival at those projects.

- Operation and maintenance funding has increased substantially since 2000 – O&M annual funding for fish passage facilities has increased from $31.5 million in 2000 to $40.1 million in 2003. Examples of O&M projects that enhance juvenile passage survival are the stilling basin repair at Lower Monumental Dam, the stilling basin repair at The Dalles, and repairs to spill gate hoists at McNary Dam.

- Predator control programs have been implemented since 2000 – The Northern Pikeminnow control program has been implemented each year since 2000. This program was expanded in 2002 and 2004. Annual reductions in pikeminnow populations have already substantially reduced smolt predation and will further reduce losses in future years. Tern predation has been reduced since the 2000 Biological Opinion. The tern colony was relocated and an EIS that evaluates long-term management options has been developed.

6.2.3 Performance Standards, Annual Reports, and Comprehensive Evaluations

The 2000 FCRPS BiOp RPA included annual reports of progress toward achieving performance standards, annual plans for implementation during subsequent one- and five-year periods, and "mid-point evaluations" in 2003, 2005, and 2008 to ensure that required measures were implemented and effective. The Action Agencies have modified these processes to reflect NOAA Fisheries' new assessment of the effects of the proposed action in Section 6.0, the new proposed implementation schedule, duration of this Opinion, and the updated activities in the Updated Proposed Action (UPA).

6.2.3.1 Annual Implementation Plans

The Action Agencies propose to continue preparing implementation plans to document the specific strategies, priorities, actions, measurable targets, and timetables that they intend to meet. NOAA Fisheries agrees that implementation plans are a useful tool for planning, adaptive management, and accountability under this BiOp. NOAA Fisheries will review Implementation Plans each year. As a matter of course, NOAA Fisheries will not issue formal annual Findings Reports, which are more appropriate when the Action Agencies are implementing an RPA recommended by NOAA Fisheries rather than their own UPA. However, NOAA Fisheries will review and will inform the Action Agencies if an annual Implementation Plan appears inconsistent with the UPA that was evaluated in this Opinion.

The Action Agencies propose to employ an adaptive management framework for adjusting the proposed action to respond to new information. To guide this process, especially during development of the annual Water Management Plan, the Action Agencies propose that any adjustments to the proposed action described in this Opinion will be in accordance with a hydro operations performance standard for juvenile survival.

6.2.3.1.1 Hydro Operations Juvenile Performance Standard for Annual Planning. The hydro operations performance standard for juvenile survival is to equal or exceed, in any given year, the level of juvenile survival that would otherwise occur if the specific hydro operations described in the Action Agencies' UPA were carried out as described. Estimates of these effects (means and ranges of in-river and system survival) are displayed in Tables 6.5 and 6.6. Because the juvenile survival rate varies annually, the performance standard, as displayed in Tables 6.5 and 6.6, reflects a range of anticipated survival rates. This performance standard could be satisfied by alternative hydro operations from those proposed in the UPA, or a combination of alternative hydro operations and qualifying non-hydro actions. For the purpose of meeting this performance standard, the Action Agencies can receive credit for non-hydro actions that are 1) in

addition to the non-hydro actions described in the UPA or in the Incidental Take Statement (Section 10.0), or 2) non-hydro actions described in the UPA or the Incidental Take Statement (Section 10.0) that result in estimated benefits in excess of those expected or relied upon in this Opinion, but only to the extent that such benefits exceed the benefits expected or relied upon.

In the case of an action agency proposal to implement a different operation than is described in the proposed action, compliance with the hydro operations performance standard will be determined on a prospective basis using the SIMPAS model and flow-survival relationships as determined by NOAA Fisheries and as updated using the best available scientific information. The modeling will be based on expected runoff and passage conditions for the year or years in which the modified hydro operation would be implemented. In the event that this modeling predicts that the alternative hydro operations, plus such non-hydro actions that qualify for crediting, will equal or exceed the level of juvenile survival that would otherwise occur if the hydro operation in the updated proposed action were carried out, the hydro operations performance standard for juvenile survival will be satisfied by the alternative hydro operation and qualifying non-hydro actions.

(NOAA Fisheries and the Northwest Power and Conservation Council are jointly sponsoring a symposium this fall to examine the state of the science regarding the relationship between flow and survival for juvenile migrants. NOAA Fisheries expects the outcome of this symposium to further inform the flow-survival relationships used in evaluating these alternative actions.)

6.2.3.2 Annual Progress Reports

The Action Agencies propose to continue preparing Progress Reports each year to document the activities implemented to date, estimates of juvenile and adult survival through the FCRPS, and progress towards meeting programmatic level performance targets for offsetting actions. The Action Agencies also propose to report on adult abundance and trends in adult abundance for listed ESUs in the action area. NOAA Fisheries agrees that these reports will be useful for confirming assumptions applied in the analyses included in this biological opinion (Section 6) and for tracking authorized incidental take associated with the proposed action (Section 10). This information will also be useful for NOAA Fisheries to evaluate whether new information reveals effects of the action that may affect listed species in a way that was not previously considered (Section 12).

The Action Agencies propose to include in the Annual Progress Reports post-season evaluations of juvenile in-river and system survival, based on empirical reach survival estimates. If the Annual Implementation Plan included pre-season estimates of the expected survival rates resulting from alternative hydro operations from those in the UPA, the post-season estimates will be compared with the pre-season estimates. This information will then be available to inform, and, if necessary, adjust accordingly, the next year's Annual Implementation Plan.

6.2.3.3 Comprehensive Evaluations in 2007 and 2010

The Action Agencies propose to produce comprehensive evaluations of programmatic progress in 2007 and again in 2010. These check-in reports will also serve as the annual progress report

for the year in which they are provided. Each comprehensive evaluation will primarily focus on the following programmatic performance targets to determine whether cumulative implementation of actions remains consistent with the objectives in this biological opinion. It is appropriate that these evaluations replace the 2005 and 2008 check-ins called for in the 2000 RPA in light of the review this remand biological opinion is providing, based on the best science now available in 2004.

6.2.3.3.1 Hydro Operations Juvenile Performance Standard. The Action Agencies propose a hydro operations performance standard for juvenile survival that equals or exceeds the levels of juvenile in-river and system survival displayed in Tables 6.5 and 6.6, unless replaced by an equivalent combination of hydro operations and non-hydro mitigation actions through the Annual Implementation Plans (see above). This is essentially the same juvenile survival standard that will be evaluated prospectively for development of the Annual Implementation Plan. However, for purposes of the comprehensive evaluations, it will be evaluated retrospectively as the mean and range of recent survival rate estimates.

6.2.3.3.2 Hydro Operations Adult Performance Standard. The Action Agencies propose a hydro operations performance standard for adult survival that equals or exceeds the level of adult survival in Table 1 of Attachment 4 of Appendix D of this biological opinion. These are the adult survival levels that have occurred in recent years. Because the level of adult survival is subject to variation, the performance standard, as displayed in Table 1 of Attachment 4 of Appendix D, reflects a range of anticipated survival. It will be evaluated as the mean and range of survival rates estimated in the most recent 3-5 year period for the comprehensive evaluations.

6.2.3.3.3 Remaining Difference between Reference Hydro and Proposed Hydro Operations. In order to avoid the possibility that annual survival differences between the reference operation and the proposed hydro operation will constitute an appreciable reduction in the likelihood of an ESU's survival and recovery, the Action Agencies proposed to compensate for any differences with a combination of proposed non-hydro mitigation actions. The general magnitude of the expected effects of the non-hydro mitigation program (VL, L, M, H) is defined for each element of the program in 2004 and 2010 in Table 6.9. For the 2007 comprehensive evaluation, intermediate values would be expected. To aid in this evaluation, the following information will be reviewed.

Northern Pikeminnow Reduction Program Performance Standard. The Action Agencies propose an average annual exploitation rate of 16% as a programmatic performance standard, as well as:

- annual effort is consistent with that assumed in the biological opinion
- study results indicate improved survival of each listed ESU, consistent with assumptions in the biological opinion

Avian Predation Reduction Performance Standard. The Action Agencies propose:

- annual effort is consistent with that assumed in the biological opinion
- study results indicate improved survival of each listed ESU, consistent with assumptions in the biological opinion

Estuary Performance Standard. The Action Agencies propose an estuary performance standard of:

- completing the specific estuary projects listed under "Estuary Actions" in the UPA
- study results indicate improved survival of each listed ESU, consistent with assumptions in the biological opinion

Tributary Performance Standard. The Action Agencies propose a tributary performance standard of:

- meeting the "cumulative metric goals" described for 2007 and 2010, which are listed for each relevant ESU in the UPA.
- study results indicate improved survival of each listed ESU, consistent with assumptions in the biological opinion

Hatchery Performance Standard. The Action Agencies propose a hatchery performance standard of:

- effects consistent with assumptions in the biological opinion

The Action Agencies propose that, should the comprehensive evaluations in 2007 or 2010 indicate a shortfall in progress relative to programmatic or biological performance standards, additional elements to improve survival will be incorporated into the most current annual implementation plan in order to achieve the effects anticipated in this biological opinion. NOAA Fisheries agrees that this approach helps to reduce the uncertainty associated with implementation of some aspects of the proposed action. These cumulative evaluations also will be useful for confirming assumptions applied in the analyses included in this biological opinion (Section 6) and for tracking authorized incidental take associated with the proposed action (Section 10). This information will also be useful for NOAA Fisheries to evaluate whether new information reveals effects of the action that may affect listed species in a way that was not previously considered (Section 12).

6.3 SNAKE RIVER SPRING/SUMMER CHINOOK SALMON

6.3.1 Effect of Proposed Hydro Operations

6.3.1.1 Effects of Proposed Hydro Operations on Mainstem Habitat Conditions, Including in the Estuary and Plume

As described in Section 6.2, proposed hydro operations are expected to produce only a minor difference in effects on habitat function with respect to water quantity, water velocity, and water quality during the spring period when juvenile and adult SR spring/summer chinook salmon migrate through the action area. This is because there is little difference in spring flows resulting from reference and proposed operations (Table 6.3; Appendix D) and because both operations restrict voluntary spill to levels that do not produce harmful dissolved gas levels. The proposed operation does have lower functioning juvenile migration habitat with respect to safe passage

past barriers by reducing spill levels from those in the reference operation. However, as described in more detail below, this reduction only affects in-river survivals and the effect on total system survival is minimal (an approximate average difference of only 1.5%).

Table 6.5. Estimated average juvenile and adult survival rates over 1994-2003 study period through the FCRPS under the 2004 proposed hydro operation.

ESU	Estimated Juvenile In-river Survival Rate	Estimated Juvenile System Survival Rate (including latent effects)	Estimated Adult Survival Rate
SR Spring/Summer Chinook Salmon	47.7% (33.2% to 58.1%)	51.1% (46.7% to 53.5%)	86.1% (75.0% to 93.6%)
SR Fall Chinook Salmon[3]	14.4% (9.1% to 22.9%)	N/A	80.0% (no range avail.)
UCR Spring Chinook Salmon	64.0% (48.3% to 74.8%)	N/A	90.1% (85.9% to 88.7%)
LCR Chinook:			
Gorge Fall MPGs[4]	85.9% (77.3% to 97.2%)	N/A	97.3% (no range avail.)
Gorge Spring MPGs[5]	88.8% (83.6% to 93.0%)	N/A	98.2% (no range avail.)
Below BON Dam MPGs	N/A	N/A	N/A
UWR Chinook Salmon	N/A	N/A	N/A
SR Steelhead	30.4% (9.7% to 40.9%)	49.7% (43.3% to 55.2%)	89.3% (88.6% to 89.9%)
UCR Steelhead	45.6% (21.7% to 57.7%)	N/A	92.8% (90.3% to 95.2%)
MCR Steelhead:[6]			
Passing MCN-BON	45.6% (21.7% to 57.7%)	N/A	94.7% (no range avail.)
Passing JDA-BON	53.9% (29.8% to 67.6%)	N/A	95.9% (no range avail.)
From JDA Dam-BON	67.1% (42.0% to 88.3%)	N/A	95.9% (no range avail.)
Passing TDA-BON	70.3% (43.9% to 92.3%)	N/A	97.2% (no range avail.)
Passing BON Dam	83.8% (64.0% to 97.3%)	N/A	98.6% (no range avail.)

[3] The estimated juvenile survival rates shown in this table are only for those SR fall chinook that remain in-river for their entire juvenile migration and are not transported.
[4] Estimated adult survival rates for LCR (fall) chinook salmon are based on per-project survival rate of SR fall chinook salmon.
[5] Estimated adult survival rates for LCR (spring) chinook salmon are based on per-project survival rate of SR spring/summer chinook salmon.
[6] Estimated adult survival rates for MCR steelhead are based on per-project survival rate of SR steelhead.

Table 6.5. Estimated average juvenile and adult survival rates over 1994-2003 study period through the FCRPS under the 2004 proposed hydro operation (continued).

ESU	Estimated Juvenile In-river Survival Rate	Estimated Juvenile System Survival Rate (including latent effects)	Estimated Adult Survival Rate
LCR Steelhead:[7] Passing BON Dam	83.8% (64.0% to 97.3%)	N/A	98.6% (no range avail.)
Below BON Dam	N/A	N/A	N/A
UWR Steelhead	N/A	N/A	N/A
CR Chum	N/A	N/A	N/A
SR Sockeye	N/A	N/A	85.7% (84.6% to 86.8%)
LCR Coho[8]	N/A	N/A	97.3% (no range avail.)

Table 6.6. Estimated average juvenile and adult survival rates over 1994-2003 study period through the FCRPS under the 2010-2014 proposed hydro operation.

ESU	Estimated Juvenile In-river Survival Rate	Estimated Juvenile System Survival Rate (including latent effects)	Estimated Adult Survival Rate
SR Spring/ Summer Chinook Salmon	51.7% (36.2% to 63.6%)	52.0% (47.9% to 55.3%)	86.1% (75.0% to 93.6%)
SR Fall Chinook Salmon[9]	15.6% (9.9% to 24.9%)	N/A	80.0% (no range avail.)
UCR Spring Chinook Salmon	67.7% (51.4% to 79.1%)	N/A	90.1% (85.9% to 88.7%)
LCR Chinook: Gorge Fall MPGs[10]	86.0% (77.4% to 97.3%)	N/A	97.3% (no range avail.)
Gorge Spring MPGs[11]	89.1% (83.7% to 93.5%)	N/A	98.2% (no range avail.)
Below BON Dam MPGs	N/A	N/A	N/A
UWR Chinook Salmon	N/A	N/A	N/A
SR Steelhead	32.9% (10.4% to 45.1%)	50.1% (43.4% to 55.3%)	89.3% (88.6% to 89.9%)

[7] Estimated adult survival rates for LCR steelhead are based on per-project survival rate of SR steelhead.
[8] Estimated adult survival rates for LCR coho salmon are based on per-project survival rate of SR fall chinook salmon.
[9] The estimated juvenile survival rates shown in this table are only for those SR fall chinook that remain in-river for their entire juvenile migration and are not transported.
[10] Estimated adult survival rates for LCR (fall) chinook salmon are based on per-project survival rate of SR fall chinook salmon.
[11] Estimated adult survival rates for LCR (spring) chinook salmon are based on per-project survival rate of SR spring/summer chinook salmon.

Table 6.6. Estimated average juvenile and adult survival rates over 1994-2003 study period through the FCRPS under the 2010-2014 proposed hydro operation (continued).

ESU	Estimated Juvenile In-river Survival Rate	Estimated Juvenile System Survival Rate (including latent effects)	Estimated Adult Survival Rate
UCR Steelhead	48.3% (23.0% to 60.9%)	N/A	92.8% (90.3% to 95.2%)
MCR Steelhead:[12]			
Passing MCN-BON	48.3% (23.0% to 60.9%)	N/A	94.7% (no range avail.)
Passing JDA-BON	55.4% (30.4% to 69.4%)	N/A	95.9% (no range avail.)
From JDA Dam-BON	69.0% (42.9% to 90.4%)	N/A	95.9% (no range avail.)
Passing TDA-BON	71.4% (44.4% to 93.6%)	N/A	97.2% (no range avail.)
Passing BON Dam	84.3% (64.1% to 97.6%)	N/A	98.6% (no range avail.)
LCR Steelhead:[13]			
Passing BON Dam	84.3% (64.1% to 97.6%)	N/A	98.6% (no range avail.)
Below BON Dam	N/A	N/A	N/A
UWR Steelhead	N/A	N/A	N/A
CR Chum	N/A	N/A	N/A
SR Sockeye	N/A	N/A	85.7% (84.6% to 86.8%)
LCR Coho[14]	N/A	N/A	97.3% (no range avail.)

[12] Estimated adult survival rates for MCR steelhead are based on per-project survival rate of SR steelhead.
[13] Estimated adult survival rates for LCR steelhead are based on per-project survival rate of SR steelhead.
[14] Estimated adult survival rates for LCR coho salmon are based on per-project survival rate of SR fall chinook salmon.

Table 6.7. Summary of effects of proposed hydro operations and 2004 system configuration on listed ESUs. Proportional survival difference expressed as (Proposed - Reference) ÷ Reference.

ESU	Relative Juvenile In-river Survival Difference	Relative Juvenile System Survival Difference (including latent effects)	Adult Survival Difference	Total Relative Survival Difference (juvenile system survival and adult survival)	Habitat Effects	Qualitative Effect Category
SR Spring/ Summer Chinook Salmon	-7.4% (-9.5 to -2.6%) Absolute Difference: -3.8% (-5.5 to -1.6%)	-1.5% (-3.7 to -0.1%) Absolute Difference: -0.8% (-1.7 to -0.1%)	None	-1.5% Absolute Difference: -0.8%	Minor or no differences in mainstem and below-BON estuary and plume habitat are expected, because the proposed action spring flows are very similar to the reference operation flows. Safe passage through barriers is significantly lower, based on the juvenile in-river survival estimate, most likely as a result of less spill. Little or no difference in water quality is expected.	Low
SR Fall Chinook Salmon	-12.7% (-22.3 to -15.0%) Absolute Difference: -2.1% (-3.3 to -0.8%	N/A	None	N/A	Difference in mainstem and below-BON habitat is expected, because the proposed action summer flows are considerably less than the reference operation flows. Differences in spill affect safe passage through barriers. Possible difference in water quality (increased temperature) due to much lower flows in the proposed action.	Medium

Table 6.7. Summary of effects of proposed hydro operations and 2004 system configuration on listed ESUs (continued)

ESU	Relative Juvenile In-river Survival Difference	Relative Juvenile System Survival Difference (including latent effects)	Adult Survival Difference	Total Relative Survival Difference (juvenile system survival and adult survival)	Habitat Effects	Qualitative Effect Category
UCR Spring Chinook Salmon	-6.6% (-9.0 to -2.8%) Absolute Difference: -4.1% (-7.1 to -2.1%	N/A	None	-6.6% Absolute Difference: -4.1	Same as SR spring/summer chinook, with less survival in proposed action due to higher John Day pool elevation.	Medium
UWR Chinook Salmon	N/A	N/A	N/A		Predominantly yearlings, but also some subyearling migrants. For yearlings, same mainstem habitat effects (minor) as for SR spring/summer chinook. For subyearlings, same as or possibly greater effects than for SR fall chinook for subyearlings. Reduced estuarine rearing habitat in summer for populations with small subyearling smolts.	Very Low

Table 6.7. Summary of effects of proposed hydro operations and 2004 system configuration on listed ESUs (continued)

ESU	Relative Juvenile In-river Survival Difference	Relative Juvenile System Survival Difference (including latent effects)	Adult Survival Difference	Total Relative Survival Difference (juvenile system survival and adult survival)	Habitat Effects	Qualitative Effect Category
LCR Chinook Salmon	Yearling populations above BON: -0.9% (-3.3 to +0.1%) Absolute Difference: -0.8% (-3.1 to +0.1%)	N/A	0	Yearling populations above BON: -0.9% Absolute Difference: -0.8%	Same as SR spring/summer chinook (minor) for yearlings from populations that spawn above Bonneville (1 of 3 extant spring-run populations in 1 of 6 MPGs).	Very Low for 2 populations in 1 MPG (Cascade Spring-run) below BON.
	Subyearling populations above BON: -1.5% (-2.5 to -0.2%) Absolute Difference: -1.3% (-2.1 to -0.2%)			Subyearling populations above BON: -1.5% Absolute Difference: -1.3%	Same (or possibly greater) mainstem habitat effects as SR fall chinook for subyearlings from fall-run populations that spawn above BON (2 of 20 fall-run populations in 1 of 6 MPGs).	Low for Upper Gorge, Hood, and Big White Salmon fall-run populations in 1 (Gorge fall-run) MPG above BON.
	Populations that spawn below BON: no difference			Populations that spawn below BON: no difference	Less estuarine rearing habitat for summer subyearling migrants from all fall-run populations.	Low for 1 (Hood) spring-run pop in 1 MPG (Gorge spring-run) above BON. Based on habitat, Low for fall-run populations in 3 fall-run MPGs below BON.

