Draft

Mainstem/Systemwide Juvenile and Adult Passage Program Summary

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Northwest Power Planning Council

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DRAFT: This document has not yet been reviewed or approved by the Northwest Power Planning Council

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Mainstem/Systemwide Juvenile and Adult Passage Program Summary

I. Program Description

The Council's responsibility is to mitigate the impact of hydropower dams on all fish and wildlife in the Columbia River Basin, including endangered species, through a program of enhancement and protection. The purpose of this program summary is to explain the history, the current status, and the future needs of meeting the juvenile and adult passage responsibilities within the Council's Fish and Wildlife Program.

A. Purpose of Program - technical and/or scientific background

Nearly concurrent with development of dams on rivers, concern about their impact on fish passage was considered, which prompted legislation to address this issue. The Rivers and Harbors Appropriation Act of 1888 identified a need for fishways when obstructions were built. The Federal Power Act of 1920 required fishways at all private hydropower dams. The Fish & Wildlife Coordination Act of 1934 (reauthorized in 1958) specifically required coordination between Federal operating agencies and Federal fish and wildlife agencies before water resource development. To a large degree, as a result of the intent of these Acts, all mainstem dams below Grand Coulee Dam on the upper Columbia River and Hells Canyon Dam on the Snake River were constructed with adult fishways. Additionally, in 1951, the Chief of the U.S. Army Corps of Engineers (COE) authorized a fisheries research program for the North Pacific Division (now called the Northwestern Division) to study problems of juvenile and adult fish passage at Columbia River Basin dams. The adoption of the Northwest Power Planning and Conservation Act of 1980 (PL 96-501) added emphasis to the COE responsibilities and established responsibility for fish protection, mitigation, and enhancement for system-wide Federal impacts from hydropower development with funding the responsibility of the Bonneville Power Administration (BPA). Finally, the Federal Energy Regulatory Commission (FERC) has responsibility to oversee fish passage issues related to mainstem dams operated by the Mid-Columbia Public Utility Districts on the upper Columbia River.

Between the 1950s and 1990s, millions of dollars were spent on research and monitoring of juvenile and adult fish passage at mainstem dams. The results of the research led to millions of dollars in costs for structural and operational fish passage improvements at the dams. In spite of these efforts and dollars spent, most species of Columbia River salmon (identified as distinct evolutionarily significant units [ESUs]) were listed during the 1990s as threatened or endangered under the U.S. Endangered Species Act (ESA). These listings led to the 2000 National Marine Fisheries Service (NMFS) Biological Opinion (BIOP) for the Federal Columbia River Power System (FCRPS). The NMFS 2000 BIOP specifies actions, research, and monitoring necessary to avoid jeopardy for the FCRPS. The BIOP outlines a number of performance standards for the mainstem, means to achieve them, and specifies that

the standards need evaluation. The evaluations of the actions to achieve the performance standards are conducted primarily through research and monitoring activities under COE and BPA funding for mainstem projects/work. Further, the Northwest Power Planning Council (NWPPC) Fish and Wildlife Program identifies the need for monitoring and evaluation of mitigation actions within the Columbia River Basin in support of an adaptive management framework.

B. Scope of Program - management application, geographic scope, and species populations affected/benefited

Historically, the scope of the Council program in juvenile and adult passage has been limited to research, monitoring, and evaluations. In a separate program, the Corps of Engineers has also made significant efforts toward passage improvements and related RM&E. The two programs have grown significantly over the past several years along with the region's interest in providing safe passage and improving the survival of salmon. Now, the Corps and Council's programs need to be considered together in order to effectively describe the juvenile and adult passage program for the Mainstem and System-wide Provincial Review. All juvenile and adult passage-related efforts to date must be considered in order to determine the future needs. By looking at all passage needs, then identifying what is already being covered by the Corps' program, we can begin to see where the Council's passage program efforts are needed. This may or may not be limited to RM&E.

The geographic scope of the juvenile and adult passage program includes the lower Columbia, lower Snake, and middle Columbia River projects with fish passage. The lower Columbia River projects include Bonneville, The Dalles, John Day, and McNary. The lower Snake River projects include Ice Harbor, Lower Monumental, Little Goose, and Lower Granite. The middle Columbia River projects include Priest Rapids, Wanapum, Rock Island, Rocky Reach, and Wells.