Table 6.7. Summary of effects of proposed hydro operations and 2004 system configuration on listed ESUs (continued)

ESU	Relative Juvenile In-river Survival Difference	Relative Juvenile System Survival Difference (including latent effects)	Adult Survival Difference	Total Relative Survival Difference (juvenile system survival and adult survival)	Habitat Effects	Qualitative Effect Category
SR Steelhead	-8.4% (-29.3 to -1.0%) Absolute Difference: -2.8% (-5.1 to -0.4%)	-0.2% (-1.8 to +1.3%) Absolute Difference: -0.1% (-0.8 to +0.7%	None	-0.2% Absolute Difference: -0.1%	Same as SR spring/summer chinook.	Low (Same rationale as SR sp/sum chinook)
UCR Steelhead	-8.9% (-25.3 to -1.1%) Absolute Difference: -4.3% (-7.3 to -0.6%	N/A	0	-8.6% Absolute Difference: -2.8%	Same as SR spring/summer chinook.	Medium

Table 6.7. Summary of effects of proposed hydro operations and 2004 system configuration on listed ESUs (continued)

ESU	Relative Juvenile In-river Survival Difference	Relative Juvenile System Survival Difference (including latent effects)	Adult Survival Difference	Total Relative Survival Difference (juvenile system survival and adult survival)	Habitat Effects	Qualitative Effect Category
MCR Steelhead	Populations migrating through **4 dams:** -8.8% (-24.7 to -1.1%) Absolute Diff.: -5.2% (-9.86 to -0.7%) **3 dams:** -0.5% (-2.6 to +4.5%) Absolute Diff.: -0.4% (-2.1 to +3.8%) **2 dams:** 0% (-2.0 to +5.0%) Absolute Diff.: -0.0% (-1.8 to +4.4) **1 dam:** -0.3% (-1.3 to +2.3%) Absolute Diff.: -0.2% (-1.0 to +2.2%)	N/A	0	4 dams: -8.8% for 5 populations in 2 MPGs Absolute Diff.: -5.2% 3 dams: -0.5% for 7 populations in 3 MPGs Absolute Diff.: -0.4% 2 dams: 0% for 2 populations in 1 MPG Absolute Diff.: -0.0%	Same as SR spring/summer chinook.	Low for 7 populations in 3 MPGs that spawn between McNary and John Day dams. Medium for 3 populations in 2 MPGs that spawn upstream of McNary Dam. Low for 2 populations in 1 MPG that spawns downstream of John Day Dam.

Table 6.7. Summary of effects of proposed hydro operations and 2004 system configuration on listed ESUs (continued)

ESU	Relative Juvenile In-river Survival Difference	Relative Juvenile System Survival Difference (including latent effects)	Adult Survival Difference	Total Relative Survival Difference (juvenile system survival and adult survival)	Habitat Effects	Qualitative Effect Category
UWR Steelhead	N/A	N/A	0	N/A	Estuary and plume habitat effects minor, because little difference in flows.	Very Low
LCR Steelhead	Populations migrating through 1 dam: -0.3% (-1.3 to +2.3%) Absolute Difference: -0.2% (-1.0 to +2.2%)	N/A	0	-0.3% for 3 of 20 populations in 2 of 4 MPGs Absolute Difference: -0.2% No difference for the other 17 populations	Same as SR spring/summer chinook	Low for 4 populations in 2 MPGs that migrate through Bonneville pool and dam Very Low for 16 populations that spawn below BON
CR Chum Salmon	N/A, if chum spawn above Bonneville Dam, but some juveniles migrate through 1 Dam: possibly ~-1.5% survival	N/A	0	~-1.5% if there is an extant population above Bonneville Dam No difference for 7 populations in 3 MPGs	Should have better spawning and rearing habitat, because fall/winter flows higher than in reference operation. Effects on juvenile migration and rearing habitat similar to SR fall chinook, but possibly more significant because of smaller smolt size and greater reliance on estuarine rearing.	Low (for all populations, because juvenile rearing habitat reduced by low summer flows and higher temperatures, although spawning and incubation improved by higher fall/winter flows

Table 6.7. Summary of effects of proposed hydro operations and 2004 system configuration on listed ESUs (continued)

ESU	Relative Juvenile In-river Survival Difference	Relative Juvenile System Survival Difference (including latent effects)	Adult Survival Difference	Total Relative Survival Difference (juvenile system survival and adult survival)	Habitat Effects	Qualitative Effect Category
SR Sockeye Salmon	N/A, assumed to be slightly greater than the difference for SR spring/summer chinook and SR steelhead	N/A	0	Assumed to be slightly greater than the difference for SR spring/summer chinook and SR steelhead	Assumed similar to SR spring/summer chinook and SR steelhead	Low
LCR Coho Salmon	N/A, but expected to be similar to yearling-type LCR chinook for populations above BON: -0.9% (-3.3 to +0.1%) No change for all other pops	N/A	0	If similar to yearling-type LCR chinook - 0.9% for 2 populations in 1 MPG No difference for 19 populations in 3 MPGs	Similar to SR spring/summer chinook (minor) for populations that spawn above Bonneville	Low for Upper Gorge and Hood River populations in the Gorge MPG Very Low for remaining 19 populations in 3 MPGs (including 1 below-BON population in the Gorge MPG)

Table 6.8. Summary of effects of proposed hydro operations and expected 2010 system configuration improvements on listed ESUs. These effects may be further reduced from 2010-2014 by additional hydro system improvements. Proportional survival change expressed as (Proposed - Reference) ÷ Reference.

ESU	Relative Juvenile In-river Survival Difference	Relative Juvenile System Survival Difference (including latent effects)	Relative Adult Survival Difference	Total Relative Survival Difference (juvenile system survival and adult survival)	Habitat Effects	Qualitative Effect Category
SR Spring/ Summer Chinook Salmon	+0.5% (-1.9 to +6.7%) Absolute Difference: +0.2% (-0.8% to +4.0%)	-0.3% (-0.8 to +2.6%) Absolute Difference: +0.2% (-0.4% to +1.4%)	None	-0.3% Absolute Difference: +0.2%	Minor or no change in mainstem and below-BON estuary and plume habitat is expected, because the 2010 proposed action spring flows are similar to the reference operation flows. Safe passage through barriers improves, based on the juvenile in-river survival estimate, most likely as a result of installation of RSWs and other passage improvements. Little or no change in water quality is expected.	Very Low
SR Fall Chinook Salmon	-5.4% (-15.5 to +2.4%) Absolute Difference: -0.9% (-2.5 to +0.6%)	N/A	None	-5.4% Absolute Difference: -0.9%	Change in mainstem and below-BON habitat expected, because the 2010 proposed action summer flows are considerably less than the reference operation flows. Changes in spill affect safe passage through barriers, although some dam passage improvements improve in-river survival slightly. Possible change in water quality (increased temperature) due to much lower flows in the proposed action.	Medium

Table 6.8. Summary of effects of proposed hydro operations and expected 2010 system configuration improvements on listed ESUs (continued)

ESU	Relative Juvenile In-river Survival Difference	Relative Juvenile System Survival Difference (including latent effects)	Relative Adult Survival Difference	Total Relative Survival Difference (juvenile system survival and adult survival)	Habitat Effects	Qualitative Effect Category
UCR Spring Chinook Salmon	-1.2% (-3.4 to +2.8%) Absolute Difference: -0.9% (-2.5 to +2.2%	N/A	None	-1.2% Absolute Difference: -0.9%	Same as SR spring/summer chinook, with slightly improved survival in 2010 proposed action due to McNary RSW and dam passage improvements in lower Columbia.	Medium
UWR Chinook Salmon	N/A	N/A	N/A	N/A	Predominantly yearlings, but also some subyearling migrants. Same as SR spring/summer chinook (minor) for yearlings. Same as or possibly greater mainstem habitat effects than SR fall chinook for subyearlings. Reduction in estuarine rearing habitat in summer for all populations with small subyearling smolts.	Very Low

Table 6.8. Summary of effects of proposed hydro operations and expected 2010 system configuration improvements on listed ESUs (continued)

ESU	Relative Juvenile In-river Survival Difference	Relative Juvenile System Survival Difference (including latent effects)	Relative Adult Survival Difference	Total Relative Survival Difference (juvenile system survival and adult survival)	Habitat Effects	Qualitative Effect Category
LCR Chinook Salmon	Yearling populations above BON: -0.5% (-2.0 to +0.3%) Absolute Difference: -0.4% (-1.9 to +0.3%) Subyearling populations above BON: -1.4% (-2.4 to -0.1%) Absolute Difference: -1.2% (-2.9 to -0.1%) Populations that spawn below BON: no change	N/A	None	Yearling populations above BON: -0.5% Absolute Difference: -0.4% Subyearling populations above BON: -1.4% Absolute Difference: -1.2% Populations that spawn below BON: no change	Same as SR spring/summer chinook (minor) for yearlings from populations that spawn above Bonneville, with some survival improvements at Bonneville Dam. Same (or possibly greater) mainstem habitat effects as SR fall chinook for subyearlings from fall-run populations that spawn above BON (2 of 20 fall-run populations in 1 of 6 MPGs). Reduction in estuarine rearing habitat in summer subyearling migrants from all fall-run populations.	Very Low for 2 populations in 1 MPG (Cascade Spring run) below BON. Low for Upper Gorge, Hood, and Big White Salmon fall-run populations in 1 Gorge fall-run MPG above BON. Low for 1 (Hood) spring-run pop in 1 MPG (Gorge spring-run) above BON. Based on habitat, Low for fall-run populations in 3 fall-run MPGs below BON.

Table 6.8. Summary of effects of proposed hydro operations and expected 2010 system configuration improvements on listed ESUs (continued)

ESU	Relative Juvenile In-river Survival Difference	Relative Juvenile System Survival Difference (including latent effects)	Relative Adult Survival Difference	Total Relative Survival Difference (juvenile system survival and adult survival)	Habitat Effects	Qualitative Effect Category
SR Steelhead	-0.7% (-23.8 to -9.0%) Absolute Difference: -0.2% (-3.3 to +3.0%)	+0.7% (-1.6 to +1.7%) Absolute Difference: +0.3 (-0.7 to 0.8%)	None	+0.7% Absolute Difference: +0.3%	Same as SR spring/summer chinook, except system survival in 2010 proposed action decreased due to installation and use of RSWs, while in-river survival decreased slightly.	Very Low (Same rationale as SR sp/sum chinook)
UCR Steelhead	-3.1% (-20.5 to +5.1%) Absolute Difference: -1.5% (-5.9 to +2.8%)	N/A	None	-3.1% Absolute Difference: -1.5%	Same as SR spring/summer chinook.	Medium

Table 6.8. Summary of effects of proposed hydro operations and expected 2010 system configuration improvements on listed ESUs (continued)

ESU	Relative Juvenile In-river Survival Difference	Relative Juvenile System Survival Difference (including latent effects)	Relative Adult Survival Difference	Total Relative Survival Difference (juvenile system survival and adult survival)	Habitat Effects	Qualitative Effect Category
MCR Steelhead	Populations migrating through **4 dams:** -6.2% (-23.0 to +2.1%) Absolute Difference: -3.7% (-9.1 to +1.3%) **3 dams:** +2.2% (-2.7 to +4.4%) Absolute Diff.: +1.5% (+0.1 to +6.0%) **2 dams:** +1.6% (-0.4 to +6.5%) Absolute Diff.: +1.1% (-0.4 to 5.7%) **1 dam:** -0.3% (-0.8 to +2.6%) Absolute Diff.: +0.2% (-0.7 to +2.5%	N/A	None	Populations migrating through **4 dams:** -6.2% for 5 populations in 2 MPGs Absolute Difference: -3.7% **3 dams**: +2.2% for 7 populations in 3 MPGs Absolute Diff.: +1.5% **2 dams:** +0.2% for 2 populations in 1 MPG Absolute Diff.: +1.1% **1 dam:** +0.3% Absolute Difference: +0.2%	Same as SR spring/summer chinook.	Low for 7 populations in 3 MPGs that spawn between McNary and John Day dams. Medium for 3 populations in 2 MPGs that spawn upstream of McNary Dam. Low for 2 populations in 1 MPG that spawns downstream of John Day Dam.

Table 6.8. Summary of effects of proposed hydro operations and expected 2010 system configuration improvements on listed ESUs (continued)

ESU	Relative Juvenile In-river Survival Difference	Relative Juvenile System Survival Difference (including latent effects)	Relative Adult Survival Difference	Total Relative Survival Difference (juvenile system survival and adult survival)	Habitat Effects	Qualitative Effect Category
UWR Steelhead	N/A	N/A	None	N/A	Estuary and plume habitat effects minor, because little change in flows.	Very Low
LCR Steelhead	Populations migrating through 1 dam: +0.3% (-0.8 to +2.6%) Absolute Difference: +0.2% (-0.7 to +2.5%)	N/A	None	+0.3% for 3 of 20 populations in 2 of 4 MPGs Absolute Difference: +0.2 No change for the other 17 populations	Same as SR spring/summer chinook	Low for 4 populations in 2 MPGs that migrate through Bonneville pool and dam Very Low for 16 populations that spawn below BON
CR Chum Salmon	N/A, if chum spawn above Bonneville Dam, but some juveniles migrate through 1 Dam: possibly ~ -1.4% survival	N/A	None	~ -2.52 if there is an extant population above Bonneville Dam No change for 7 populations in 3 MPGs	Should have improved spawning and rearing habitat, because fall/winter flows higher than in reference operation. Juvenile migration and rearing habitat effects similar to SR fall chinook, but possibly more significant because of smaller size and greater reliance on estuarine rearing.	Low (for all populations, because juvenile rearing habitat reduced by low summer flows and higher temperatures, although spawning and incubation improved by higher fall/winter flows

Table 6.8. Summary of effects of proposed hydro operations and expected 2010 system configuration improvements on listed ESUs (continued)

ESU	Relative Juvenile In-river Survival Difference	Relative Juvenile System Survival Difference (including latent effects)	Relative Adult Survival Difference	Total Relative Survival Difference (juvenile system survival and adult survival)	Habitat Effects	Qualitative Effect Category
SR Sockeye Salmon	N/A, assumed to range between SR spring/summer and fall chinook	N/A	None	Assumed to range between SR spring/ summer and fall chinook	Assumed similar to SR spring/ summer chinook and SR steelhead	Low-Medium (same rationale as SR sp/sum chinook)
LCR Coho Salmon	N/A, but expected to be similar to yearling-type LCR chinook for populations above BON: ~ -0.5% (~ -2.0 to +0.3%) No change for all other pops Absolute Difference: -0.4% (-1.9 to +1.3%)	N/A	none	If similar to yearling-type LCR chinook -~- 0.5% for 2 populations in 1 MPG Absolute Difference: -1.9% No change for 19 populations in 3 MPGs	Similar to SR spring/summer chinook (minor) for populations that spawn above Bonneville	Low for Upper Gorge and Hood River populations in the Gorge MPG Very Low for remaining 19 populations in 3 MPGs (including 1 below-BON population in the Gorge MPG)

Proposed hydro operations are expected to have only a minor effect on the quantity and quality of juvenile migration and rearing habitat in the Columbia River estuary and plume during the spring, when SR spring/summer chinook salmon are in these areas. Again, this is because the proposed hydro operation will result in only slightly lower spring flows than in the reference operation, and water quality is unlikely to be affected. As a result, there should be little difference in juvenile migration time through the estuary, predation rates by birds, or in the shape and extent of the Columbia River plume. Yearling chinook salmon have a very low reliance on shallow-water rearing habitat in the Columbia River estuary (Fresh *et al.* 2004). There is likely to be only a minor difference in the amount of shallow-water habitat available to SR spring/summer chinook juveniles based on the small difference in flow between the proposed hydro operation and the reference operation.

6.3.1.2 Effect of Proposed Hydro Operations on Juvenile and Adult Mainstem Reach Survival

6.3.1.2.1 Effect of Proposed Hydro Operations and 2004 System Configuration. The Action Agencies have proposed delaying the date when SR spring chinook fish are collected and transported until after April 15. Prior to that date, all fish collected would be returned to the river. This change is consistent with current research information that indicates there is typically no benefit provided from transportation during the month of April for wild juvenile SR spring chinook (Williams *et al.* 2004). Although, on an average annual basis, transportation has not been shown to provide any increase in adult returns relative to wild fish that migrated in-river, recent data has shown that transport benefits improve later in the spring season (Williams et al. 2004, Anderson et al. 2004). Williams *et al.* (2004) noted that, in some years transported fish had higher average annual returns than the in-river fish, but in some years lower. Hatchery origin SR spring chinook have consistently shown a benefit from transport operations.

Balancing the potential benefits of transportation with the possible risks that this operation poses to long-term diversity of the ESU is challenging. Providing both spill and transportation is a method to balance the potential risks that might arise from relying solely on transportation as a management tool. Spill reduces the percentage of fish transported and increases the survival of the fish migrating in-river. The reference operation provided spill through the month of April in years when the average seasonal flow at Lower Granite Dam was projected to be between 70 to 85 kcfs, and terminated spill on May 1 during these relatively low runoff years. The proposed action provided no spill when the seasonal flow was projected to be less than 85 kcfs. The 70 kcfs threshold was chosen to reflect a breakpoint where in-river survival benefits exist for spring juvenile migrants. This breakpoint may also be associated with increasing water temperatures, which usually occur during the month of May. In the reference operation for transportation, the percentage of SR spring chinook transported during the early spring would be lower than in the proposed action, since that operation has not been demonstrated to provide a survival benefit.

SIMPAS modeling results indicate that proposed 2004 hydro system operations with present system configuration and fish passage facilities would reduce the survival of juvenile Snake River spring/summer chinook salmon that remain in-river through the Lower Granite to Bonneville reach by an average of 7.3%, with a range of 2.6 to 9.5% (Table 6.7; Appendix D). Because a large proportion of juvenile migrants are collected and transported past FCRPS dams,

there is a much smaller reduction in system survival, which includes direct survival and differential post-Bonneville survival (D) of transported fish. On average, the relative survival difference is 1.5% (Appendix D; Table 6.7) between system survival under the proposed hydro operation and the reference operation. The range of system survival estimates indicates that the proposed operation would have more significant impacts (up to a 3.7% reduction in relative survival) in some years but would also result in essentially no difference in survival (a relative difference of only -0.1 to -0.2%) in other years.

The 1.5% average relative reduction in system survival means that an average survival improvement 1.015 times greater than the current survival rate in another life stage would offset the mortality associated with the proposed hydro operations (range 1.002 to 1.038). Although the Comparative Survival Study demonstrated different D values for various stocks,, the mortality associated with the proposed hydro operations is expected to affect all populations of Snake River spring/summer chinook salmon equally, and that mortality is expected to begin immediately.

No reduction in adult survival is expected as a result of proposed hydro operations (Appendix D).

6.3.1.2.2 Effect of Proposed Hydro Operations and 2010-2014 System Configuration. Based on a survival assessment of the Action Agencies' Updated Proposed Action (August 30, 2004), NOAA Fisheries adjusted various fish passage parameters in the SIMPAS analysis to reflect proposed juvenile passage improvements expected to be implemented during the life of the biological opinion. The following narrative summarizes the major fish passage parameter changes assumed to be in effect for spring migrants in the 2010-2014 timeframe.

Turbine survivals for all dams were increased by 1 to 2% to account for operational changes resulting from the biological index testing program and tailrace egress modifications, as well as for changes in turbine design from the various powerhouse upgrade programs (e.g., McNary, Bonneville, and Ice Harbor dams). Dams undergoing turbine index testing were given a 1% survival increase while those dams with a combination of improvements were given a 2% improvement. Spillway survivals were increased at Lower Monumental, Ice Harbor and McNary dams due to the assumption that a combination of removable spill weirs (RSWs), bulk spill and improved tailrace egress would improve survivals. Because Little Goose presently has high spillway survival, no changes were made to the survival estimates. Spillway survival was also increased at The Dalles Dam to account for the continuing spillway improvement program at that project, which includes a 1% improvement for stilling basin modifications and a 1% improvement for a change in spill volume (assuming the high spill efficiencies can be maintained).

Bypass survivals were increased for McNary and John Day dams in response to proposed outfall relocation and improved tailrace egress conditions. Sluiceway survivals were increased at The Dalles and Bonneville dams for the same reason. Fish passage efficiency was increased at Bonneville Dam in response to the continuation of the fish guidance efficiency (FGE) improvement program at the second powerhouse and sluiceway efficiency was adjusted for the Bonneville Dam corner collector based on preliminary 2004 research data. RSW survivals and

efficiencies for Little Goose, Lower Monumental and McNary dams were based on empirical Lower Granite Dam RSW data and assumptions. We deviated somewhat from the Lower Granite RSW data with the McNary Dam RSW efficiency assumptions because of the higher flow levels experienced in the lower Columbia River compared to the Snake River. In this case, RSW and spill flow percentages at McNary Dam were maintained within the ranges observed at Lower Granite during the 2002 and 2003 studies. We assumed that at least four new turbines would be installed at McNary and that the powerhouse capacity would be approximately 188 kcfs. Given this we maintained McNary spill at 30% of total river flow and adjusted RSW flow to maintain approximately the same passage efficiency as calculated by the model for the RSW at Lower Granite Dam.

For SR spring/summer chinook, with expected 2010-2014 system configuration improvements described below, the relative system survival difference from the proposed action to the reference operation decreased by roughly one-half to -0.8% (range -2.8 to +0.45%) (Table 6.8; Appendix D). This 50% reduction in the system survival gap, and about a 35% reduction in the in-river survival gap, for SR spring chinook by 2010 is due largely to system configuration improvements such as: a) installation and operation of RSWs at Little Goose, Lower Monumental and McNary dams; b) various improvements in spillway, turbine and bypass survivals at several mainstem FCRPS dams.

6.3.1.3 Qualitative Characterization of All Effects of Proposed Hydro Operations

Application of the combined qualitative "habitat approach" and the quantitative "survival approach" leads NOAA Fisheries to conclude that the proposed hydro operation is likely to reduce abundance and productivity (productivity) of Snake River spring/summer chinook salmon by a **Low** amount for all populations and major population groups. It is not likely that the proposed action would reduce distribution or diversity of the ESU.

6.3.2 Effect of Non-hydro Measures

6.3.2.1 Effect of Measures to Protect, Enhance, and Restore Estuarine Habitat and to Reduce Predation in the Estuary

6.3.2.1.1 Enhance and Restore Estuarine Habitat. The Corps and BPA will continue to implement actions based on the estuary action plan in the 2000 FCRPS Biological Opinion (entitled *Action Plan to Implement the Federal Columbia River Power System Biological Opinion in the Columbia River Estuary*) and the estuary restoration approach (entitled *An Ecosystem-Based Approach to Habitat Restoration Projects with Emphasis on Salmonids in the Columbia River Estuary)* and directed at providing biological benefit to ESA-listed fish.

The Action Agencies have proposed that they will implement two habitat restoration projects in the upper estuary between Bonneville Dam and the mouth of the Columbia River, for the purpose of improving the survival of juvenile SR fall chinook (page 51 of the August 30, 2004, Updated Proposed Action). For BPA funded projects, the Action Agencies identified the status of project funding and implementation time lines by referencing the associated BPA project

proposals. For these projects, the proposed action identifies when each project will be completed (completion dates vary from 2005 to 2006).

As more acres are added and restored, the cumulative benefit of the Action Agencies' estuary program, and other regional and local efforts, could be expected to fully support the medium ranking of importance assigned to the estuary by (Fresh *et al.* 2004) for this ESU. The Northwest Fisheries Science Center is working to further refine how any acres should be encompassed in the one-third estimates of acres needed to be restored to fully achieve a program response (Kratz et al. 2004). A critical information gap and uncertainty is how to value the contribution of the proposed habitat restoration actions in the Columbia River estuary to improvements in salmon population production and viability, both for the short- and long-term. NOAA Fisheries, with support from the action agencies, has recently started programs to develop the time series of information regarding salmon use of Columbia River estuarine habitats, with the intent of reducing the uncertainty outlined above. Until that information is available, however, studies have been conducted for the past decade in the Skagit River system in Puget Sound for fall chinook salmon that could provide insight to help quantitatively value the beneficial accrual gained in juvenile salmon productivity (e.g. number of juveniles per acre of habitat) based on improving estuarine habitat. NOAA Fisheries is currently evaluating the available data to try to establish the likely range of benefit that could be achieved for Columbia River estuary restoration action. This information will potentially allow NOAA Fisheries to value the benefit of a suite of actions in the Columbia River system to improve salmon population (and ESU) productivity and viability. This information will assist in placing added context to the current benefit of the projects proposed by the Action Agencies and provide future direction on the magnitude, extent, and distribution of estuary restoration projects to be developed by the Action Agencies.

The Action Agencies propose to implement action effectiveness monitoring for each project, as well as status monitoring for the estuary as a whole as described in the final draft of the Action Agencies plan entitled, "*Research, Monitoring, and Evaluation of Salmon in the Columbia River Estuary*."

Snake River spring/summer chinook display a stream-type life history strategy (Fresh et al., 2004) which relies less on estuary habitat to sustain viability than ocean-type ESUs. Since the 2000 FCRPS Biological Opinion, the Action Agencies have developed the infrastructure to begin an estuary and RME program which focuses on the long-term benefit to ESA-listed salmonids through estuary habitat restoration. The two projects the Action Agencies have proposed in their proposed action dated August 30, 2004, are the start of this on-going program. NOAA Fisheries assigned benefits to these projects based on an examination of how these projects relate to each of the ESUs across their entire geographic ranges. The two projects, while having localized and important benefits, are still limited enough in their magnitude, extent, and distribution that a higher benefit cannot be assigned at this time. Therefore NOAA Fisheries concludes that the magnitude, extent, and distribution of the two proposed estuary actions would provide a **0 short-term** and a **0 long-term** benefit to the Snake River spring/summer chinook ESU. This level of benefit would apply to all populations and major population groups within the ESU.

6.3.2.1.2 Reduction in Caspian Tern Predation Rates in the Estuary. The Action Agencies commit to implement additional Caspian tern management actions to reduce predation of juvenile salmonids in the Columbia River estuary consistent with the preferred alternative in the forthcoming joint Corps/USFWS/NOAA Fisheries Final Environmental Impact Statement (FEIS) on Caspian tern management. This action is described in more detail in Section III.D.1 of the Updated Proposed Action.

One option to implement the Record of Decision (ROD) for the Caspian Tern FEIS, once it is signed, would rely solely on Action Agencies for implementation responsibility. The other option designates US Fish and Wildlife Service as the lead implementing agency, but the FCRPS Action Agencies could still provide funding and the Corps would continue to perform operation and maintenance activities on the nesting islands in the estuary (Rice Island, Miller Sands, and East Sand Island). Either way, the activity is appropriate for inclusion in the proposed action because the Action Agencies are either carrying it out or funding [see ESA Section 7(a)(2) (Action Agencies must consult on activities that they propose to authorize, fund or carry out)].

The draft joint Corps/USFWS/NOAA Fisheries EIS on Caspian tern management is currently available for public review and comment. The implementation schedule assumes that a Record of Decision (ROD) for the Caspian Tern EIS between the Corps and USFWS will be signed in February 2005.

Based on the projected levels of tern colony size resulting from implementation of alternatives C and D of the draft Tern EIS, NOAA Fisheries estimated the survival improvements for SR spring/summer chinook as approximately 2.3%.[15] NOAA Fisheries concludes that implementation of alternative C or D would result in a low benefit to SR spring/summer chinook. This level of benefit would apply to all populations and major population groups within the ESU. Efforts to redistribute the Columbia River estuary Caspian tern population could begin in FY05 once the federal agencies complete the final EIS and issue the Record of Decision and could begin producing results (lower predation rates) in FY06. Consequently, NOAA Fisheries anticipates that there will be no short-term benefit from these projects. Therefore, the proposed action for reducing tern predation on East Sand Island will provide **0 short-term** but **low long-term** (by 2010) survival benefits for SR spring/summer chinook salmon. This level of benefit will accrue to all populations and all major population groups in the ESU. This Opinion constitutes the consultation on the Caspian Tern relocation program

The Action Agencies commit to monitor and evaluate the response to the proposed management action and to submit annual reports of survival benefits to NOAA Fisheries. Performance metrics will include annual Caspian tern predation rates on juvenile salmonids and estimates of the resulting juvenile survival rates, although the action agencies do not describe the method(s) they will use to derive these estimates.

[15] Alternative A is the "no action" alternative and therefore its implementation would not result in lowered tern predation rates. In Alternative B, nesting habitat would not be maintained on East Sand Island. Some terns would still nest in the estuary, but the draft EIS is unable to specify how many. There is no estimate of the predation rate under Alternative B, except that it would be somewhat less than for C or D.

6.3.2.2 Effect of Measures to Protect, Enhance, or Restore Tributary Habitat

The Action Agencies have implemented a number of tributary habitat projects to benefit this ESU since the 2000 Biological Opinion was issued. As reported in the *2003 Check-in Report*, they have implemented actions that provide near-term survival improvements, including 23 barrier removals, 114 screening diversions, and four lease or purchases of in-stream flows. Long-term survival improvements are also accruing through the implementation of three conservation easements or land acquisitions to protect riparian habitat from degradation and two actions to establish riparian buffers and/or obtain long-term easements to restore riparian habitat.

In the August 30, 2004, version of the Updated Proposed Action, USBR proposed to continue a tributary habitat technical assistance program in three subbasins of the Salmon River drainage, which was instituted under the 2000 RPA (Action 149). This measure is intended to provide an additional increment of overall survival for three populations Snake River spring/summer chinook (i.e., in the Lemhi, Upper Salmon, and Little Salmon subbasins) during their spawning and rearing life stages.[16] NOAA Fisheries concludes that there is a **Medium** potential to improve spawning and rearing habitat for these three subbasins (Appendix A). USBR considered the primary limiting factors identified by NOAA Fisheries and considered its ability to implement a habitat improvement program that attempted to address those limiting factors. USBR concluded that it does not have the legal authority to implement projects that would protect riparian habitat enhancement actions. USBR has the authority to provide technical assistance to solve engineering issues affiliated with channel morphology. However, it currently does not have authority to fund the construction of such projects (authority to fund construction of instream projects has been introduced in the Congress). USBR can lease or acquire instream flows in compliance with state water law. USBR can also provide technical assistance on channel morphology and screens. Consequently, it formulated this measure as a commitment to continue its current technical assistance program across the three selected subbasins during the first 3-years of the term of this Biological Opinion and achieve the following:

- Design screens for 10 unscreened diversions across the three subbasins during the first 3 years
- Protect 20 cfs of water for instream flows
- Provide technical assistance to restore access to 54 miles of currently unoccupied habitat
- Provide technical assistance to restore 0.25 miles of channel complexity

NOAA Fisheries assumes that the technical assistance program described as the USBR's measures, along with the actions already implemented and documented in the Action Agencies ESA progress reports, will provide **very low short-term** and a **very low long-term** (by 2010) benefit to a small portion of the SR spring/summer chinook salmon ESU.[17]

[16] Absent this measure, Reclamation would be required to withdraw from its current participation in tributary habitat improvements in the Lemhi, Upper Salmon, and Little Salmon Rivers basins due to a lack of funding authority.
[17] The USBR's conservation measures will benefit only one or two of the populations in each of two of the five major population groups [South Fork Salmon River and Upper Salmon].

6.3.2.3 Effect of Artificial Propagation Measures

BPA funds a safety-net project for this ESU to reduce the extinction risk and to "buy time" for survival improvement measures to take effect. In their August 30, 2004 Updated Proposed Action, the Action Agencies commit to continue to fund these programs at appropriate levels as long as they are determined by NOAA Fisheries to be effective at reducing the short-term risk of extinction. NOAA Fisheries has determined that the safety-net program for this ESU is effective at reducing the short-term risk of extinction.

The Action Agencies also propose to complete the HGMP planning process designed to identify hatchery improvements and reforms which could affect SR spring/summer chinook salmon. However, development of the plan itself will have no direct effect on the viability of this ESU.

6.3.2.4 Effect of Measures to Reduce Fish Predation

The northern pikeminnow has been responsible for approximately 8% predation-related mortality of juvenile salmonid migrants in the Columbia River basin in the absence of the Northern Pikeminnow Management Program (NPMP) (2000 FCRPS BiOp at 9-106). The Action Agencies estimated that the ongoing NPMP, which they propose to continue, has reduced the pikeminnow predation-related mortality rate to approximately 6% (August 30, 2004, Updated Proposed Action p. 43). The Action Agencies estimate that proposed expansion of the NPMP would result in a relative improvement in survival of approximately 5.4%. The Action Agencies estimate that this reduction applies to all listed ESUs.

The ongoing NPMP is already accounted for in the estimation of the survival difference between the proposed action and the reference operation. This is because the modeling estimates are calibrated to empirical reach survival estimates that included the ongoing program. Therefore, although the ongoing NPMP clearly can be considered as a non-hydro mitigation measure that would contribute to improving survival, its effects have already been accounted for in the survival differences included in Tables 6.7 and 6.8.

The additional improvement expected from the expanded NPMP has not been included in the estimates of Tables 6.7 and 6.8, except for the 2001 estimate. Because the increase in the predator removal program in this single year has a minor impact on the mean estimates of the difference between the proposed and reference operations, the effects of the expanded NPMP can be considered as measures that would further improve survival. The expected survival improvement would be an immediate 0.6% change, based on the Action Agencies' calculations, which would result in a **Low** improvement.

The Action Agencies also propose to study the possibility of initiating a program of targeted removals of non-indigenous predators, such as smallmouth bass, beginning with a predation workshop in fall 2004. If researchers and policy makers can agree on testing of removals of nonindigenous predators in key locations such as Lower Granite pool, John Day and The Dalles tailrace, then testing could begin as early as 2005. From there, quantification of the benefits associated with nonindigenous predation management can be estimated using existing modeling capabilities. Because the implementation program is not scheduled to begin before the end of

year 6 (2010), NOAA Fisheries does not consider it an action that can apply to offsetting the proposed hydro action in this biological opinion.

6.3.3 Net Effect of Hydro and Non-hydro Actions

6.3.3.1 Net Effect on Productivity, Abundance, and Distribution

NOAA Fisheries considered the net effect of proposed hydro operations, proposed hydro configuration changes, and off-site actions, as described in Sections 6.3.1 and 6.3.2 (Table 6.9).

In 2004, proposed hydro operations are expected to reduce the survival of all major population groups of SR spring/summer chinook salmon an average of -1.5% (relative change; less than 1% absolute change), a Low negative effect compared to the reference operation. Continuation and expansion of the Northern Pikeminnow Management Program is estimated to have a Low positive effect (+1-2% relative change), as described in Section 6.3.2.4. Because the positive fish predator reduction effect is approximately equivalent to the negative effects of proposed hydro operations, the net effect of the proposed action would be no net difference in survival, and therefore no net change in the abundance, productivity, or distribution of this ESU as a result of the proposed action.

By 2010, the Action Agencies' propose to complete structures that will improve fish passage at mainstem FCRPS dams, further reducing the impact of proposed hydro improvement actions to a no net difference in system survival (range -0.8% to +2.6%) for all major population groups compared to the reference operation. In addition to the fish predation reduction program, the Action Agencies propose to implement the preferred alternative for estuarine avian predation reduction, which is also expected to result in a Low survival improvement for all major population groups. The USBR proposes to implement its measures in the Lemhi, Upper Salmon, and Little Salmon subbasins, which would have a **Very Low** benefit to a small portion of the ESU (Section 6.3.2.2). The combination of a no net difference in system survival, on average, of long-term proposed FCRPS improvements and additional avian predation reduction activities indicate that by 2010 it is likely that there would be no net change, or possibly an improvement, in the abundance, productivity, or distribution of this ESU as a result of the proposed action.

Table 6.9. Assessment of net effect of August 30, 2004, Updated Proposed Action for most significant components. Safety-net programs reduce short-term risk of extinction for several ESUs. The difference in the relative hydro survival gap between 2004 and 2010 is due to hydrosystem improvements phased in during this period. Additional hydro improvements between 2010 and 2014 may further reduce the gap. "NC" = no net change in abundance, productivity, and distribution. "Improve" and "Reduce" refer to net improvement or reduction in abundance, productivity, or distribution.

ESU	Major Population Groups (MPGs)	Year	(-) Relative Hydro Survival Gap (% survival difference and qual. est. including habitat effects)	(+) Estuary Habitat	(+) Tributary Habitat	(+) Fish Predation	(+) Bird Predation	(+) Hatchery	(+) Combined Non-hydro Improve-ment	(=) MPG Net Effect	ESU Net Effect
SR Spring/ Summer Chinook	All	2004	-1.5% L	0	VL	L	0	0	L	Reduce	Reduce (short-term)
		2010	+.3%	0	VL (for a few pop-ulations)	L	L	0	L- M	NC - Improve	
SR Fall Chinook	Only One	2004	-12.7% M	0	0	L	0	0	L	Reduce	Reduce (short-term)
		2010	-5.4% M	L	0	L	L	0	M	NC	
	Note: The hydro survival gaps shown in this assessment are for about half of the SR Fall Chinook ESU which remains in-river for its entire migration and is not transported. Measures to fill the gap apply to the entire ESU. The "NC" determination in 2010 takes the proportion of affected fish into consideration.										
UCR Spring Chinook	Only One	2004	-6.6% M	0	VL	L	0	0	L	Reduce	Reduce (short-term)
		2010	-1.2% L	0	L-M	L	L	0	M	NC	
LCR Chinook	Cascade Spring MPG (0 dams)	2004	VL	0	0	0	0	0	0	NC	Reduce (short-term)
		2010	VL	0	0	0	L	0	L-M	NC - Improve	
	Gorge Spring MPG (1 dam)	2004	-0.8% L	0	0	L	0	0	L	Reduce	
		2010	-0.4% L	0	0	L	L	0	L-M	NC - Improve	
	3 Fall MPGs (0 dams)	2004	L	0	0	0	0	0	0	Reduce	
		2010	L	L	0	0	L	0	L	NC	
	Gorge Fall MPG (1 dam)	2004	-1.4% L	0	0	L	0	0	L	Reduce	
		2010	-1.3% L	L	0	L	L	0	L-M	NC	
UWR Chinook	All	2004	VL	0	0	0	0	0	0	NC	NC
		2010	VL	0 (for yearlings) L (for subs)	0	0	L	0	L	NC - Improve	

ESU	Major Population Groups (MPGs)	Year	(-) Relative Hydro Survival Gap (% survival difference and qual. est. including habitat effects)	(+) Estuary Habitat	(+) Tributary Habitat	(+) Fish Predation	(+) Bird Predation	(+) Hatchery	(+) Combined Non-hydro Improve-ment	(=) MPG Net Effect	ESU Net Effect
SR Steelhead	All	2004	-0.2% L	0	VL	L	0	0	L	NC	NC
		2010	+0.7%	0	VL (for a few pop-ulations)	L	M	0	M	NC - Improve	
UCR Steelhead	Only One	2004	-8.6% M	0	VL	L	0	0	L	Reduce	Reduce (short-term)
		2010	-3.1% M	0	L-M	L	M	0	M	NC	
MCR Steelhead	2 MPGs (1-2 dams)	2004	-0.3 to 0% L	0	0	L	0	0	L	NC	Reduce (short-term)
		2010	-0.3 to +1.6% L	0	0	L	M	0	M	NC- Improve	
	John Day MPG (3 dams)	2004	-0.5% L	0	VL	L	0	0	L	NC	
		2010	+2.2%	0	VL	L	M	0	M	Improve	
	2 MPGs (mostly 4 dams)	2004	-8.6% M	0	0	L	0	0	L	Reduce	
		2010	-3.1% M	0	0	L	M	0	M	NC	
UWR Steelhead	All	2004	VL	0	0	0	0	0	0	NC	NC
		2010	VL	0	0	0	M	0	M	NC	
LCR Steelhead	2 MPGs (0 dams)	2004	VL	0	0	0	0	0	0	NC	NC
		2010	VL	0	0	0	M	0	M	NC	
	2 MPGs (mostly 1 dam)	2004	-0.3% L	0	0	L	0	0	L	NC	
		2010	+0.3%	0	0	L	M	0	M	NC	
CR Chum	1 MPG (1/2 pops 1 dam)	2004	L	0	0	L	0	0	L	NC	Reduce (short-term)
		2010	L	L	0	L	VL	0	L-M	NC	
	2 MPGs (0 dams)	2004	L	0	0	0	0	0	0	Reduce	
		2010	L	L	0	0	VL	0	L	NC	
LCR Coho	2 MPGs (0 dams)	2004	VL	0	0	0	0	0	0	NC	NC
		2010	VL	0	0	0	L-M	0	M	NC	
	1 MPG (2/3 pops 1 dam)	2004	L	0	0	L	0	0	L	NC	
		2010	L	0	0	L	L-M	0	M	NC - Improve	
SR Sockeye	Only One	2004	L	0	0	L	0	H	L	Reduce	Reduce (short-term)
		2010	L (close to VL)	0	0	L	0 (no info)	VL	L	NC	

6.3.3.2 Net Effect on Essential Features of Critical Habitat

[***NOTE:*** A very recent decision by the 9th Circuit Court of Appeals in the case of *Gifford Pinchot Task Force v. U.S. Fish & Wildlife Service*, No. 03-35279 (9th Cir. August 6, 2004) invalidates the critical habitat analysis in several Fish & Wildlife Service biological opinions that applied the regulatory definition of "destruction or adverse modification," 50 CFR § 402.02, which the court found to be unlawful. In light of this decision, NOAA Fisheries requires additional time to consider the implications of this holding for the proper application in this opinion of the statutory requirement that an action not destroy or adversely modify designated critical habitat. For that reason, an analysis of the effect of this proposed action on designated critical habitat is not attempted in this draft opinion.]