The species populations affected and benefited by the passage program include Snake River fall chinook salmon, Upper Columbia River spring chinook salmon, Lower Columbia River chinook salmon, Snake River steelhead, Upper Columbia River steelhead, Middle Columbia River steelhead, Lower Columbia River steelhead, Columbia River chum salmon, and Snake River sockeye salmon, lamprey, bull trout.

II. Accomplishments/Results

A. Adaptive Management Implications – historic and current changes in management, future applications

B. Benefits to fish and wildlife - role of program efforts in the Council's Program

Projects funded over the past several years by BPA under the NWPPC Fish and Wildlife Program have formed a mainstem RM&E program that provides a basis for within-year fish

passage management and implementation of BIOP measures. In addition, the continuity and consistency of the monitoring programs provides a basis for longer-term mitigation decisions. BPA is currently funding a total of nine interrelated juvenile and adult passage projects in the mainstem. The nine-mainstem BPA funded projects are shown in Table X.

C. Project funding to date - total amount of BPA funding since program inception

Table 1. Current Adult and Juvenile Passage Programs Funded by BPA Through the Council Program.

Project ID	Project Title	Sponsor	Funding to Date
199008000	Columbia River Basin PIT Tag Information Systems	Pacific States Marine Fisheries Commission	$ 17,050,000
198331900	New Marking and Monitoring Techniques for Fish	National Marine Fisheries Service	$ 18,400,000
200100300	Adult PIT Detector Installation (formerly funded under 198331900)	Pacific States Marine Fisheries Commission	$ 600,000
199808001	PIT Tag Purchase and Distribution	Pacific States Marine Fisheries Commission	$ 8,990,000
199302900	Survival Estimates for the Passage of Juvenile Salmonids Through Snake and Columbia River Dams and Reservoirs	National Marine Fisheries Service	$ 7,250,000
199102900	Understand the Effects of Summer Flow Augmentation on the Migrating Behavior and Survival of Juvenile Fall Chinook Salmon Migrating through Lower Granite Reservoir	U.S. Fish and Wildlife Service	$ 9,820,000
198712700	Smolt Monitoring by Federal and Non-Federal Agencies	Pacific States Marine Fisheries Commission	$ 30,530,000
199602000	Comparative Survival Rate Study (CSS) of Hatchery Pit Tagged Chinook & Comparative Survival Study Oversight Committee	Pacific States Marine Fisheries Commission	$ 1,250,000
199403300	The Fish Passage Center (FPC)	Pacific States Marine Fisheries Commission	$ 9,160,000
199105100	Monitoring and Evaluation Statistical Support	University of Washington	$ 3,490,000
198910700	Statistical Support for Salmonid Survival Studies	University of Washington	$ 2,250,000

These funded projects fall into three general categories, as follows:

1. **Fundamental structure for research and monitoring.** All of the projects in the mainstem research/monitoring group rely to a large extent, or almost exclusively, on information gathered from PIT-tagged fish. Additionally, over 60 other NWPPC Fish and Wildlife Program projects utilize PIT tags, as do many projects funded by the COE. The Columbia Basin PIT tag Information System (PITAGIS), Project #199008000, maintains and manages all regional PIT tag data. New Marking and Monitoring Techniques for Fish, Project #198331900, develops and evaluates PIT tag interrogation systems and ancillary equipment in the mainstem and throughout the basin. For example, this project developed technology for interrogating tagged salmonids in fish ladders and is currently developing technology for interrogating tagged salmonids in small streams; the latter effort would provide a tool that would enable fish passage data and survival estimates to include natal stream information. The evaluations of the technologies developed are critical because they determine the accuracy of the data that will be collected by future users. Project 200100300, Adult PIT Detector Installations, is currently installing detectors in all of the fish ladders at Bonneville and McNary. PIT Tag Purchase and Distribution, Project #199808001, provides tags for approved marking studies. These four projects provide the fundamental structure for the implementation of the remaining mainstem projects as well as other COE funded projects and tributary projects that utilize PIT tags. The implementation of the other mainstem research and monitoring projects are dependent upon the successful implementation of these projects.