6.4 SNAKE RIVER FALL CHINOOK SALMON

6.4.1 Effect of Proposed Hydro Operations

6.4.1.1 Effect of Proposed Hydro Operations on Mainstem Habitat Conditions, Including in the Estuary and Plume

As described in Section 6.2, proposed hydro operations are expected to have a significant effect on habitat function with respect to water quantity and water velocity during the summer period when juvenile SR fall chinook salmon migrate through the action area when compared to the theoretical reference operation. This is because there is a substantial difference in summer flows resulting from the reference and proposed operations (Table 6.3; Appendix D). The proposed operation also reduces the functioning of juvenile migration habitat with respect to safe passage past barriers by reducing spill levels from those in the reference operation, which are described below. Water quality may be impacted because the reduced summer flows may result in higher temperatures in the migration corridor. This can increase the rate of predation by fish such as Northern Pikeminnow.

Habitat conditions for adult migrants and for spawning and rearing habitat are expected to either remain unchanged or improve, because flow is expected to be higher during the fall and winter in comparison to reference operation flows.

Proposed hydro operations are expected to have a significant effect on the quantity and quality of juvenile migration and rearing habitat in the Columbia River estuary and plume during the summer, when SR fall chinook salmon are in these areas. As a result, there may be differences in juvenile survival and migration time through the estuary and in the shape and extent of the Columbia River plume. As the ocean-type SR fall chinook salmon smolt and migrate as subyearlings, much of their growth and development occurs above Lower Granite Dam (Connor *et al.* 2003). As a result, SR fall chinook more closely resemble yearling chinook salmon by the time they reach the estuary (Fresh *et al.* 2004). In addition, Connor et al. 2004 indicate the existence of an alternative life history for SR fall chinook, e.g., a reservoir-type SR fall chinook, which migrates as a yearling smolt. Accordingly, yearling chinook salmon have a very low reliance on shallow-water rearing habitat in the Columbia River. Therefore, although there is likely to be a reduction in the amount of shallow-water habitat available to SR fall chinook

juveniles in the estuary because of the change in summer flow, this reduction should have a fairly small impact on this ESU.

6.4.1.2 Effect of Proposed Hydro Operations on Juvenile and Adult Mainstem Reach Survival.

6.4.1.2.1 Effect of Proposed Hydro Operations and 2004 System Configuration. The Action Agencies' proposed transport operation is to maximize the collection and transportation of juvenile fall chinook, and initiate an evaluation of fall chinook transportation with more favorable in-river passage conditions at Snake River collector projects beginning in 2007/2008 timeframe. In order to maximize transportation, the proposed operation calls for no spill at all collector projects and transportation of all fish collected. The proposed action includes flow augmentation and spill at Lower Columbia River projects equivalent to that included in the 2000 FCRPS Biological Opinion.

The proposed operation is identical to the reference operation relative to the strategy of maximizing transportation of juveniles (Section 5.2.4). Under both the proposed action and the reference operation, a little less than half of the fish arriving at the head of Lower Granite pool are expected to end up on barges (Table 15 of Appendix D). This estimated percentage of transported fish is subject to uncertainty about survival prior to reaching transport sites, including uncertainty regarding the percentage of fish that may residualize as yearlings rather than continuing their migration as subyearlings. Recent information indicates that a significant proportion of returning adults is composed of fish that emigrated as yearlings, rather than subyearlings (Connor et al. 2004), suggesting that some fish may over-winter within the hydrosystem. If these fish are transported as yearlings during the following year, the proportion of transported SR fall chinook is under-estimated.

For the fish that are barged, survival is identical under the proposed and reference operations. Therefore, there is no difference in survival, compared to the reference operation, for approximately half of the juveniles in this ESU. NOAA Fisheries did not attempt to model the survival of transported fish because of great uncertainty regarding their differential survival below Bonneville Dam, relative to that of non-transported fish i.e. how to calculate and apply "D" to the proposed/reference operation calculations. Although the specific survival of transported fish is unknown and was not estimated, it is likely that the same survival rate would apply to fish transported under both the proposed and reference operations.

For the juvenile SR fall chinook that are not barged, modeling results indicate that proposed hydro operations would result in lower survival, compared to that which would be expected under the reference operation. That is, for about half of the ESU that is not barged, in-river survival through the Lower Granite to Bonneville reach is estimated to be an average of 12.7% less than that associated with the reference operation, with a range from -5.8% to -22.1% (Appendix D; Table 6.7). The -12.7% average difference in in-river survival means that an average survival improvement 1.16 times greater than the current in-river survival rate in another life stage would offset the mortality associated with proposed hydro operations (range 1.06 to 1.28). The mortality associated with proposed hydro operations is expected to affect the single

population of Snake River fall chinook salmon, and that mortality is expected to begin immediately.

The reasons that in-river survival rates are lower in the proposed action, compared to the reference operation, are because flows are lower and spill at lower Columbia River dams is lower than in the reference operation. Both the additional flow and spill in the reference operation increase the survival of the fish migrating in-river to Bonneville Dam. There is uncertainty associated with these estimates, largely because empirical reach survival estimates are only available for fish migrating through the Snake River. Extrapolations are necessary to estimate survival through lower Columbia River projects. Uncertainty also exists about the proportion of fish which do not migrate as subyearlings. Recent information has indicated that Snake River fall chinook demonstrate both a subyearling and yearling life history (Connor 2004). At this time, we lack the information to accurately model this complicated life history pattern.

Although NOAA Fisheries did not attempt to estimate combined in-river and transportation system survival rates for the ESU, the combined difference in survival, relative to the reference operation, can be approximated. Because there is no difference in the two operations for about half the juveniles in the ESU and a relative 12% difference, on average, for the other half, the combined difference would be only about half that estimated for the in-river migrants. The new information about a yearling life history pattern further qualifies this estimate.

No difference in adult survival is expected as a result of proposed hydro operations (Appendix D).

6.4.1.2.2 Effect of Proposed Hydro Operations and 2010-2014 System Configuration Improvements. Based on a survival assessment of the Action Agencies' Updated Proposed Action (August 30, 2004), NOAA Fisheries adjusted various fish passage parameters in the SIMPAS analysis to reflect proposed juvenile passage improvements expected to be implemented during the life of the biological opinion. The following narrative summarizes the major fish passage parameter changes assumed to be in effect for SR fall chinook migrants by 2010-2014.

Turbine passage survival rates were increased for all dams from Lower Granite Dam down to John Day Dam in response to both operational and hardware improvements mentioned above under yearling chinook. The John Day Dam turbine survival estimate was increased by 13%, a much larger increase than the other dams, because of the Corps' proposal to focus turbine survival improvement efforts on this project, which has a much lower summer turbine survival (only 72%) than any other mainstem FCRPS dam. Spillway survivals were increased at Ice Harbor, McNary and The Dalles dams for the same reasons they were increased for yearling chinook. Bypass and sluiceway survivals were increased at the same projects for the same reasons as for yearling chinook. Fish passage efficiency was increased at Bonneville Dam in response to the continuation of the FGE improvement program at the second powerhouse.

Modeling results indicate that, as with the 2004 analysis, a nearly identical proportion of juvenile SR fall chinook (about half) would be transported under both the reference and proposed operations (Table 16 of Appendix D). As in the 2004 analysis, the survival of transported fish in

each operation would be identical. For those juveniles that are not transported, proposed long-term hydro improvements and operations would lower the relative difference, relative to the reference operation, to an average of -5.4%, with a range of survival reduction from the reference operation from -15.3% to +2.4% (Appendix D; Table 6.8). As noted for the 2004 analysis, the difference in survival for the ESU as a whole would be about half that described for the in-river migrants and is further qualified by a possible yearling life history component.

As described in the 2004 analysis, no difference in adult survival is expected as a result of proposed hydro operations (Appendix D).

6.4.1.3 Qualitative Characterization of All Effects of Proposed Hydro Operations

Application of the combined qualitative "habitat approach" and the quantitative "survival approach" leads NOAA Fisheries to conclude that the proposed action is likely to reduce abundance and productivity of Snake River fall chinook salmon by a **Medium** amount for the single population in this ESU. It is not likely that the proposed action would reduce distribution or diversity of the ESU.

6.4.2 Effect of Non-hydro Measures

6.4.2.1 Effect of Measures to Protect, Enhance, and Restore Estuarine Habitat and to Reduce Predation in the Estuary

6.4.2.1.1 Enhance and Restore Estuarine Habitat. The Action Agencies' proposed action for estuarine habitat improvements is described in section 6.3.2.1.1. Snake River fall chinook exhibit an ocean-type life history strategy (Fresh *et al*. 2004), which puts more reliance on rearing in estuarine habitat to sustain population viability than does the stream-type life-history strategy. Ocean-type chinook salmon use shallow-water habitat as subyearlings and expand into deeper water estuarine habitat as yearlings. The specific use of estuarine habitat varies by ocean-type ESU; whereas CR chum salmon rear in the lower portion of the estuary, SR fall chinook probably rear in tidally-influenced freshwater habitat in the upper estuary, the reach between Bonneville Dam and RM 40. Studies are on-going to determine the extent of their habitat use throughout both the upper and lower estuary. Since the 2000 FCRPS Biological Opinion, the Action Agencies have developed the infrastructure to begin an estuary and RME program which focuses on the long-term benefit to ESA-listed salmonids through estuary habitat restoration. The two projects the Action Agencies have proposed in their proposed action dated August 30, 2004, Crims Island and Sandy River, are the start of this on-going program. NOAA Fisheries assigned benefits to these projects based on an examination of how these projects relate to each of the ESUs across their entire geographic ranges. The two projects, while having localized and important benefits, are still limited enough in their magnitude, extent, and distribution that a higher benefit cannot be assigned at this time. Because none of these projects is completed at this time, this opinion is unable to assign short-term benefit to them, but anticipates at least **Low** long-term benefit for SR fall chinook. This level of benefit would accrue to the single remaining population.

As more acres are added and restored, the cumulative benefit of the Action Agencies' estuary program, and other regional and local efforts, could be expected to fully support the medium ranking of importance assigned to the estuary by Fresh *et al.* 2004 for this ESU. The Northwest Fisheries Science Center is working to further refine how any acres should be encompassed in the one-third estimates of acres needed to be restored to fully achieve a program response (Appendix E). A critical information gap and uncertainty is how to value the contribution of the proposed habitat restoration actions in the Columbia River estuary to improvements in salmon population production and viability, both for the short- and long-term. NOAA Fisheries, with support from the action agencies, has recently started programs to develop the time series of information regarding salmon use of Columbia River estuarine habitats, with the intent of reducing the uncertainty outlined above. Until that information is available, however, studies have been conducted for the past decade in the Skagit River system in Puget Sound for fall chinook salmon that could provide insight to help quantitatively value the beneficial accrual gained in juvenile salmon productivity (e.g. number of juveniles per acre of habitat) based on improving estuarine habitat. NOAA Fisheries is currently evaluating the available data to try to establish the likely range of benefit that could be achieved for Columbia River estuary restoration action. This information will potentially allow NOAA Fisheries to value the benefit of a suite of actions in the Columbia River system to improve salmon population (and ESU) productivity and viability. This information will assist in placing added context to the current benefit of the projects proposed by the Action Agencies and provide future direction on the magnitude, extent, and distribution of estuary restoration projects to be developed by the Action Agencies.

6.4.2.1.2 Reduction in Caspian Tern Predation Rates in the Estuary. The Action Agencies' proposed action for reducing predation rates by Caspian terns nesting in the estuary is described in section 6.3.2.1.2. Direct estimates of tern predation rates on fall run chinook ESUs are not available. However, Fresh *et al.* (2004) state that tern predation has probably affected the viability of ocean-type ESUs, but less than for stream-type ESUs. Fresh *et al.* (2004) concluded that terns have a low effect on ocean-type ESUs (approximately 2%). Therefore, implementation of alternative C or D in the Draft Joint EIS is expected to result in a low benefit to Snake River fall chinook. This level of benefit would apply to all populations and major population groups within the ESU. Efforts to redistribute the Columbia River estuary Caspian tern population could begin in FY05 and could begin producing results in FY06. Consequently, NOAA Fisheries anticipates that there will be no short-term benefit from these projects. Therefore, the proposed action for reducing tern predation on East Sand Island will provide **0 short-term** and **low long-term** (by 2010) benefits to SR fall chinook. This level of benefit would accrue to the single remaining population.

6.4.2.2 Effect of Measures to Protect, Enhance, or Restore Tributary Habitat

The Action Agencies do not propose any non-hydro mitigation in the tributaries affecting Snake River fall chinook. NOAA Fisheries concludes **no benefit** to population or ESU viability from tributary non-hydro mitigation actions for this ESU.

6.4.2.3 Effect of Artificial Propagation Measures

BPA funds a safety-net project for this ESU to reduce the extinction risk and to "buy time" for survival improvement measures to take effect. In their August 30, 2004 Updated Proposed Action, the Action Agencies commit to continue to fund these programs at appropriate levels as long as they are determined by NOAA Fisheries to be effective at reducing the short-term risk of extinction. NOAA Fisheries has determined that the safety-net program for this ESU is effective at reducing the short-term risk of extinction.

The hatchery program also helped preserved genetic diversity in the 1990s by only using fish known to be from the ESU to prevent incorporating out-of-basin hatchery stray fall chinook salmon into the broodstock. However, this resulted in the hatchery program being operated in genetic isolation, as very few natural-origin-fish have been incorporated into the hatchery broodstock since 1990. The benefit potential of the program is decreased due to increasing genetic risks associated with domestication and divergence with the natural fish. The longer this occurs, the greater the risks to the long-term viability of the ESU. In addition, there is considerable uncertainty as to the effects that large numbers of hatchery fish in the habitat are having on natural-origin fish productivity and viability.

6.4.2.4 Effect of Measures to Reduce Fish Predation

As described in Section 6.3.2.4, the ongoing NPMP is already accounted for in the estimation of the survival difference between the proposed action and the reference operation. The expected survival improvement from the expanded NPMP would be an immediate 0.6% change, based on the Action Agencies' calculations, which would result in a Low improvement.

6.4.3 Net Effect of Hydro and Non-hydro Actions

6.4.3.1 Net Effect on Abundance, Productivity, and Distribution

NOAA Fisheries considered the net effect of proposed hydro operations, proposed hydro configuration changes, and off-site actions, as described in Sections 6.3.1 and 6.3.2 (Table 6.9).

Compared to the theoretical reference operation, proposed hydro operations are expected to reduce the in-river survival of the single major population group of SR fall chinook salmon in 2004 by an average of -12.7% (relative change; -2.1% absolute change), a **Medium** negative effect. Expansion of the Northern Pikeminnow Management Program (**Low** positive relative survival change of <1%) and the existing supplementation programs are the only immediate offsetting actions. Therefore, on balance, at the beginning of the implementation period for this proposed action, there will likely be a significant net reduction in the numbers, productivity, or distribution of this ESU compared to the reference operation n the short-term.

By 2010, the Action Agencies' propose to complete structures and make passage facility improvements that could improve fish passage survival at mainstem FCRPS dams, and these improvements are expected to have a beneficial effect on those relatively few fish that migrate in-river. However, because the vast majority of SR fall chinook will be collected and transported under the proposed hydro operation, there is less effect on overall SR fall chinook survival. In addition to the fish predation reduction program, the Action Agencies propose to implement the

preferred alternative developed in the Record of Decision for Caspian tern management and to restore some estuarine habitat, which are also expected to result in Low survival improvements for the single major population group of SR fall chinook salmon. The combination of these **Low** improvements would result in a **Medium** (very low end of the **Medium** range) improvement of the entire ESU. This improvement for the entire ESU is likely to result in at least a 5.4% survival improvement for the in-river component of the ESU. The estuary actions would also have **Low** potential for offsetting the downstream hydro effects. Therefore, the combination of expected improvements by 2010 would likely result in no net reduction in the numbers, reproduction, or distribution of this ESU as a result of the proposed action.

6.4.3.2 Net Effect on Essential Features of Critical Habitat

[***NOTE:*** A very recent decision by the 9th Circuit Court of Appeals in the case of *Gifford Pinchot Task Force v. U.S. Fish & Wildlife Service*, No. 03-35279 (9th Cir. August 6, 2004) invalidates the critical habitat analysis in several Fish & Wildlife Service biological opinions that applied the regulatory definition of "destruction or adverse modification," 50 CFR § 402.02, which the court found to be unlawful. In light of this decision, NOAA Fisheries requires additional time to consider the implications of this holding for the proper application in this opinion of the statutory requirement that an action not destroy or adversely modify designated critical habitat. For that reason, an analysis of the effect of this proposed action on designated critical habitat is not attempted in this draft opinion.]

6.5 UPPER COLUMBIA RIVER SPRING CHINOOK SALMON

6.5.1 Effect of Proposed Hydro Operations

6.5.1.1 Effect of Proposed Hydro Operations on Mainstem Habitat Conditions, Including in the Estuary and Plume

As described in Section 6.2, proposed hydro operations, when compared with the theoretical reference operation, are expected to have only a minor effect on habitat function with respect to water quantity, water velocity, and water quality during the spring period when juvenile and adult UCR spring chinook salmon migrate through the action area. The proposed operation does reduce the functioning of juvenile migration habitat with respect to safe passage past barriers due to lower spill levels from those in the reference operation. The magnitude of this habitat modification is significant, as reflected in results of quantitative modeling of in-river survival, which are described below.

Proposed hydro operations are expected to have only a minor effect on the quantity and quality of juvenile migration and rearing habitat in the Columbia River estuary and plume during the spring, when UCR spring chinook salmon are in these areas. Habitat effects in the estuary are essentially the same as those described for SR spring/summer chinook salmon in Section 6.3.

6.5.1.2 Effect of Proposed Hydro Operations on Juvenile and Adult Mainstem Reach Survival.

6.5.1.2.1 Effect of Proposed Hydro Operations and 2004 System Configuration. Modeling results indicate that proposed hydro operations would result in lower survival of juvenile UCR spring chinook salmon between McNary Dam and Bonneville Dam by an average of 6.6%, with a range of 2.8% to 8.9% (Appendix D; Table 6.7) compared with the theoretical reference operation. The 6.6% average relative reduction in system survival means that an average survival improvement 1.071 times greater than the current survival rate in another life stage would offset the mortality associated with proposed hydro operations (range 1.028 to 1.098). The mortality associated with proposed hydro operations is expected to affect all populations of UCR spring chinook salmon equally, and that mortality is expected to begin immediately.

No difference in adult survival is expected between the proposed hydro operations and the reference operation (Appendix D).

6.5.1.2.2. Effect of Proposed Hydro Operations and 2010-2014 System Configuration Improvements. For UCR spring chinook, the relative in-river survival change from the 2010-2014 proposed action to the reference operation decreases substantially to -1.2% (range -3.4 to +2.8%) (Table 6.8; Appendix D). This roughly 80% reduction in the survival gap for UCR spring chinook by 2010 is due to system configuration improvements such as: a) installation and operation of two RSWs at McNary Dam; and b) various improvements in spillway, turbine and bypass survivals at all four lower Columbia River dams.

6.5.1.3 Qualitative Characterization of All Effects of Proposed Hydro Operations

Application of the combined qualitative "habitat approach" and the quantitative "survival approach" leads NOAA Fisheries to conclude that the proposed action is likely to reduce abundance and productivity (productivity) of UCR spring chinook salmon by a **Medium** amount for all populations and the single major population group. It is not likely that the proposed action would reduce distribution or diversity of the ESU.

6.5.2 Effect of Non-hydro Measures

6.5.2.1 Effect of Measures to Protect, Enhance, and Restore Estuarine Habitat and to Reduce Predation in the Estuary

6.5.2.1.1 Enhance and Restore Estuarine Habitat. Like SR spring/summer chinook salmon, UCR spring chinook display a stream-type life history strategy (Fresh *et al.* 2004). The two estuary habitat projects proposed by the Action Agencies are located in the lower portion of estuary and will have the greatest benefit for ocean-type ESUs, although they may have some potential to provide off-channel refugia for the Upper Columbia River spring chinook stream-type salmonids. As described in section 6.3.2.1.1, the magnitude, extent, and distribution of the proposed estuary actions are expected to provide a 0 benefit to yearling chinook migrants (in the case of UCR spring chinook, this level of benefit would apply to all the populations and the single major population group). The full benefit to be derived from these 2 projects will accrue

over the term of the Biological Opinion. Thus, the proposed action for estuary habitat restoration will provide **0 short-term** and a **0 long-term** (by 2010) benefit to the UCR spring chinook. This level of benefit will accrue to all the populations in the single major population group. NOAA Fisheries' ongoing efforts to refine relationships between estuary habitat and salmon viability in order to inform our assessment of estuary habitat restoration over time is described in Section 6.3.2.1.1.

6.5.2.1.2 Reduction in Caspian Tern Predation Rates in the Estuary. The Action Agencies' proposed action for reducing predation rates by Caspian terns nesting in the estuary and the resulting expected benefit for yearling UCR chinook migrants (**0 short-term**; **low long-term** [by 2010]) are described in section 6.3.2.1.2. This level of benefit will accrue to all the populations in the single major population group.

6.5.2.2 Effect of Measures to Protect, Enhance, or Restore Tributary Habitat

The Action Agencies have proposed a tributary habitat program on non-Federal lands which they feel will improve overall survival for the ESU during its spawning and rearing life stages. This program will include projects which address the following limiting factors: 1) fish entrainment, 2) instream flow deficiencies, 3) compromised channel morphology, and 4) riparian condition (Table 6.10). The Action Agencies state that these limiting factors will be addressed in the following manner. Fish entrainment at screens may be addressed through adding new screens, modifying existing screens to meet current criteria, or eliminating the diversion through replacement wells or other means. Instream flow projects include lease or purchase of streamflow, water conservation projects which yield actual "wet water" instream which may be secured through state water law. Not counted in this metric are gaging stations or other water measurement initiatives or investigations which may be necessary to support the evaluation and protection of instream flows for fish. Channel morphology projects include access projects which provide fish passage at structures or conditions that create migration barriers including diversion dams, culverts, low flow channels, etc. Stream complexity restoration projects include side channel connectivity, flood plain connectivity, channel reconfiguration, large woody debris placement, etc. Riparian protection projects include acquisition of riparian easements or purchases. Riparian enhancement projects include streambank stabilization and riparian treatments such as fencing or reconstruction.

This program is explained more fully in Section III. D. 4 of the Updated Proposed Action. Summarizing that section, the Action Agencies propose to address the following limiting factors across the subbasins listed:

> ***Wenatchee***: The Action Agencies will focus on projects which address changes in channel morphology which includes floodplain connectivity, entrainment, and riparian enhancement.
>
> ***Entiat***: The Action Agencies will focus on projects which address changes in channel morphology in the lower river to include improvements to stream complexity and channel connectivity. The AAS state that other channel morphology improvements are anticipated in other reaches of the subbasin.

Methow: The Action Agencies will primarily focus on projects which address changes in channel morphology with additional projects to effect limited improvements to instream flow. Some riparian protection and enhancement projects are also proposed.

Although the Action Agencies do not identify individual actions, they provide specific commitments in the form of three- and six-year targets across these subbasins. Financial and other necessary resources will be available to meet the 3 and 6 year metric goals described above contingent upon continuing Congressional funding (Updated Proposed Action 30 Aug. 2004 draft, Appendix B. General Description of the Tributary Habitat Proposed Action Approach).

Table 6.10. Proposed action, apper Columbia spring chinook, Wenatchee, Entiat, and Methow subbasins. (from Updated Proposed Action, 30 August 2004)

Limiting Factor	Metric Measurement	Metric Goal in three years	Cumulative Metric Goal in six years
Entrainment	a. Number of screens addressed	5	10
Instream flow projects	a. Cubic Feet per Second (cfs) of water protected for instream flows	12 cfs	40 cfs
Channel Morphology	a. Miles of access restored	60 miles	105 miles
	b. Miles complexity restored	5 miles	10 miles
Riparian Protection	a. Number of miles protected	4 miles	12 miles
Enhancement	b. Number of miles enhanced.	6 miles	12 miles

However, the Upper Columbia River spring Chinook ESU is composed of a single major population group composed of three populations. Therefore the distribution of projects across multiple major population groups is not a complicating factor in the analysis of effect to the ESU. In this evaluation, NOAA Fisheries considered, in part, the likely ultimate distribution of the achieved performance metrics across the three populations within the ESU. This task was possible because each population is described by a single subbasin.

The Action Agencies state that, based on their analysis, the total proposed habitat improvements in the Wenatchee subbasin would meet the level of intrinsic potential needed to improve habitat conditions and juvenile survival, that the survival improvements anticipated in the Wenatchee, Entiat, and Methow subbasins will fulfill the "medium" habitat improvement potential and that the Updated Proposed Action is expected to exceed the -3.2% survival gap. NOAA Fisheries can not evaluate the Action Agencies analyses leading to these conclusions since these are not included as part of the proposed action. NOAA Fisheries does not agree with the Action Agencies approach to arriving at non-hydro benefit. That approach, described in Appendix B, step 9 of the Updated Proposed Action bases cumulative biological benefit on a schedule of completing an array of projects identified by current opportunity and landowner willingness. The

Action Agencies provide no assessment of the relationship between completing projects identified using such criteria and achieving the program magnitude and intensity needed to ensure the overall cumulative biological benefit needed to offset hydrosystem operation mortality.

In its qualitative analysis of the proposed action, NOAA Fisheries reviewed the proposed action for the Upper Columbia spring chinook, as expressed by the cumulative performance metric goal commitments, against the limiting factors originally identified for these populations in Appendix E. Based on its knowledge of the distribution and severity of limiting factors across the three populations comprised by this ESU, NOAA Fisheries believes that, if the performance metrics are achieved by directing projects at the identified factors limiting Upper Columbia River spring chinook, the aggregate benefit will address a **Low-Medium** survival gap. NOAA Fisheries considered those tributary UCR spring/summer chinook projects identified in the PCTS since 2000 and determined that they would provide a **Very Low** immediate benefit. Therefore, if the proposed metric goals are achieved at three and six years, at a minimum, NOAA Fisheries concludes that the proposed non-hydro mitigation program for Upper Columbia River spring chinook will be capable of addressing a **Low-Medium** survival gap will be in place by 2010.

The Action Agencies commit to implement a habitat effectiveness monitoring program in the Methow subbasin to confirm that the survival improvement goals are achieved. They expect this program to inform them about the survival effects of habitat improvement projects for this ESU. RM&E actions in the Updated Proposed Action will include an effects monitoring program for some of the projects implemented as part of the tributary proposed action. The Action Agencies commit to adapting the mix and locations to meet metric goals when subbasin and recovery plans, other peer-reviewed information, and RME results indicate that a different mix would be more beneficial to fish populations in the ESUs addressed in the tributary proposed action.

6.5.2.3 Effect of Artificial Propagation Measures

The Action Agencies are proposing to complete the HGMP planning process designed to identify hatchery improvements and reforms which could affect UCR spring chinook salmon. However, development of the plan itself will have no direct effect on the viability of this ESU.

6.5.2.4 Effect of Measures to Reduce Fish Predation

As described in Section 6.3.2.4, the ongoing NPMP is already accounted for in the estimation of the survival difference between the proposed action and the reference operation. The expected survival improvement from the expanded NPMP would be an immediate 0.6% change, based on the Action Agencies' calculations, which would result in a Low improvement.

6.5.3 Net Effect of Hydro and Non-hydro Actions

6.5.3.1 Net Effect on Abundance, Productivity, and Distribution

NOAA Fisheries considered the net effect of the proposed hydro operations, proposed hydro configuration changes, and off-site actions, as described in Sections 6.5.1 and 6.5.2 (Table 6.9).

In 2004, the proposed hydro operations are expected to result in less survival of the single major population group of UCR spring chinook salmon an average of -6.6% (relative difference; 4.5% absolute difference), a Medium negative effect compared with the reference operation. Continuation and expansion of the Northern Pikeminnow Management Program is estimated to have a Low positive effect (+<1% relative difference), as described in Section 6.3.2.4. Because the positive fish predator reduction effect is less than the difference of the proposed hydro operations, the net effect of the proposed action would have lower survival, and therefore a net reduction in the numbers and reproduction of this ESU compared with the reference operation.

By 2010, the Action Agencies' propose to complete structures that will improve fish passage at mainstem FCRPS dams, further reducing the difference between the proposed hydro actions and the reference operation to -1.2% for this ESU. In addition to the fish predation reduction program, the Action Agencies propose to implement the preferred alternative developed in the Record of Decision for Caspian tern management reduction, which is expected to result in a **Low** relative change, which was estimated to be near +2% in Section 6.4.2. The Action Agencies also propose to implement habitat improvement projects that are likely to result in a **Low to Medium** improvement. The combination of the fish and avian predator reduction activities and the habitat improvements (at least three **Low** improvements) would, if quantified, approximate a survival improvement significantly higher than +1.2%. Therefore, the combination of expected improvements indicates that by 2010 it is likely that there would be no net change in the numbers, reproduction, or distribution of this ESU as a result of the proposed action as compared with the reference operation.

6.6 UPPER WILLAMETTE CHINOOK SALMON

6.6.1 Effect of Proposed Hydro Operations

6.6.1.1 Effects of Proposed Hydro Operations on Mainstem Habitat Conditions, Including in the Estuary and Plume

UWR Chinook benefit from the Northern Pikeminnow Management Program from the estuary to the mouth of the Willamette. As described in Section 6.3.2.4, the ongoing NPMP is already accounted for in the estimation of the survival difference between the proposed action and the reference operation. The expected survival improvement from the expanded NPMP would be an immediate 0.6% change, based on the Action Agencies' calculations, which would result in a **Low** improvement.

6.6.1.2 Qualitative Characterization of All Effects of Proposed Hydro Operations

Qualitatively, NOAA Fisheries concludes that the proposed action is likely to reduce abundance and productivity (productivity) of UWR spring chinook salmon by a **Very Low** amount for all populations and major population groups.

6.6.2 Effect of Non-hydro Measures

6.6.2.1 Effect of Measures to Protect, Enhance, and Restore Estuarine Habitat and to Reduce Predation in the Estuary

6.6.2.1.1 Enhance and Restore Estuarine Habitat. UWR spring chinook display predominantly a stream-type life history strategy like that of SR spring/summer chinook salmon, but some emigrants are subyearlings and thus presumably ocean-type fish. Considering the magnitude, extent, and distribution of the proposed estuary actions, they are expected to provide **0 short-term** and **very low long-term** (by 2010) benefits to stream-type juvenile migrants. Those UWR chinook that exhibit an ocean-type life history strategy probably make use of shallow-water habitat in the upper tidally-influenced and lower estuary and then expand into deeper water habitat as they mature (Fresh *et al.* 2004). NOAA Fisheries concludes that the magnitude, extent, and distribution of the proposed estuary actions would also provide **0 short-term** and **low long-term** (by 2010) benefits to ocean-type migrants from this ESU. These levels of benefit will accrue to all populations in the single major population group. NOAA Fisheries' ongoing efforts to refine the relationship between estuary habitat and salmon viability in order to inform our assessment of estuary habitat restoration over time is described in Section 6.3.2.1.1.

6.6.2.1.2 Reduction in Caspian Tern Predation Rates in the Estuary. The Action Agencies' proposed action for reducing predation rates by Caspian terns nesting in the estuary and the resulting expected level of benefit (**0 short-term**; **low long-term** [by 2010]), which can be applied to both yearling and subyearling UWR chinook migrants, are described in Section 6.3.2.1.2. These levels of benefit will accrue to all of the populations in the single major population group.

6.6.2.2 Effect of Measures to Protect, Enhance, or Restore Tributary Habitat

The Action Agencies do not propose any non-hydro mitigation in the tributaries affecting Upper Willamette River chinook. NOAA Fisheries concludes no benefit to population or ESU viability from tributary non-hydro mitigation actions for this ESU.

6.6.2.3 Effect of Artificial Propagation Measures

The Action Agencies are proposing to complete the HGMP planning process designed to identify hatchery improvements and reforms which could affect UWR chinook salmon. However, development of the plan itself will have no direct effect on the viability of this ESU.

6.6.3 Net Effect of Hydro and Non-hydro Actions

6.6.3.1 Net Effect on Abundance, Productivity, and Distribution

NOAA Fisheries considered the net effect of the proposed hydro operations, proposed hydro configuration changes, and off-site actions, as described in Sections 6.3.1 and 6.3.2 (Table 6.9).

The proposed hydro operations are expected to result in a **Very Low** effect (i.e., close to zero) on survival of UWR chinook through the estuary compared to that of the reference operation. It is possible that the proposed reduction in Caspian tern predation and proposed estuary habitat projects below the confluence of the Willamette River would have low positive effects on the survival of UWR chinook salmon. In summary, it is likely that there would be no net difference, or possibly better numbers, reproduction, or distribution of this ESU as a result of the proposed action compared with the reference operation.

6.7 LOWER COLUMBIA RIVER CHINOOK SALMON

6.7.1 Effect of Proposed Hydro Operations

6.7.1.1 Effects of Proposed Hydro Operations on Mainstem Habitat Conditions, Including in the Estuary and Plume

Juvenile LCR chinook salmon migrate as both yearlings and subyearlings, depending upon population. Similarly, adults return to spawn in both the spring and fall.

For spring-run populations with yearling juvenile migrants, the primary mainstem and estuary habitat differences between the proposed hydro operations and the reference operation are expected to be minor, as described in Section 6.3 for SR spring/summer chinook salmon.

Most LCR chinook populations are fall-run, with subyearling juveniles that migrate during the spring and summer. The primary mainstem, estuary, and plume habitat differences between the proposed hydro operations and the reference operation are expected to be similar to those described in Section 6.2 for SR fall chinook salmon, with the exception of the effects on juvenile rearing habitat. Unlike SR fall chinook, which are more like yearlings in their size and behavior in the estuary, LCR chinook are subyearlings that are more dependent upon shallow-water rearing areas (Fresh *et al.* 2004). To the extent that LCR chinook rear in the estuary during the summer when proposed flows are significantly lower than reference operation flows, their habitat will be reduced.

6.7.1.2 Effect of Proposed Hydro Operations on Juvenile and Adult Mainstem Reach Survival.

6.7.1.2.1 Effect of Proposed Hydro Operations and 2004 System Configuration. Most populations of LCR chinook salmon originate below Bonneville Dam and do not migrate past hydro projects. However, two populations (Hood River and Upper Gorge) that are in two of the six major population groups (Gorge Fall-Run and Gorge Spring-Run) migrate through Bonneville pool and dam.

Modeling results indicate that the relative differences in survival between the 2004 proposed hydro operations and the reference operation for the two populations of yearling-type LCR chinook salmon that migrate past Bonneville Dam by an average of 0.8%, ranging from a slight improvement of 0.1% to a maximum survival reduction of 3.3% (Appendix D; Table 6.7). The 0.8% average relative reduction in system survival means that an average survival improvement

1.008 times greater than the current survival rate in another life stage would offset the mortality associated with proposed hydro operations (range 1.0 to 1.034).

No quantitative estimates are available to determine the effect of proposed hydro operations on survival of the single population of juvenile LCR chinook salmon that migrates past Bonneville Dam as subyearlings. The survival rate would likely be no higher than that of SR fall chinook salmon, which are subyearlings that migrate past Bonneville Dam at a larger size. Therefore, modeling results indicate a minimum estimate of a 1.5% reduction in survival is likely (Appendix D; Table 6.7). The 1.5% average relative reduction in system survival means that an average survival improvement 1.015 (1.002 to 1.026) times greater than the current survival rate in another life stage would offset the mortality associated with proposed hydro operations.

No difference in adult survival through Bonneville Dam and pool is expected between the proposed hydro operation and the reference operation (Appendix D).

6.7.1.2.2 Effect of Proposed Hydro Operations and 2010-2014 System Configuration Improvements. Modeling results indicate that the relative differences in survival between the long-term proposed hydro improvements and operations and the reference operation for the two populations of yearling-type LCR chinook salmon that migrate past Bonneville Dam drops to an average of 0.5%, ranging from a slight improvement of 0.3% to a maximum survival reduction of 2% (Appendix D; Table 6.8).

For the single population of juvenile LCR chinook salmon that migrates past Bonneville Dam as subyearlings, modeling results for the long-term proposed hydro improvements and operations show a minimum estimate of a 1.4% reduction in survival is likely, with a range from -0.1% to -2.4% (Appendix D; Table 6.8).

6.7.1.3 Qualitative Characterization of All Effects of Proposed Hydro Operations

Application of the combined qualitative "habitat approach" and the quantitative "survival approach" leads NOAA Fisheries to conclude that the proposed action is likely to reduce abundance and productivity (productivity) of LCR chinook salmon by a **Low** amount for the Upper Gorge fall-run population and for all other fall-run populations; and by a **Very Low** amount for all spring-run populations. Because of the differential effect on various populations, the proposed operation also is likely to reduce distribution and diversity of the ESU.

6.7.2 Effect of Non-hydro Measures

6.7.2.1 Effect of Measures to Protect, Enhance, and Restore Estuarine Habitat and to Reduce Predation in the Estuary

6.7.2.1.1 Enhance and Restore Estuarine Habitat. LCR chinook salmon display both stream- and ocean-type life history (Fresh *et al.* 2004). Benefits of the proposed estuary actions are expected to be similar to those discussed for stream- and ocean-type migrants from the UWR chinook ESU (Section 6.6.2.1.1), **0 short-term** and **0** and **low long-term** (by 2010) benefits for the two life-history strategies, respectively. These levels of benefit will accrue to all of the

populations in all of the major population groups. NOAA Fisheries' ongoing efforts to refine the relationship between estuary habitat and salmon viability in order to inform our assessment of estuary habitat restoration over time is described in 6.3.2.1.1.

6.7.2.1.2 Reduction in Caspian Tern Predation Rates in the Estuary. The Action Agencies' proposed action for reducing predation rates by Caspian terns nesting in the estuary and the resulting expected level of benefit (**0 short-term**; **low long-term** [by 2010]), which can be applied to both yearling and subyearling LCR chinook salmon migrants, are described in Section 6.3.2.1.2. These levels of benefit will accrue to all of the populations in all of the major population groups.

6.7.2.2 Effect of Measures to Protect, Enhance, or Restore Tributary Habitat

The Action Agencies do not propose any non-hydro mitigation in the tributaries affecting Lower Columbia River chinook. NOAA Fisheries concludes no benefit to population or ESU viability from tributary non-hydro mitigation actions for this ESU.

6.7.2.3 Effect of Artificial Propagation Measures

The Action Agencies are proposing to complete the HGMP planning process designed to identify hatchery improvements and reforms which could affect LCR chinook salmon. However, development of the plan itself will have no direct effect on the viability of this ESU.

6.7.2.4 Effect of Measures to Reduce Fish Predation

As described in Section 6.3.2.4, the ongoing NPMP is already accounted for in the estimation of the survival difference between the proposed action and the reference operation. The expected survival improvement from the expanded NPMP would be an immediate 0.6% change, based on the Action Agencies' calculations, which would result in a **Low** improvement.

6.7.3 Net Effect of Hydro and Non-hydro Actions

6.7.3.1 Net Effect on Abundance, Productivity, and Distribution

NOAA Fisheries considered the net effect of the proposed hydro operations, proposed hydro configuration changes, and off-site actions, as described in Sections 6.3.1 and 6.3.2 (Table 6.9). The proposed action affects major population groups that originate at different locations differentially.

6.7.3.1.1 Cascade Spring-Run MPG. This major population group originates below Bonneville Dam and rears primarily in streams, so there is a **Very Low** negative effect of the proposed action on this MPG compared with the reference operation. Some of the habitat restoration projects in the estuary below the confluence with the Willamette River may result in a **Very Low** improvement for this MPG and the reduction in Caspian tern predation may result in a **Low** improvement. Therefore, it is likely that there would be no net difference, and over time an

improvement, in the numbers, reproduction, and possibly distribution of this MPG as a result of the proposed action compared with the reference operation.

6.7.3.1.2 Cascade Fall-Run, Cascade Late Fall-Run, and Coast Fall-Run MPGs. These three major population groups originate below Bonneville Dam and use the estuary for rearing. There is an unquantifiable **Low** difference between the proposed action and the reference operation on this MPG due to lower flows and smaller rearing habitat under the proposed action, relative to the reference operation. Some of the habitat restoration projects in the estuary below the confluence with the Willamette River and the reduction in Caspian tern predation may result in **Low** improvements for this MPG. Therefore, it is likely that in the short-term impacts to fish would be greater with the proposed operation, but over time no net difference or a net improvement in the numbers, reproduction, or distribution of this MPG as a result of the proposed action compared with the reference operation.

6.7.3.1.3 Gorge Spring-Run MPG. This major population group originates upstream of Bonneville Dam migrates through Bonneville pool and dam. There is likely to be a -1% **Low** negative difference between the proposed operation and the reference operation due to lower reduced passage survival through the Bonneville project. Continuation and expansion of the Northern Pikeminnow Management Program is estimated to have a **Low** positive effect (+<1% relative change) for this MPG. Some of the habitat restoration projects in the estuary below the confluence with the Willamette River may result in a **Very Low** improvement for this MPG and the reduction in avian predation may result in a **Low** improvement. Therefore, it is likely in the short-term there would be reduction, but in the long-term no net difference and possibly an improvement, in the numbers, reproduction, or distribution of this MPG as a result of the proposed action compared with the reference operation.