2. **Research/monitoring.** Information on the effects of the FCRPS operation on fish passage through the mainstem is gathered by five research/monitoring projects. Survival Estimates for the Passage of Juvenile Salmonids Through the Snake and Columbia Dams and Reservoirs, Project #199302900, provides estimates of reach and project survival with known precision and explores the relationships among fish travel time, fish survival and environmental conditions, and compares them to adult returns. Understanding The Effects Of Summer Flow Augmentation On The Migratory Behavior And Survival Of Juvenile Fall Chinook Salmon Migrating Through Lower Granite Reservoir, Project #199102900, addresses the effects of summer flow augmentation in the Snake River on water velocity and temperature in Lower Granite Reservoir; the resulting effect of water velocity and temperature on migratory behavior of naturally spawning fall chinook salmon; and the period and location of fall chinook salmon mortality in their downstream passage from natal areas in the free flowing Snake River. The Annual Smolt Monitoring Program, Project # 198712700, marks fish at traps and collects data on real-time passage, condition, and species composition of fish as they pass trapping and juvenile passage facilities at mainstem dams. The Fish Passage Center, Project #199602000, gathers real time smolt passage data, such as travel time, passage timing, and passage indices relative to project operations, from throughout the Snake and Columbia Rivers and provides it to regional managers daily

as a basis for hydrosystem management relative to fish passage and the implementation of BIOP measures. The Comparative Survival Study, Project #198712700, marks fish at specific hatcheries and evaluates smolt to adult return data from hatchery and wild PIT-tag groups based on their passage routes through the hydropower system.

3. **Technical Support.** Two projects in the mainstem system-wide review provide technical support for BPA. Statistical Support for Salmonids Survival Studies, Project #198910700, and Monitoring and Evaluation Statistical Support, Project #199105100, assess all salmon tagging projects in the BPA Fish and Wildlife Program to assure that these studies are designed and analyzed from the onset to extract the best available information utilizing state of the art statistical methods. These projects are intended to assist the entire regional fisheries community in design and analysis of tagging studies and data.

D. COE funded mainstem projects - The following is a summary of the passage-related work that the Corps currently plans to fund.

RPA	Project Description
Adult Passage	
107, 111	Evaluation of Adult Salmon and Steelhead Migrations Past Dams, Through Reservoirs and Into Tributaries at McNary Dam and Snake River – 2001
109	Evaluate steelhead kelt downstream migration from Lower Granite Dam to Bonneville Dam and investigate methods to increase returns to repeat spawners to the Snake River Basin.
50, 192	Evaluation of the performance of the Adult PIT Tag Detection Systems at McNary Dam
60, 107, 111, 113, 118	Evaluation of Adult Salmon and Steelhead Migrations Past Dams, Through Reservoirs and Into Tributaries in the Lower Columbia River – 2001
60, 107, 111, 113, 116, 118	Evaluation of Adult Salmon and Steelhead Migrations Past Dams, Through Fish Ladders and Into Tributaries in the Lower Columbia River- 2001
60, 113,118	Evaluation of Energy Expenditure in Adult Salmon and Steelhead Migrating Upstream in the Columbia and Snake Rivers: Understanding the Influence of Delay, Fallback, Water Temperature and Dam Operations on Fish Performance
118, 119	Evaluation of Adult Salmon, Steelhead and Lamprey Migrations Past Dams and Through Reservoirs in the Lower Columbia River and Into Tributaries

RPA	Project Description
119	Swimming Performance and Exhaustive Stress in Pacific Lampreys (*Lampetra tridentate)*: Implications for Upstream Migrations Past Dams
119	Assessment of Steel Floor Plates Installed on Diffuser Gratings to Facilitate Passage of Adult Pacific Lamprey Through Fish Ladders
109	Evaluation of Steelhead Kelt Passage Through the Lower Columbia River
192	Evaluation of adult salmonid behavior passing weirs with and without orifice pit-tag detector inserts installed
106	Pinniped Distribution and Behavior in Response to Adult Salmonid Passage at Bonneville Dam
106	Evaluation of Sea Lion (*Zalophus californianus)* Predation in the Bonneville Dam Tailrace
108	Prevention of Prespawning Salmon Mortality: Cause of Salmon Headburns and Cranial Lesions
Juvenile Bypass Systems	
74	Studies to Establish Biological Design Criteria for Fish Passage Facilities: Prototype Testing of a Cylindrical Dewatering Screen at McNary Dam
87, 94	Post-Construction Evaluation of the Modified PIT-Tag Diversion System and Bypass at Little Goose Dam
193	Evaluation of Full-Flow PIT-Tag Interrogation System at McNary Dam
67	Continued Evaluation of Intake Modifications at Bonneville Dam Second Powerhouse
67	Evaluation of Juvenile Fish Guidance Efficiency and Gap Loss at a Powerhouse 2 Submerged Traveling Screen Using Fixed-Aspect Hydroacoustics and an Acoustic Camera
73	Evaluation of Modified Vertical Barrier Screens, Outlet Flow Control Device and Extended-Length Bar Screens at John Day Dam
73	Use of the Acoustic Camera to Evaluate the Intake Environment at the Modified ESBS at John Day Dam
87	Development of a Full-Flow PIT-Tag Interrogation System for Bonneville Dam
97	Completion of Bonneville First Powerhouse Juvenile Bypass System Plans and Specifications. Holding for decision to proceed with construction.