6.7.3.1.4 Gorge Fall MPG. This major population group originates upstream of Bonneville Dam migrates through Bonneville pool and dam and uses the estuary for rearing. There is likely to be a -1.4% lower survival with the proposed action due to lower passage survival through the Bonneville project, as well as a negative effect of lower estuary flow and less shallow-water rearing habitat compared with the reference operation. Combined, a **Medium** negative effect of the proposed hydro operation is expected. Some of the habitat restoration projects in the estuary below the confluence with the Willamette River and the reduction in avian predation may result in a **Low** level of improvements for this MPG. Therefore, it is likely that there would be a short-term reduction, but in the long-term there would be no net difference in the numbers, reproduction, or distribution of this MPG as a result of the proposed action compared with the reference operation.

Because the numbers and reproduction of two major population groups are expected to be lower during the initial years of this proposed action than with the reference operation, it is expected that the ESU as a whole would be lower. Whether or not this constitutes an appreciable reduction in the likelihood of survival and recovery of the ESU is the subject of Chapter 8.

6.8 SNAKE RIVER STEELHEAD

6.8.1 Effect of Proposed Hydro Operations

6.8.1.1 Effects of Proposed Hydro Operations on Mainstem Habitat Conditions, Including in the Estuary and Plume

Effects of the proposed action on habitat function are expected to be very similar to those described for SR spring/summer chinook salmon in Section 6.3. These effects are minor, except for safe passage past barriers, which is impaired due to lower spill levels provided under the proposed hydro operations.

6.8.1.2 Effect of Proposed Hydro Operations on Juvenile and Adult Mainstem Reach Survival

6.8.1.2.1 Effect of Proposed Hydro Operations and 2004 System Configuration.
Effect of transport operations on SR steelhead. The Action Agencies' proposed action for transport operations for SR steelhead delays the date when fish are collected and transported until April 15. Prior to that date, all fish collected would be returned to the river. This change is consistent with current research information that indicates there is not a consistent benefit provided from transportation during the month of April for wild juvenile SR steelhead. However, only several years of data are available on this issue at this time. Williams *et al*. (2004) noted that, sometimes survival for hatchery and wild steelhead transported to below Bonneville Dam as a juvenile to return as an adult is lower than the adult return rate for in-river migrants, but at other times higher. Hatchery steelhead, however, have shown a survival benefit from transport operations.

Balancing the potential survival benefits of transportation with the possible risks that this operation poses to long-term diversity of the ESU is challenging. Providing both spill and transportation is a method to balance the degree transportation is used as a management tool. Spill reduces the percentage of fish transported and increases the survival of the fish migrating in-river. The reference operation provided spill through the month of April in those years when the average seasonal flow at Lower Granite Dam was projected to be between 70 to 85 kcfs, and terminated spill on May 1 during these relatively low runoff years. The proposed action transport operation calls for no spill when the seasonal flow is projected to be less than 85 kcfs, similar to the 2000 Biological Opinion operation. The 70 kcfs flow threshold was chosen to reflect a breakpoint where in-river survival appears to exist for spring juvenile migrants. This breakpoint also appears to be associated with increasing water temperatures, which usually occur during the month of May. Due to the high guidance efficiency of SR steelhead at collector projects, the percentage of steelhead collected will generally be quite high. The reference operation calls for decreasing the percentage of fish transported during the early spring, since this operation has not been demonstrated to provide a consistent survival benefit.

Modeling results indicate that proposed hydro operations would result in lower survival of juvenile Snake River steelhead that remain in-river through the Lower Granite to Bonneville reach by an average of 8.4%, with a range of -1.0% to -29.3% (Appendix D; Table 6.7). Because

a large proportion, approximately 75-80%, of juvenile migrants are collected and transported past FCRPS dams, there is a much smaller reduction in system survival, which includes direct survival and differential post-Bonneville survival (D) of transported fish. On average, there is essentially no difference (-0.2%; Table 6.7) between relative system survival under the proposed hydro and the reference operation. The range of system survival estimates indicates that the proposed hydro operation would have slightly more impacts (up to a 1.8% reduction in survival) in some years, but could also result in minor survival improvements (up to 1.2%) in other years.

The 0.2% average relative reduction in system survival means that an average survival improvement 1.002 times greater than the current survival rate in another life stage would offset the mortality associated with proposed hydro operations (range of from no survival improvement needed to 1.018). The mortality associated with proposed hydro operations is expected to affect all populations of Snake River spring/summer chinook salmon equally, and that mortality is expected to begin immediately.

No difference in adult survival is expected between the proposed hydro operation and the reference operation (Appendix D).

6.8.1.2.2 Effect of Proposed Hydro Operations and 2010-2014 System Configuration Improvements. For this ESU, with expected long-term system configuration improvements described below, the relative system survival difference between the proposed hydro operation and the reference operation decreased from the 2004 gap analysis to result in average slight beneficial effect of less than 1% (+0.7%; range -1.6% to +1.7%), while the relative in-river survival rate decreased to -0.7% (Table 6.8; Appendix D). This large reduction in the 2010 survival gap compared to the 2004 gap is due to the installation and operation of RSWs at Little Goose, Lower Monumental and McNary dams, which results in more juvenile fish remaining in the river due to increased spill efficiencies at these projects in the 2010 proposed hydro operation, thus increasing the in-river survival rates with the planned survival improvements, including various improvements in spillway, turbine and bypass survivals at several mainstem FCRPS dams. Note that system configuration parameter changes assumed for SR steelhead for the 2010 proposed hydro operation are similar to those of SR spring chinook, above.

6.8.1.3 Qualitative Characterization of All Effects of Proposed Hydro Operations

Application of the combined qualitative "habitat approach" and the quantitative "survival approach" leads NOAA Fisheries to conclude that the proposed action is likely to reduce abundance and productivity (productivity) of Snake River steelhead by a **Low** amount for all populations and major population groups. It is not likely that the proposed action would reduce distribution or diversity of the ESU.

The reduction in abundance and productivity would be **Very Low**, if based only on mean system survival, but the range of impacts includes **Low** reductions under some conditions, and this results in an overall **Low** impact.

The proposed action will also alter essential features of designated critical habitat by a **Low** amount. Safe passage conditions in the juvenile migration corridor will be reduced substantially

by the reduction of spill in the proposed operation, as indicated by in-river survival estimates. However, the transportation program largely mitigates this effect, as evidenced by system survival estimates, and this reduces the expected impact to **Low**.

6.8.2 Effect of Non-hydro Measures

6.8.2.1 Effect of Measures to Protect, Enhance, and Restore Estuarine Habitat and to Reduce Predation in the Estuary

6.8.2.1.1 Enhance and Restore Estuarine Habitat. Like SR spring/summer chinook salmon, SR steelhead display a stream-type life history strategy (Fresh *et al.* 2004). As described in section 6.3.2.1.1, the magnitude, extent, and distribution of the proposed estuary actions are expected to provide a very low benefit to yearling migrants (in the case of SR steelhead, this level of benefit would apply to all the populations and major population groups). The full benefit to be derived from these two projects will accrue over the term of the Biological Opinion. Thus, the proposed action for estuary habitat restoration will provide **0 short-term** and **0 long-term** benefits to the SR steelhead ESU. This level of benefit will accrue to all of the populations in all of the major population groups. NOAA Fisheries' ongoing efforts to refine the relationship between estuary habitat and salmon viability in order to inform our assessment of estuary habitat restoration over time is described in 6.3.2.1.1.

6.8.2.1.2 Reduction in Caspian Tern Predation Rates in the Estuary. The Action Agencies' proposed action for reducing predation rates by Caspian terns nesting in the estuary is described in section 6.3.2.1.2. Based on the projected levels of tern colony size resulting from implementation of alternatives C and D of the draft EIS, NOAA Fisheries estimates level of benefit for SR steelhead as approximately **0 short-term** and **medium long-term** (by 2010) benefits (i.e., a 6.6% relative increase in survival). This level of benefit will accrue to all of the populations in all of the major population groups.

6.8.2.2 Effect of Measures to Protect, Enhance, or Restore Tributary Habitat

USBR's conservation actions implemented since 2000 and proposed conservation measures, discussed in Section 6.3.2.2, would provide **very low short-term** and **very low long-term** benefits to a small portion of the Snake River steelhead ESU (i.e., populations in the Lemhi, Upper Salmon, and Little Salmon subbasins).

6.8.2.3 Effect of Artificial Propagation Measures

BPA funds a safety-net project for this ESU to reduce the extinction risk and to "buy time" for survival improvement measures to take effect. In their August 30, 2004 Updated Proposed Action, the Action Agencies commit to continue to fund these programs at appropriate levels as long as they are determined by NOAA Fisheries to be effective at reducing the short-term risk of extinction. NOAA Fisheries has determined that the safety-net program for this ESU is effective at reducing the short-term risk of extinction. It is not, however, considered to apply toward mitigating the hydro effects described in Sections 6.8.1.1 and 6.8.1.2.

6.8.2.4 Effect of Measures to Reduce Fish Predation

As described in Section 6.3.2.4, the ongoing NPMP is already accounted for in the estimation of the survival difference between the proposed action and the reference operation. The expected survival improvement from the expanded NPMP would be an immediate 0.6% change, based on the Action Agencies' calculations, which would result in a Low improvement.

6.8.3 Net Effect of Hydro and Non-hydro Actions

6.8.3.1 Net Effect on Abundance, Productivity, and Distribution

NOAA Fisheries considered the net effect of the proposed hydro operations, proposed hydro configuration changes, and off-site actions, as described in Sections 6.8.1 and 6.8.2 (Table 6.9).

In 2004, the proposed hydro operations are expected to result in lower survival of all major population groups of SR steelhead by an average of less than 1% (relative change; also less than 1% absolute change), a **Low** negative effect compared with the reference operation. Continuation and expansion of the Northern Pikeminnow Management Program is estimated to have a **Low** positive effect (+<1% relative change), as described in Section 6.3.2.4. By 2010, the Action Agencies' propose to complete structures that will improve fish passage at mainstem FCRPS dams, so survival with the proposed action is expected to be greater than that associated with the reference operation. In addition to the fish predation reduction program, the Action Agencies propose to implement the preferred alternative for Caspian tern management, which is also expected to result in a Medium survival improvement for all major population groups. Estuarine habitat improvement projects are not expected to benefit this ESU. The combination of these effects is likely to result in no net change in the short-term and a likely improvement in the numbers, reproduction, and distribution of this ESU as a result of the proposed action compared with the reference operation.

6.9 UPPER COLUMBIA RIVER STEELHEAD

6.9.1 Effect of Proposed Hydro Operations

6.9.1.1 Effects of Proposed Hydro Operations on Mainstem Habitat Conditions, Including in the Estuary and Plume

As described in Section 6.2, proposed hydro operations are expected to have only a minor effect on habitat function with respect to water quantity, water velocity, and water quality during the spring period when juvenile and adult UCR steelhead migrate through the action area. The proposed operation does reduce the functioning of juvenile migration habitat with respect to safe passage past barriers by reducing spill levels from those in the reference operation. The magnitude of this habitat modification is significant, as reflected in results of quantitative modeling of in-river survival, which are described below.

Proposed hydro operations are expected to have only a minor effect on the quantity and quality of juvenile migration and rearing habitat in the Columbia River estuary and plume during the

spring, when UCR spring chinook salmon are in these areas. Habitat effects in the estuary are essentially the same as those described for SR spring/summer chinook salmon in Section 6.3.

6.9.1.2 Effect of Proposed Hydro Operations on Juvenile and Adult Mainstem Reach Survival.

6.9.1.2.1 Effect of Proposed Hydro Operations and 2004 System Configuration. Modeling results indicate that proposed hydro operations would reduce the survival of juvenile UCR steelhead between McNary Dam and Bonneville Dam an average of 8.6%, with a range of 1.1% to 25.2% (Appendix D; Table 6.7). The 8.6% average relative reduction in system survival means that an average survival improvement 1.115 times greater than the current survival rate in another life stage would offset the mortality associated with proposed hydro operations (range 1.011 to 1.336). The mortality associated with proposed hydro operations is expected to affect all populations of UCR steelhead equally, and that mortality is expected to begin immediately.

No difference in adult survival is expected between the proposed hydro operation and the reference operation (Appendix D).

6.9.1.2.2 Effect of Proposed Hydro Operations and 2010-2014 System Configuration. For UCR steelhead, the relative difference in the in-river survival rate of -3.1% (range -20.5% to +5.1%) for the long-term proposed hydro improvements and operation, when compared to the reference operation, decreased by an average of nearly two-thirds from the 2004 survival gap (Table 6.8; Appendix D). The substantial reduction in the relative in-river survival gap for UCR steelhead in the long-term is due to system configuration improvements such as installation of RSWs at McNary Dam and various other fish passage improvements made at several lower Columbia River dams to increase spillway, turbine and bypass survivals.

6.9.1.3 Qualitative Characterization of All Effects of Proposed Hydro Operations

Application of the combined qualitative "habitat approach" and the quantitative "survival approach" leads NOAA Fisheries to conclude that the proposed action is likely to reduce abundance and productivity (productivity) of UCR steelhead by a **Medium** amount for all populations and the single major population group. It is not likely that the proposed action would reduce distribution or diversity of the ESU.

6.9.2 Effect of Non-hydro Measures

6.9.2.1 Effect of Measures to Protect, Enhance, and Restore Estuarine Habitat and to Reduce Predation in the Estuary

6.9.2.1.1 Enhance and Restore Estuarine Habitat. Like SR spring/summer chinook salmon, UCR steelhead display a stream-type life history strategy (Fresh *et al.* 2004). As described in section 6.3.2.1.1, the magnitude, extent, and distribution of the proposed estuary actions are expected to provide a very low benefit to yearling migrants (in the case of UCR steelhead, this level of benefit would apply to all the populations and the single major population group). The full benefit to be derived from these two projects will accrue over the term of the Biological

Opinion. Thus, the proposed action for estuary habitat restoration will provide **0 short-term** and **0 long-term** (by 2010) benefits to UCR steelhead. This level of benefit will accrue to all of the populations in the single major population group. NOAA Fisheries' ongoing efforts to refine the relationship between estuary habitat and salmon viability in order to inform our assessment of estuary habitat restoration over time is described in 6.3.2.1.1.

6.9.2.1.2 Reduction in Caspian Tern Predation Rates in the Estuary. The Action Agencies' proposed action for reducing predation rates by Caspian terns nesting in the estuary is described in section 6.3.2.1.2. Based on the projected levels of tern colony size resulting from implementation of alternatives C and D of the draft EIS, NOAA Fisheries estimates **0 short-term** and **medium long-term** (by 2010) benefits (i.e., a 15% relative increase in survival) to UCR steelhead. This level of benefit will accrue to all of the populations in the single major population group.

6.9.2.2 Effect of Measures to Protect, Enhance, or Restore Tributary Habitat

The Action Agencies have proposed a tributary habitat program on non-Federal lands in the lower reaches of the systems which they feel will improve overall survival for the ESU during its spawning and rearing life stages. Upper Columbia steelhead spawn and rear in tributaries to the upper Columbia River below Chief Joseph Dam. These tributaries include populations of the ESU in the Wenatchee, Entiat, Methow, and the Okanogan. Actions to improve spawning and rearing habitat in three of these tributaries (or subbasins) are included in the proposed action. The Action Agencies state that the Okanogan is not included due to a low potential for habitat improvements due to extensive practical constraints to effect habitat changes in the near-term.

This program will include projects which address the following limiting factors 1) fish entrainment, 2) instream flow deficiencies, 3) compromised channel morphology, and 4) riparian condition. The Action Agencies state that these limiting factors will be addressed in the following manner (Table 6.11). Fish entrainment at screens may be addressed through adding new screens, modifying existing screens to meet current criteria, or eliminating the diversion through replacement wells or other means. Instream flow projects include lease or purchase of streamflow, water conservation projects which yield actual "wet water" instream which may be secured through state water law. Not counted in this metric are gaging stations or other water measurement initiatives or investigations which may be necessary to support the evaluation and protection of instream flows for fish. Channel morphology projects include access projects which provide fish passage at structures or conditions that create migration barriers including diversion dams, culverts, low flow channels, etc. Stream complexity restoration projects include side channel connectivity, flood plain connectivity, channel reconfiguration, large woody debris placement, etc. Riparian protection projects include acquisition of riparian easements or purchases. Riparian enhancement projects include streambank stabilization and riparian treatments such as fencing or reconstruction.

The limiting factors identified for Upper Columbia steelhead in each of the subbasins are similar to those identified for the Upper Columbia spring chinook. The Action Agencies considered those similarities and selected an identical suite of habitat improvements for both ESUs in each subbasin. The Action Agencies state that although steelhead tend to utilize habitat higher in the river systems than chinook, much of those high spawning and rearing streams are located on

lands administered by the U.S. Forest Service which is formulating its own programs to improve habitat. To avoid duplication of effects, the Action Agencies are focusing on habitat improvement programs for the four selected limiting factors which are lower in the subbasin systems and which will improve survival for both ESUs. Therefore, the proposed action metrics goals are identical for both species.

Table 6.11. Proposed Action, Upper Columbia Steelhead, Wenatchee, Entiat, and Methow Subbasin (from Updated Proposed Action, 30 August 2004).

Limiting Factor	Metric Measurement	Metric Goal in three years	Cumulative Metric Goal in six years
Entrainment	a. Number of screens addressed	5	10
Instream flow projects	a. Cubic Feet per Second (cfs) of water protected for instream flows	12 cfs	40 cfs
Channel Morphology	a. Miles of access restored	60 miles	105 miles
	b. Miles complexity restored	5 miles	10 miles
Riparian Protection	a. Number of miles protected	4 miles	12 miles
Enhancement	b. Number of miles enhanced.	6 miles	12 miles

This program is explained more fully in Section III. D. 4 of the Updated Proposed Action. Summarizing that section, the Action Agencies propose to address the following limiting factors across the subbasins listed:

> ***Wenatchee***: The Action Agencies will focus on projects which address changes in channel morphology which includes floodplain connectivity, entrainment, and riparian enhancement.
>
> ***Entiat***: The Action Agencies will focus on projects which address changes in channel morphology in the lower river to include improvements to stream complexity and channel connectivity. The AAS state that other channel morphology improvements are anticipated in other reaches of the subbasin.
>
> ***Methow***: The Action Agencies will primarily focus on projects which address changes in channel morphology with additional projects to effect limited improvements to instream flow. Some riparian protection and enhancement projects are also proposed.

The Action Agencies do not commit to implementing specific projects in these subbasins and therefore do not describe the associated planning, regulatory, or implementation processes. The Action Agencies do provide specific commitments in the form of three- and six-year targets across these subbasins. Financial and other necessary resources will be available to meet the

3 and 6 year metric goals described above contingent upon continuing Congressional funding (Updated Proposed Action, 30 Aug. 2004, Appendix B).

The Action Agencies tributary habitat program commits to addressing limiting factors identified in NOAA Fisheries' recent analysis of potential habitat improvement across all three subbasins (Appendix E). In some subbasins the Action Agencies have modified the relative importance of limiting factors identified by NOAA Fisheries. In these instances, the Action Agencies state that the reprioritization was based on opportunities verified by contacting local knowledgeable individuals and organizations, reviewing the considerable information made available by the Council's recently drafted subbasin plans, and consulting other state and local documents.

However, the Upper Columbia River steelhead ESU is composed of a single major population group comprised of three populations. Therefore the distribution of projects across multiple major population groups is not a complicating factor in the analysis of effect to the ESU. In this evaluation, NOAA Fisheries considered, in part, the likely ultimate distribution of the achieved performance metrics across the three populations within the ESU. This task was possible because each population is described by a single subbasin.

The Action Agencies state that, based on their analysis, the total proposed habitat improvements in the Wenatchee subbasin would meet the level of intrinsic potential needed to improve habitat conditions and juvenile survival, that the survival improvements anticipated in the Wenatchee, Entiat, and Methow subbasins will fulfill the "medium" habitat improvement potential and that the Updated Proposed Action is expected to exceed the -3.8% survival gap. NOAA Fisheries can not evaluate the Action Agencies analyses leading to these conclusions since these are not included as part of the proposed action. NOAA Fisheries does not agree with the Action Agencies approach to arriving at non-hydro benefit. That approach, described in the Updated Proposed Action, Appendix B step 9 (Updated Proposed Action, 30 Aug. 2004) bases cumulative biological benefit on a schedule of completing an array of projects identified by current opportunity and landowner willingness. The Action Agencies provide no assessment of the relationship between completing projects identified using such criteria and achieving the program magnitude and intensity needed to ensure the overall cumulative biological benefit needed to offset hydrosystem operation mortality.

In its qualitative analysis of the proposed action, NOAA Fisheries reviewed the proposed action for the Upper Columbia River steelhead, as expressed by the cumulative performance metric goal commitments, against the limiting factors originally identified for these populations in Appendix E. Based on its knowledge of the distribution and severity of limiting factors across the four populations comprised by this ESU, NOAA Fisheries believes that, if the performance metrics are achieved by directing projects at the identified factors limiting Upper Columbia River steelhead, the aggregate benefit will address a **Low-Medium** survival gap. NOAA Fisheries considered those tributary UCR steelhead projects identified in the PCTS since 2000 and determined that they would provide a **Very Low** immediate benefit. Therefore, if the proposed metric goals are achieved at three and six years, at a minimum, NOAA Fisheries concludes that the proposed non-hydro mitigation program for Upper Columbia River steelhead will be capable of addressing a **Low-Medium** survival gap will be in place by 2010.

The Action Agencies commit to implement a habitat effectiveness monitoring program in the Methow subbasin to confirm that the survival improvement goals are achieved. They expect this program to inform them about the survival effects of habitat improvement projects for this ESU. RM&E actions in the Updated Proposed Action will include an effects monitoring program for some of the projects implemented as part of the tributary proposed action. The Action Agencies commit to adapting the mix and locations to meet metric goals when subbasin and recovery plans, other peer-reviewed information, and RME results indicate that a different mix would be more beneficial to fish populations in the ESUs addressed in the tributary proposed action.

6.9.2.3 Effect of Artificial Propagation Measures

The Action Agencies are proposing to complete the HGMP planning process designed to identify hatchery improvements and reforms which could affect UCR steelhead. However, development of the plan itself will have no direct effect on the viability of this ESU.

6.9.2.4 Effect of Measures to Reduce Fish Predation

As described in Section 6.3.2.4, the ongoing NPMP is already accounted for in the estimation of the survival difference between the proposed action and the reference operation. The expected survival improvement from the expanded NPMP would be an immediate 0.6% change, based on the Action Agencies' calculations, which would result in a Low improvement.

6.9.3 Net Effect of Hydro and Non-hydro Actions

6.9.3.1 Net Effect on Abundance, Productivity, and Distribution

NOAA Fisheries considered the net effect of the proposed hydro operations, proposed hydro configuration changes, and off-site actions, as described in Sections 6.9.1 and 6.9.2 (Table 6.9).

In 2004, proposed hydro operations are expected to reduce the survival of the single major population group of UCR steelhead an average of roughly -9% (relative change; -4.3% absolute change), a Medium negative effect. Continuation and expansion of the Northern Pikeminnow Management Program is estimated to have a Low positive effect (+1-2% relative change), as described in Section 6.3.2.4. Because the positive fish predator reduction effect is less than the negative effects of proposed hydro operations, the net effect of the proposed action would be a net reduction in survival, and therefore a net reduction in the abundance and productivity of this ESU.

By 2010, the Action Agencies' propose to complete structures that will improve fish passage at mainstem FCRPS dams, including RSWs at McNary Dam, thereby reducing the impact of proposed long-term hydro operations by two-thirds, to -3% (relative survival change; -1.5% absolute change). In addition to the fish predation reduction program, the Action Agencies propose to implement the preferred alternative for estuarine avian predation reduction, which is expected to result in a Medium relative change, which was estimated to be near +15% in Section 6.4.2. The Action Agencies also propose to implement habitat improvement projects that are likely to result in a Low to Medium improvement. Therefore, the combination of expected

improvements indicates that by 2010 it is likely that there would be no net change in the abundance, productivity, or distribution of this ESU as a result of the proposed action.

6.10 MID-COLUMBIA RIVER STEELHEAD

6.10.1 Effect of Proposed Hydro Operations

6.10.1.1 Effects of Proposed Hydro Operations on Mainstem Habitat Conditions, Including in the Estuary and Plume

The primary estuary and plume habitat changes associated with proposed hydro operations are expected to be very similar to those described in Section 6.3 for SR spring/summer chinook salmon.

6.10.1.2 Effect of Proposed Hydro Operations on Juvenile and Adult Mainstem Reach Survival

6.10.1.2.1 Effect of Proposed Hydro Operations and 2004 System Configuration. MCR steelhead migrate through one, two, three, or four hydro projects, depending upon the population. Modeling results indicate that proposed hydro operations would reduce the relative survival of juvenile MCR populations from that of the reference operation by an average of 8.6%, with a range of 1.1% to 25.2%, for populations originating above McNary Dam; 8.7%, with a range of 1.1% to 24.7%, for populations migrating through the John Day reservoir to Bonneville Dam; 0.5%, with a range of a 4.5% survival improvement to a 2.6% reduction, for the John Day River populations originating between McNary and John Day dams; 0.03%, ranging from a 2.0% reduction to a 5% improvement, for populations originating between The Dalles and John Day dams; and 0.3%, ranging from a 1.3% reduction to a 2.3% improvement, for populations originating between Bonneville and The Dalles dams (Appendix D; Table 6.7).

The 8.6 to 8.7% relative difference in survival for MCR steelhead originating from above or just below McNary Dam means that a survival improvement 1.114 (range of 1.011 to 1.336) times greater than the current survival rate in another life stage would be needed to offset the mortality associated with proposed hydro operations. The 0% to 0.5% relative reduction in survival for MCR steelhead stocks originating above three, two or one hydro projects means that no survival improvement to 1.005 times greater than the current survival rate in another life stage would be necessary to offset the mortality associated with proposed hydro operations (range of no improvement factor to 1.026). The mortality associated with proposed hydro operations is expected to affect all populations of MCR steelhead, and that mortality is expected to begin immediately.

No difference in adult survival is expected between the proposed hydro operation and the reference operation (Appendix D).

6.10.1.2.2 Effect of Proposed Hydro Operations and 2010-2014 System Configuration Improvements. Modeling results indicate that proposed long-term hydro improvements and operations would lead to a lower relative survival of the various juvenile MCR populations from

that of the reference operation by an average of 3.1%, with a range of 20.5% to a survival improvement of 5%, for populations originating above McNary Dam; 6.2%, with a range of 23% to a survival improvement of 2.1%, for populations migrating through the John Day reservoir to Bonneville Dam; an average survival improvement of 2.2%, with a range of 0.1% to 7.1% survival improvement, for the John Day River populations originating between McNary and John Day dams; an average survival improvement of 1.6%, ranging from a 0.4% reduction to a 6.5% improvement, for populations originating between The Dalles and John Day dams; and 0.3%, average improvement, ranging from a 0.8% reduction to a 2.6% improvement, for populations originating between Bonneville and The Dalles dams (Appendix D; Table 6.8). The substantial reduction in the relative in-river survival gap for most MCR steelhead stocks in the long-term is due to system configuration improvements such as installation of RSWs at McNary Dam and various other fish passage improvements made at several lower Columbia River dams to increase spillway, turbine and bypass survivals.

6.10.1.3 Qualitative Characterization of All Effects of Proposed Hydro Operations

Application of the combined qualitative "habitat approach" and the quantitative "survival approach" leads NOAA Fisheries to conclude that the proposed action is likely to reduce abundance and productivity (productivity) of MCR steelhead by a **Medium** amount for all populations originating upstream of McNary Dam and by a **Low** amount for all other populations. Because of the differential effect on various populations, the proposed operation also is likely to reduce distribution and diversity of the ESU.

6.10.2 Effect of Non-hydro Measures

6.10.2.1 Effect of Measures to Protect, Enhance, and Restore Estuarine Habitat and to Reduce Predation in the Estuary

6.10.2.1.1 Enhance and Restore Estuarine Habitat. Like SR spring/summer chinook salmon, MCR steelhead display a stream-type life history strategy (Fresh *et al.* 2004). As described in section 6.3.2.1.1, the magnitude, extent, and distribution of the proposed estuary actions are expected to provide a very low benefit to yearling migrants (in the case of MCR steelhead, this level of benefit would apply to all the populations and major population groups). The full benefit to be derived from these two projects will accrue over the term of the Biological Opinion. Thus, the proposed action for estuary habitat restoration will provide **0 short-term** and a **0 long-term** (by 2010) benefit to MCR steelhead. This level of benefit will accrue to all of the populations in all of the major population groups. NOAA Fisheries' ongoing efforts to refine the relationship between estuary habitat and salmon viability in order to inform our assessment of estuary habitat restoration over time is described in 6.3.2.1.1.

6.10.2.1.2 Reduction in Caspian Tern Predation Rates in the Estuary. The Action Agencies' proposed action for reducing predation rates by Caspian terns nesting in the estuary is described in section 6.3.2.1.2. Based on the projected levels of tern colony size resulting from implementation of alternatives C and D of the draft EIS, NOAA Fisheries estimates **0 short-term** and **medium long-term** (by 2010) benefits (i.e., a >6% relative increase in survival) to

MCR steelhead. This level of benefit will accrue to all of the populations in all of the major population groups.

6.10.2.2 Effect of Measures to Protect, Enhance, or Restore Tributary Habitat

NOAA Fisheries has identified 16 populations of the Mid-Columbia River ESU grouped into four major populations groups which spawn and rear in tributaries to the Columbia River ranging from the Klickitat River to the Yakima River. A distinctive characteristic of this ESU is that different populations must navigate different numbers of the FCRPS dams during upstream and downstream migrations. Populations may need to pass one to four dams, depending upon the location of their particular spawning and rearing tributaries. The Action Agencies' proposed tributary habitat conservation measures will focus on four of the 16 identified populations identified by NOAA Fisheries' Interior Columbia Basin Technical Recovery Team. These populations constitute one of the four major population groups in this ESU.

The Action Agencies propose a tributary habitat conservation measure on non-Federal lands which addresses those populations which fall within the medium range of habitat improvement potential. The Action Agencies commit to focusing actions in lower reaches of these systems based on opportunities provided by private landowners. The tributary habitat improvement program for those populations which spawn in tributary streams which enter the Columbia River between McNary and John Day Dams (3 dam fish) will be addressed by USBR's conservation measure in three subbasins of the John Day River which improve habitat conditions for four populations. The John Day basin subbasins are the North Fork John Day, the Middle Fork John Day, and the Upper Mainstem John Day which includes the South Fork John Day.

This program will include projects which address the following limiting factors 1) fish entrainment, 2) instream flow deficiencies, and 3) compromised channel morphology. The USBR states that these limiting factors will be addressed in the following manner (Table 6.12). Fish entrainment at screens may be addressed through adding new screens, modifying existing screens to meet current criteria, or eliminating the diversion through replacement wells or other means. Instream flow projects include lease or purchase of streamflow, water conservation projects which yield actual "wet water" instream which may be secured through state water law. Not counted in this metric are gaging stations or other water measurement initiatives or investigations which may be necessary to support the evaluation and protection of instream flows for fish. Channel morphology projects include access projects which provide fish passage at structures or conditions that create migration barriers including diversion dams, culverts, low flow channels, etc. Stream complexity restoration projects include side channel connectivity, flood plain connectivity, channel reconfiguration, large woody debris placement, etc.

This program is explained more fully in Section III. D. 4 of the Updated Proposed Action. Summarizing that section, the Action Agencies propose to address the following limiting factors across the subbasins listed:

> ***John Day***: For the North Fork John Day, Middle Fork, Upper Mainstem and South Fork John Day subbasins the Action Agencies translated NOAA Fisheries' description of anthropomorphic limiting factors into those which are considered to describe the habitat

condition instead of "causative factors" in formulating the conservation measure. The Action Agencies also eliminated from consideration some of the "limiting factors" provided by NOAA Fisheries (such as fire activity and forestry) where the Action Agencies have no proposed authority to affect or influence local land use policy. The remaining "limiting factors" were translated into three factors which the Action Agencies can potentially influence by working with local willing landowners: streamflow, entrainment, and channel morphology.

Table 6.12. Proposed Conservation Measure, John Day Populations of Mid Columbia Steelhead, North Fork John Day, Middle Fork John Day, and Upper Mainstem John Day including the South Fork John Day Subbasins (from Updated Proposed Action, 30 August 2004).

Limiting Factor	Metric Measurement	Metric Goal in three years
Entrainment	a. Number of screens addressed	30
Instream flow projects	a. Cubic Feet per Second (cfs) of water protected for instream flows	7 cfs
Channel Morphology	a. Miles of access restored	24 miles
	b. Miles complexity restored	3 miles

USBR does not commit to implementing specific projects in these subbasins and therefore does not describe the associated planning, regulatory, or implementation processes. USBR does provide specific commitments in the form of three-year metric goals. These tables are excerpted below. Financial and other necessary resources will be available to meet the 3-year metric goals described above contingent upon continuing Congressional funding (Updated Proposed Action, 30 Aug. 2004, Appendix B).

USBR's tributary habitat conservation measure commits to addressing limiting factors identified in NOAA Fisheries' recent analysis of potential habitat improvement (Appendix E) across only the subbasins identified above based on opportunities verified by contacting local knowledgeable individuals and organizations, reviewing information made available by the Council's recently drafted subbasin plans, and consulting other state and local documents.

The Mid-Columbia River steelhead ESU is composed of 16 populations distributed across four major population groups. Therefore the distribution of projects across multiple major population groups is a complicating factor in the analysis of effect to the ESU. NOAA Fisheries is unable to determine the likely ultimate distribution of the achieved performance metrics across the targeted populations and major population groups within the ESU. NOAA Fisheries does not mean that the potential benefit of individual projects is insignificant at a local scale, but NOAA Fisheries cannot evaluate the overall benefit to the ESU based on the information provided.

The Action Agencies state that, based on their analysis, survival improvements can be anticipated from the conservation measure in the North Fork John Day, Middle Fork John Day, and Upper Mainstem John Day, including the South Fork John Day.

NOAA Fisheries cannot evaluate the likely effects of USBR's conservation measure. The Action Agencies' approach, described in step 9 of in Appendix B (Updated Proposed Action, 30 August 2004) bases estimates of cumulative biological benefits on a schedule for completing an array of projects identified by current opportunity and landowner willingness. The Action Agencies provide no assessment of the relationship between completing projects identified using such criteria and achieving the program magnitude and intensity needed to ensure the overall cumulative biological benefit needed to offset hydrosystem operation mortality. As an example, the Draft John Day Subbasin Plan (NPCC 2004) identifies instream temperature and instream flow as a moderate to high ubiquitous limiting factors in three of the four subbasins (Upper Mainstem excluded) within the proposed action in the John Day basin. These three subbasins cumulatively contain 247 miles of mainstem rivers alone which feed into the lower John Day River. NOAA Fisheries cannot consider the Action Agencies' cumulative performance metric goals appropriately enough to evaluate biological potential without additional information that explains the significance of the cumulative metric goals to the scope and magnitude factors limiting Mid-Columbia steelhead. NOAA Fisheries considered those tributary MCR steelhead projects identified in the PCTS since 2000 and determined that they would provide a Very Low immediate benefit.

The Action Agencies commit to implement a habitat effectiveness monitoring program in the John Day subbasin to confirm that the survival improvement goals are achieved. They expect this program to inform them about the survival effects of habitat improvement projects for this ESU. RM&E actions in the Updated Proposed Action will include an effects monitoring program for some of the projects implemented as part of the tributary conservation measure. The Action Agencies commit to adapting the mix and locations to meet metric goals when subbasin and recovery plans, other peer-reviewed information, and RME results indicate that a different mix would be more beneficial to fish recovery in the ESUs addressed in the tributary conservation measure.

6.10.2.3 Effect of Artificial Propagation Measures

BPA funds a safety-net project for this ESU to reduce the extinction risk and to "buy time" for survival improvement measures to take effect. In their August 30, 2004 Updated Proposed Action, the Action Agencies commit to continue to fund these programs at appropriate levels as long as they are determined by NOAA Fisheries to be effective at reducing the short-term risk of extinction. NOAA Fisheries has determined that the safety-net program for this ESU is effective at reducing the short-term risk of extinction.

6.10.2.4 Effect of Measures to Reduce Fish Predation

As described in Section 6.3.2.4, the ongoing NPMP is already accounted for in the estimation of the survival difference between the proposed action and the reference operation. The expected

survival improvement from the expanded NPMP would be an immediate 0.6% change, based on the Action Agencies' calculations, which would result in a **Low** improvement.

6.10.3 Net Effect of Hydro and Non-hydro Actions

6.10.3.1 Net Effect on Abundance, Productivity, and Distribution

NOAA Fisheries considered the net effect of the proposed hydro operations, proposed hydro configuration changes, and off-site actions, as described in Sections 6.10.1 and 6.10.2 (Table 6.9).

In 2004, the proposed hydro operations are expected to result in lower survival of the two major population groups that originate above McNary Dam an average of -9% (relative difference; 4.5% absolute difference), a **Medium** negative effect compared with the reference operation. Survival of three other major population groups that originate below McNary Dam would be lower by less than 1%, a **Low** negative effect compared with the reference operation. Continuation and expansion of the Northern Pikeminnow Management Program is estimated to have a **Low** positive effect (+<1% relative change) for all major population groups, as described in Section 6.3.2.4. For the two major population groups originating above McNary Dam, the difference between the proposed action and the reference operation would be a lower survival, and therefore a net reduction in the numbers and reproduction, because the positive fish predator reduction effect in the early years of the proposed action is less than the difference between the proposed hydro operations. There would be no net difference in these factors between the proposed action and the reference operation for the three MPGS originating below McNary Dam.

By 2010, the Action Agencies propose to complete structures that will improve fish passage at mainstem FCRPS dams, further reducing the impact of proposed long-term hydro operations by two-thirds to -3.1% for the two MPGs originating above McNary Dam and is, on average, a net slightly positive relative survival effect for the three MPGs originating at or below John Day Dam. In addition to the fish predation reduction program, the Action Agencies propose to implement the preferred alternative for Caspian tern management, which is expected to result in a Medium relative difference, which was estimated to be near +6% in Section 6.4.2 compared with the reference operation. Additionally, for the John Day major population group (which originates below McNary Dam), tributary habitat projects are proposed, which could further improve survival or increase distribution. The combination of the fish and avian predator reduction activities (two **Low** improvements) would, if quantified, be significantly higher than 3.1%. Therefore, for the two major population groups that originate above McNary Dam, the combination of expected improvements indicates that by 2010 it is likely that there would be no net change in the numbers, reproduction, or distribution of any of the MPGs in this ESU as a result of the proposed action compared with the reference operation.

6.11 UPPER WILLAMETTE STEELHEAD

6.11.1 Effect of Proposed Hydro Operations

6.11.1.1 Effects of Proposed Hydro Operations on Mainstem Habitat Conditions, Including in the Estuary and Plume

UWR steelhead enter the Columbia River at its confluence with the Willamette River, so they do not migrate past any mainstem dams. The primary estuary and plume habitat changes associated with proposed hydro operations are expected to be very similar to those described in Section 6.3 for SR spring/summer chinook salmon.

6.11.1.2 Qualitative Characterization of All Effects of Proposed Hydro Operations

Qualitatively, NOAA Fisheries concludes that the proposed action is likely to reduce abundance and productivity (productivity) of UWR steelhead by a **Very Low** amount for all populations and major population groups. It is not likely that the proposed action would reduce distribution or diversity of the ESU.

6.11.2 Effect of Non-hydro Measures

6.11.2.1 Effect of Measures to Protect, Enhance, and Restore Estuarine Habitat and to Reduce Predation in the Estuary

6.11.2.1.1 Enhance and Restore Estuarine Habitat. Like SR spring/summer chinook salmon, UWR steelhead display a stream-type life history strategy (Fresh *et al.* 2004). As described in section 6.3.2.1.1, the magnitude, extent, and distribution of the proposed estuary actions are expected to provide a very low benefit to yearling migrants (in the case of UWR steelhead, this level of benefit would apply to all the populations in the major population group). The full benefit to be derived from these two projects will accrue over the term of the Biological Opinion. Thus, the proposed action for estuary habitat restoration will provide **0 short-term** and a **0 long-term** (by 2010) benefit to the UWR steelhead. This level of benefit will accrue to all of the populations in the single major population group. NOAA Fisheries' ongoing efforts to refine the relationship between estuary habitat and salmon viability in order to inform our assessment of estuary habitat restoration over time is described in 6.3.2.1.1.

6.11.2.1.2 Reduction in Caspian Tern Predation Rates in the Estuary. The Action Agencies' proposed action for reducing predation rates by Caspian terns nesting in the estuary is described in section 6.3.2.1.2. Based on the projected levels of tern colony size resulting from implementation of alternatives C and D of the draft EIS, NOAA Fisheries estimates **0 short-term** and **medium long-term** (by 2010) benefit to UWR steelhead. This level of benefit will accrue to all of the populations in the single major population group.

6.11.2.2 Effect of Measures to Protect, Enhance, or Restore Tributary Habitat

The Action Agencies do not propose any non-hydro mitigation in the tributaries affecting Upper Willamette River steelhead. NOAA Fisheries concludes no benefit to population or ESU viability from tributary non-hydro mitigation actions for this ESU.

6.11.2.3 Effect of Artificial Propagation Measures

The Action Agencies are proposing to complete the HGMP planning process designed to identify hatchery improvements and reforms which could affect UWR steelhead. However, development of the plan itself will have no direct effect on the viability of this ESU.