RPA	Project Description
62	Evaluation of Bonneville First Powerhouse Fish Guidance Improvements, potential addition of extended length screens at the bypass system. Determine need for additional prototype testing for extended screens meeting fry criteria. If warranted, begin modeling to develop new prototypes for testing.
81	Reinitiation of design of the Lower Granite juvenile bypass facility, which includes a new flume, holding & loading facility, and channel modifications.
	Bull Trout
	Supplement Tributary Marking of Bulltrout to Asses Mainstem Use and Distribution
	Surface Bypass
80, 138	Fixed-Location Hydroacoustic Evaluation of the Removable Spillway at Lower Granite Dam
80, 138	Migrational Characteristics of Juvenile Spring Chinook Salmon and Steelhead in the Forebay of Lower Granite Dam Relative to Removable Spillway Weir Tests
80, 138	Three Dimensional Fish Tracking in Conjunction with the Operation of the Lower Granite Removable Spillway Weir (RSW) Tests
86	Use of Turbulent Flow to Improve Juvenile Salmon Guidance
69	Hydroacoustic Evaluation and Surface Flow Bypass Studies at The Dalles Dam in 2002
69	Studies of Surface Flow Bypass at The Dalles Dam
	Transportation and Delayed Mortality
45, 46, 47	A Study to Compare SAR's of Inriver Migrating Versus Transported Anadromous Salmonids (LGR and McNary)
45,46,47	Evaluation of Migration and Survival of Juvenile Steelhead Following Transportation
45,46,47	Evaluation of Physiological Condition of Transported Juvenile Salmonids and Effects on Survival
45,46,47	Evaluate the Migration Behavior of PIT-Tagged Juvenile Salmonids in the Columbia River Estuary
45,46,47	Evaluation of Physiological Changes in Migrating Juvenile Salmonids and Effects on Performance and Survival
45,46,47	A Study to Compare Long-Term Survival and Disease Susceptibility of Yearling Hatchery Chinook Salmon Smolts With Different Juvenile Migration Histories
189	Evaluation of Delayed Mortalitiy of Juvenile Salmonids in the Near Ocean Environment Following Passage Through the Columbia River Hydrosystem