6.11.2.4 Effect of Measures to Reduce Fish Predation

As described in Section 6.3.2.4, the ongoing NPMP is already accounted for in the estimation of the survival difference between the proposed action and the reference operation. The expected survival improvement from the expanded NPMP would be an immediate 0.6% change, based on the Action Agencies' calculations, which would result in a Low improvement.

6.11.3 Net Effect of Hydro and Non-hydro Actions

6.11.3.1 Net Effect on Abundance, Productivity, and Distribution

NOAA Fisheries considered the net effect of the proposed hydro operations, proposed hydro configuration changes, and off-site actions, as described in Sections 6.11.1 and 6.11.2 (Table 6.9).

The proposed hydro operations are expected to have a **Very Low** effect (i.e., close to zero) on survival of UWR steelhead through the estuary. It is likely that the proposed reduction in Caspian tern predation and proposed estuary habitat projects below the confluence of the Willamette River would have positive effects on the survival of UWR steelhead. In summary, it is likely that there would be no net difference, or possibly an improvement, in the numbers, reproduction, or distribution of this ESU between the proposed action and the reference operation.

6.12 LOWER COLUMBIA RIVER STEELHEAD

6.12.1 Effect of Proposed Hydro Operations

6.12.1.1 Effects of Proposed Hydro Operations on Mainstem Habitat Conditions, Including in the Estuary and Plume

The primary estuary and plume habitat changes associated with proposed hydro operations are expected to be very similar to those described in Section 6.3 for SR spring/summer chinook salmon.

6.12.1.2 Effect of Proposed Hydro Operations on Juvenile and Adult Mainstem Reach Survival

6.12.1.2.1 Effect of Proposed Hydro Operations and 2004 System Configuration. Most LCR steelhead originate below Bonneville Dam and do not migrate through any hydro projects. However, three populations in two major population groups migrate through Bonneville Dam and pool. Modeling results indicate that proposed hydro operations would reduce the survival of these three juvenile LCR steelhead populations an average of 0.3%, ranging from a survival improvement of 2.3% to a reduction of 1.3% (Table 6.7; Appendix D). The 0.3% relative reduction means that a survival improvement 1.003 times greater than the current survival rate in another life stage would be needed to offset the mortality associated with proposed hydro operations (range of no improvement needed to 1.013). The mortality associated with proposed hydro operations is expected to affect three populations of LCR steelhead, and that mortality is expected to begin immediately.

No difference in adult survival through Bonneville Dam and pool from the reference operation is expected as a result of proposed hydro operations (Appendix D).

6.12.1.2.2 Effect of Proposed Hydro Operations and 2010-2014 System Configuration Improvements. Modeling results indicate that proposed long-term hydro improvements and operations would slightly improve the relative survival of these three juvenile LCR steelhead populations that migrate through Bonneville Dam and pool by an average of 0.3%, ranging from a survival improvement of 2.6% to a reduction of 0.8% (Table 6.8; Appendix D). The 0.3% relative improvement means that, on average, no survival improvement in another life stage would be needed to offset the mortality associated with proposed long-term hydro operations (range of no survival improvement needed to an improvement of 1.008).

6.12.1.3 Qualitative Characterization of All Effects of Proposed Hydro Operations

Application of the combined qualitative "habitat approach" and the quantitative "survival approach" leads NOAA Fisheries to conclude that the proposed action is likely to reduce abundance and productivity (productivity) of LCR steelhead by a **Low** amount for all populations originating upstream of Bonneville Dam and by a **Very Low** amount for all other populations. Because of the differential effect on various populations, the proposed operation also is likely to reduce distribution and diversity of the ESU.

6.12.2 Effect of Non-hydro Measures

6.12.2.1 Effect of Measures to Protect, Enhance, and Restore Estuarine Habitat and to Reduce Predation in the Estuary

6.12.2.1.1 Enhance and Restore Estuarine Habitat. Like SR spring/summer chinook salmon, LCR steelhead display a stream-type life history strategy (Fresh *et al.* 2004). As described in section 6.3.2.1.1, the magnitude, extent, and distribution of the proposed estuary actions are expected to provide a very low benefit to yearling migrants (in the case of LCR steelhead, this level of benefit would apply to all the populations and major population groups). The full benefit

to be derived from these two projects will accrue over the term of the Biological Opinion. Thus, the proposed action for estuary habitat restoration will provide **0 short-term** and **0 long-term** (by 2010) benefits to LCR steelhead. This level of benefit will accrue to all of the populations in all of the major population groups. NOAA Fisheries' ongoing efforts to refine the relationship between estuary habitat and salmon viability in order to inform our assessment of estuary habitat restoration over time is described in 6.3.2.1.1.

6.12.2.1.2 Reduction in Caspian Tern Predation Rates in the Estuary. The Action Agencies' proposed action for reducing predation rates by Caspian terns nesting in the estuary is described in section 6.3.2.1.2. Based on the projected levels of tern colony size resulting from implementation of alternatives C and D of the draft EIS, NOAA Fisheries estimates level of benefit for LCR steelhead as approximately **0 short-term** and **medium long-term** (by 2010) benefits (i.e., a 5% relative increase in survival) to LCR steelhead. This level of benefit will accrue to all of the populations in all of the major population groups.

6.12.2.2 Effect of Measures to Protect, Enhance, or Restore Tributary Habitat

The Action Agencies do not propose any non-hydro mitigation in the tributaries affecting Lower Columbia River steelhead. NOAA Fisheries concludes no benefit to population or ESU viability from tributary non-hydro mitigation actions for this ESU.

6.12.2.3 Effect of Artificial Propagation Measures

BPA funds a safety-net project for this ESU to reduce the extinction risk and to "buy time" for survival improvement measures to take effect. In their August 30, 2004 Updated Proposed Action, the Action Agencies commit to continue to fund these programs at appropriate levels as long as they are determined by NOAA Fisheries to be effective at reducing the short-term risk of extinction. NOAA Fisheries has determined that the safety-net program for this ESU is effective at reducing the short-term risk of extinction. It is not, however, considered to apply toward mitigating the hydro effects described in Sections 6.12.1.1 and 6.12.1.2.

6.12.2.4 Effect of Measures to Reduce Fish Predation

As described in Section 6.3.2.4, the ongoing NPMP is already accounted for in the estimation of the survival difference between the proposed action and the reference operation. The expected survival improvement from the expanded NPMP would be an immediate 0.6% change, based on the Action Agencies' calculations, which would result in a Low improvement.

6.12.3 Net Effect of Hydro and Non-hydro Actions

6.12.3.1 Net Effect on Abundance, Productivity, and Distribution

NOAA Fisheries considered the net effect of the proposed hydro operations, proposed hydro configuration changes, and off-site actions, as described in Sections 6.12.1 and 6.12.2 (Table 6.9).

6.12.3.1.1 Cascade Summer-Run and Coastal Winter-Run MPGs. These major population groups originate below Bonneville Dam and rear primarily in streams, so there is a **Very Low** negative difference between the proposed action and the reference operation for these MPGs. The reduction in avian predation is expected to result in a **Medium** improvement for this MPG. Therefore, it is likely that there would be no net difference, and over time an improvement, in the numbers, reproduction, and possibly distribution of these MPGs as a result of the proposed action.

6.12.3.1.2 Gorge Winter-Run and Gorge Summer-Run MPGs. Most populations in these major population groups originate upstream of Bonneville Dam and migrate through Bonneville pool and dam. There is likely to be less than a -1% **Low** negative difference due to lower passage survival through the Bonneville. No difference in adult survival through Bonneville Dam and pool from the reference operation is expected as a result of proposed hydro operations (Appendix D).

6.12.3.1.3 Effect of Proposed Hydro Operations and 2010-2014 System Configuration Improvements. Modeling results indicate that proposed long-term hydro improvements and operations would slightly improve the relative survival of these three juvenile LCR steelhead populations that migrate through Bonneville Dam and pool by an average of 0.3%, ranging from a survival improvement of 2.6% to a reduction of 0.8%.

Continuation and expansion of the Northern Pikeminnow Management Program is estimated to have a **Low** positive effect (+<1% relative change) for this MPG. The reduction in avian predation is expected to result in a **Medium** improvement for this MPG. Therefore, it is likely that there would be no net difference, and possibly an improvement over time, in the numbers, reproduction, or distribution of this MPG as a result of the proposed action.

6.13 COLUMBIA RIVER CHUM SALMON

6.13.1 Effect of Proposed Hydro Operations

6.13.1.1 Effects of Proposed Hydro Operations on Mainstem Habitat Conditions, including in the Estuary and Plume

Most populations of CR chum salmon originate below Bonneville Dam and do not migrate past hydro projects. However, if there is an extant population in the Upper Gorge (Section 4.3.11), some juveniles migrate through Bonneville pool and dam. Juvenile migration occurs during the spring, when flows are very similar to reference operation flows, so little or no effect on water quantity and velocity is expected for any populations. As with other spring migrants, water quality is also unlikely to be reduced by the proposed action during the spring. Safe passage through barriers could be impacted by reduced spill at Bonneville Dam for the Upper Gorge population. Adult migration, spawning, and rearing occur during the late fall and early winter, when the proposed action provides higher flows than those associated with the reference operation. Therefore, there is likely to be either no change or an improvement in functioning of spawning and incubation habitat for the mainstem populations.

Rearing habitat is likely to be unaffected by the proposed action during the spring. To the extent that CR chum salmon rear in the estuary during the summer, when proposed flows are significantly lower than reference operation flows, the amount of available shallow-water habitat would be reduced by the lower summer flows under the proposed operation. Juvenile chum salmon have a high reliance on shallow-water rearing habitat in the Columbia River estuary (Fresh *et al.* 2004).

6.13.1.2 Effect of Proposed Hydro Operations on Juvenile and Adult Mainstem Reach Survival

6.13.1.2.1 Effect of Proposed Hydro Operations and 2004 and 2010 System Configuration. There are no quantitative estimates of the effect of the proposed action on this ESU. Individuals emerging from the Upper Gorge that would migrate through Bonneville pool and dam could experience mortality within the range estimated for other ESUs, but this assumption and the existence of an Upper Gorge population are both very uncertain. Assuming the survival effect is similar to the effect on listed chinook, there would be an approximately 1% reduction in survival for this population due to proposed hydro operations in 2004, and less than a 1% reduction in survival for this population under the long-term proposed hydro operation.

No difference in adult survival through Bonneville Dam and pool from the reference operation is expected as a result of proposed hydro operations (Appendix D).

6.13.1.3 Qualitative Characterization of All Effects of Proposed Hydro Operations

Based on the qualitative "habitat approach" and application of approximate survival estimates derived from other species to the individuals that migrate past Bonneville Dam, NOAA Fisheries concludes that the proposed action is likely to reduce abundance and productivity (productivity) of CR chum salmon by a **Low** amount. Because of the differential effect on various populations, the proposed operation also is likely to reduce distribution and diversity of the ESU.

6.13.2 Effect of Non-hydro Measures

6.13.2.1 Effect of Measures to Protect, Enhance, and Restore Estuarine Habitat and to Reduce Predation in the Estuary

6.13.2.1.1 Enhance and Restore Estuarine Habitat. Columbia River chum salmon are small ocean-type migrants when they leave their spawning tributaries and enter the lower Columbia River. Expected benefits of the proposed estuary actions are the same as those described in section 6.6.2.1.1 for subyearling UWR chinook salmon, **0 short-term** and **low long-term** (by 2010). This level of benefit will accrue to all of the populations in all of the major population groups. NOAA Fisheries' ongoing efforts to refine the relationship between estuary habitat and salmon viability in order to inform our assessment of estuary habitat restoration over time is described in 6.3.2.1.1.

6.13.2.1.2 Reduction in Caspian Tern Predation Rates in the Estuary. The Action Agencies' proposed action for reducing predation rates by Caspian terns nesting in the estuary is described

in section 6.3.2.1.2. NOAA Fisheries anticipates that there will be **0 short-term** and **very low long-term** (by 2010) benefits to small subyearling CR chum salmon. This level of benefit will accrue to all of the populations in all of the major population groups.

6.13.2.2 Effect of Measures to Protect, Enhance, or Restore Tributary Habitat

The Action Agencies do not propose any non-hydro mitigation in the tributaries affecting Columbia River chum salmon. NOAA Fisheries concludes no benefit to population or ESU viability from tributary non-hydro mitigation actions for this ESU.

6.13.2.3 Effect of Artificial Propagation Measures

BPA funds a safety-net project for this ESU to reduce the extinction risk and to "buy time" for survival improvement measures to take effect. In their August 30, 2004 Updated Proposed Action, the Action Agencies commit to continue to fund these programs at appropriate levels as long as they are determined by NOAA Fisheries to be effective at reducing the short-term risk of extinction. NOAA Fisheries has determined that the safety-net program for this ESU is effective at reducing the short-term risk of extinction. It is not, however, considered to apply toward mitigating the hydro effects described in Sections 6.13.1.1 and 6.13.1.2.

6.13.2.4 Effect of Measures to Reduce Fish Predation

As described in Section 6.3.2.4, the ongoing NPMP is already accounted for in the estimation of the survival difference between the proposed action and the reference operation. The expected survival improvement from the expanded NPMP would be an immediate 0.6% change, based on the Action Agencies' calculations, which would result in a **Low** improvement.

6.13.3 Net Effect of Hydro and Non-hydro Actions

6.13.3.1 Net Effect on Abundance, Productivity, and Distribution

NOAA Fisheries considered the net effect of the proposed hydro operations, proposed hydro configuration changes, and off-site actions, as described in Sections 6.13.1 and 6.13.2 (Table 6.9).

6.13.3.1.1 Cascade and Coastal MPGs. These major population groups originate below Bonneville Dam and use the estuary for rearing. There is an unquantifiable **Low** effect of the proposed action on this MPG due to lower flows and smaller rearing habitat under the proposed action, relative to the reference operation. The reduction in estuarine tern predation would result in a **Medium** improvement for this MPG. Therefore, it is possible that in the short term there would be lower numbers but likely that such a decrease will be balanced over time by an improvement in the numbers, reproduction, or distribution of these MPGs as a result of the proposed action.

6.13.3.1.2 Gorge MPG. One of two populations in this major population group may originate upstream of Bonneville Dam and migrate past Bonneville dam. There is an unquantifiable **Low**

negative difference due to lower reduced passage survival through the Bonneville project in the proposed action compared with the reference operation. Continuation and expansion of the Northern Pikeminnow Management Program is estimated to have a Low positive effect (+<1% relative change) for this MPG. The reduction in estuarine tern predation would result in a **Medium** improvement for this MPG. Therefore, it is possible that in the short term there would be lower numbers but likely that such a decrease will be balanced over time by an improvement in the numbers, reproduction, or distribution of these MPGs as a result of the proposed action.

6.14 SNAKE RIVER SOCKEYE SALMON

6.14.1 Effect of Proposed Hydro Operations

6.14.1.1 Effects of Proposed Hydro Operations on Mainstem Habitat Conditions, Including in the Estuary and Plume

Effects of the proposed action on habitat function are expected to be nearly identical to those described for SR spring/summer chinook salmon in Section 6.3. These effects are minor, except for safe passage past barriers, which is impaired by lower spill levels in the proposed hydro operation.

6.14.1.2 Effect of Proposed Hydro Operations on Juvenile and Adult Mainstem Reach Survival

6.14.1.2.1 Effect of Proposed Hydro Operations and 2004 and 2010 System Configuration. There are no quantitative estimates of the effect of the proposed 2004 hydro operation on SR sockeye salmon. This ESU may experience mortality that is somewhat greater than the ranges estimated for SR spring/summer chinook salmon and SR steelhead, but this assumption is very uncertain, especially with regards to transportation effectiveness. Assuming the survival effect is similar to that of listed chinook , there is likely to be, on average, a low effect of hydro operations in 2004 and an effect between **Very Low** and **Low** by 2010. Some additional improvements would also be expected between 2010 and 2014 as additional configuration changes are implemented.

No difference in adult survival is expected between the proposed hydro operation and the reference operation (Appendix D).

6.14.1.3 Qualitative Characterization of All Effects of Proposed Hydro Operations

Application of the combined qualitative "habitat approach" and the quantitative "survival approach" leads NOAA Fisheries to conclude that the proposed action is likely to reduce abundance and productivity (productivity) of Snake River sockeye salmon by a **Low** amount for the single extant population in 2004 and a **Very Low** to **Low** amount by 2010-2014. It is not likely that the proposed action would reduce distribution or diversity of the ESU.

6.14.2 Effect of Non-hydro Measures

6.14.2.1 Effect of Measures to Protect, Enhance, and Restore Estuarine Habitat and to Reduce Predation in the Estuary

6.14.2.1.1 Enhance and Restore Estuarine Habitat. Like SR spring/summer chinook salmon, SR sockeye display a stream-type life history strategy (Fresh *et al.* 2004). As described in section 6.3.2.1.1, the magnitude, extent, and distribution of the proposed estuary actions are expected to provide a very low benefit to yearling migrants (in the case of SR sockeye, this level of benefit would apply to the single remaining population). The full benefit to be derived from these two projects will accrue over the term of the Biological Opinion. Thus, the proposed action for estuary habitat restoration will provide **0 short-term** and **0 long-term** (by 2010) benefits to SR sockeye salmon. This level of benefit will accrue to the single remaining population. NOAA Fisheries' ongoing efforts to refine the relationship between estuary habitat and salmon viability in order to inform our assessment of estuary habitat restoration over time is described in 6.3.2.1.1.

6.14.2.1.2 Reduction in Caspian Tern Predation Rates in the Estuary. The Action Agencies' proposed action for reducing predation rates by Caspian terns nesting in the estuary is described in section 6.3.2.1.2. Because so few sockeye salmon reach the estuary, NOAA Fisheries anticipates that the proposed action will result in **0 short-term** and **0 long-term** (by 2010) benefits to yearling SR sockeye salmon migrants. This level of benefit will accrue to the single remaining population.

6.14.2.2 Effect of Measures to Protect, Enhance, or Restore Tributary Habitat

The Action Agencies do not propose any non-hydro mitigation in the tributaries affecting Snake River sockeye. NOAA Fisheries concludes no benefit to population or ESU viability from tributary non-hydro mitigation actions for this ESU.

6.14.2.3 Effect of Artificial Propagation Measures

BPA has funded a safety-net program for Snake River sockeye salmon since 1991. This program has included captive broodstock rearing and research, genetic analysis, and habitat and limnological research. The Action Agencies are proposing to continue funding this safety-net program. In their August 30, 2004 Updated Proposed Action, the Action Agencies commit to continue to fund these programs at appropriate levels as long as they are determined by NOAA Fisheries to be effective at reducing the short-term risk of extinction.

The safety-net program has prevented likely extinction (60 FR 33102, June 14, 2004) of this ESU and remains very important to the ESU's continued existence. However, risks to all four VSP parameters (abundance, productivity, spatial structure, and diversity) are still very high, resulting in considerable uncertainty about its future viability. Nearly the entire ESU resides in the captive broodstock program, which has demonstrated limited success in returning anadromous adults. In 2000, over 250 anadromous adults returned to the Stanley Basin, most from a yearling smolt release. A consistent yearling smolt program has not occurred due to lack

of dedicated rearing facilities and disease concerns, and anadromous adults have numbered fewer than 30 since 2001 (69 FR 33102, June 14, 2004). The longer this ESU relies on the captive broodstock program for its existence, the greater the risks associated with domestication and loss of genetic diversity, which will increase the difficulty of reestablishing a viable population in its native habitat. As indicated in Table 6.9, the safety-net program is providing a high level of benefit by assuring the continued existence of the ESU, but the current benefit would likely lessen over time unless a rapid increase in anadromous adults occurs.

6.14.2.4 Effect of Measures to Reduce Fish Predation

As described in Section 6.3.2.4, the ongoing NPMP is already accounted for in the estimation of the survival difference between the proposed action and the reference operation. The expected survival improvement from the expanded NPMP would be an immediate 0.6% change, based on the Action Agencies' calculations, which would result in a Low improvement.

6.14.3 Net Effect of Hydro and Non-hydro Actions

6.14.3.1 Net Effect on Abundance, Productivity, and Distribution

NOAA Fisheries considered the net effect of the proposed hydro operations, proposed hydro configuration changes, and off-site actions, as described in Sections 6.14.1 and 6.14.2 (Table 6.9).

In 2004, the proposed hydro operations are expected to result in lower survival of the single major population group of SR sockeye an unquantifiable **Low** negative effect compared with the reference operation. Continuation and expansion of the Northern Pikeminnow Management Program is estimated to have a **Low** positive effect (+<1% relative change), as described in Section 6.3.2.4. By 2010, the Action Agencies' propose to complete structures that will improve fish passage at mainstem FCRPS dams, further reducing the differences between the proposed hydro actions and the reference operation from **Low** to **Very Low** for the single major population group. The combination of hydro and fish predator reduction effects is likely to result in a reduction in the short-term but no long-term change in the numbers, reproduction, and distribution of this ESU as a result of the proposed action compared with the reference operation.