RPA	Project Description
Project and System Survival Studies	
82, 83, 84, 134	Evaluation of Ice Harbor Dam Spillway Survival
82, 83, 134	Evaluation of Lower Granite Dam Spillway Survival
82, 83, 134	Evaluation of Lower Monumental Spillway Survival and Efficiency
83,84	Evaluation of Tailrace Egress and Outfall Survival at McNary Dam
134, 82, 83	Hydroacoustic Evaluation of Juvenile Fish Passage and Project Fish Passage Efficiency (FPE) at Bonneville Dam in 2002
82, 83, 134, 90, 64	Movement, Distribution and Passage Behavior of Radio-Tagged Juvenile Salmonids at Bonneville Dam Associated with FPE and Survival Tests
82, 83, 71, 90, 64	Estimate the Survival of Migrant Juvenile Salmonids in the Columbia River from John Day Dam Through Bonneville Dam Using Radio-Telemetry
68, 70, 82, 92	Tailrace Egress Times and Routes of Travel of Juvenile Salmonids Following Sluiceway and Turbine Passage at The Dalles Dam
68, 83	Estimate the Stilling Basin Residence Time and Lateral Distribution of Passage of Juvenile Chinook Salmon Passing Through the Spillway at The Dalles Dam
68, 83	Characterizations of The Dalles Dam Spillway Environment
100	Behavior and Modeling of Predator-Prey Interactions in The Dalles and John Day Dam Tailraces
83, 82, 71	Hydroacoustic Evaluation of Downstream Fish Passage at John Day Dam in 2002
82, 83, 71	Evaluation of the John Day Dam Spillway as a Juvenile Salmon Passage Route
82, 83, 71	Estimate the Spill Efficiency and Effectiveness and Forebay Residence Times of Juvenile Salmonids to 12-Hour and 24-Hour Spill at John Day Dam
82, 83, 71	Monitor Tailrace Egress in the Stilling Basin and at the Juvenile Bypass System Outfall Under Test Discharge Levels at John Day Dam
104	Electronic Recovery of ISO-PIT Tags from Piscivorous Bird Colonies in the Columbia River Basin
Turbine Survival Studies	
88, 89, 90, 92, 93	Turbine Survival Program- Estimate mortality and identify injury rate and type to juvenile salmon and kelts passed through turbines at the McNary Hydroelectric Station
Estuary Studies	
189	Evaluation of Delayed Mortalitiy of Juvenile Salmonids in the Near Ocean Environment Following Passage Through the Columbia River Hydrosystem
195, 161	A Study to Estimate Salmonid Survival Through the Columbia River Estuary Using Acoustic Tags
197, 161	Evaluation of the Relationship Among Time of Ocean Entry, Physical and Biological Characteristics of the Estuary and Plume Environment and Adult Return Rates

RPA	Project Description
105,158, 159, 196, 161	Estuarine Habitat and Juvenile Salmon- Current and Historic Linkages in the Lower Columbia River and Estuary
196, 161	Development and Evaluation of Habitat Restorations in the Lower Columbia River and Estuary: Comparative Studies of Natural and Restored Estuarine Habitats by Juvenile Salmon
161	Movements of Coastal Cutthroat Trout (*Oncorynchus clarki*) in the Lower Columbia River: Tributary, Main-Stem and Estuary Use

E. Mid-Columbia projects

Mainstem passage projects conducted in the upper Columbia River under auspices of the mid-Columbia Public Utility Districts are reviewed and approved within a separate FERC process. This program is described in the Upper Middle Mainstem Summary, although BPA funded mainstem-monitoring projects described in this mainstem summary extend into the Upper Middle Mainstem province.

Currently, the Douglas and Chelan County PUD's are working with Federal, state, and tribal agencies to finalize a plan for implementing the mid-Columbia Habitat Conservation Plan (HCP). The HCP's goals, objectives and strategies are described in the Upper Middle Mainstem Summary. But from a system wide perspective, it is worth noting the project goal is to provide dam passage juvenile survival rates of 95% for each plan species (spring chinook, summer/fall chinook, sockeye, and coho salmon and steelhead) at each project.

Juvenile project passage and survival studies have been completed or are ongoing at Wells, Rocky Reach, and Rock Island Dams for yearling chinook and steelhead. Additional studies are expected in the next three to ten years, including studies for subyearling chinook, sockeye, and coho salmon when technology and/or fish numbers allow.

Chelan PUD, NMFS, and USGS are cooperatively evaluating the potential for acoustic tags to be used as a tool for evaluating juvenile dam passage survival at Rocky Reach and Rock Island Dams. Should this technology prove adequate for this task, dam passage survival studies for plan species may be implemented over the next three to ten years.

A juvenile bypass system is likely to be operational at Rock Island Dam in the spring of 2003. Biological and hydraulic studies to evaluate the operation and effectiveness of this system as well as the survival of juveniles through this system are expected to begin in 2003 and continue for several years. Yearling and subyearling chinook salmon and steelhead will likely be tested initially with sockeye and coho being tested at a later date when technology and/or fish numbers allow.

In addition, adult radio-telemetry studies have been conducted to evaluate the passage of spring chinook and steelhead through the Mid-Columbia projects. These studies are expected to continue and expand to include all plan species in the next three to ten years.

F. Reports and Technical Papers – reports or scientific papers produced as a result of this program and how they have been disseminated

This program has produced numerous reports, technical papers, and related documents. A listing of those funded by the BPA through the Council program is included in Attachment 1.

III. Relationship of program to USFWS/NMFS Biological Opinion - RPA Actions and the Action Agencies Implementation Plans for the FCRPS Biological Opinions

This program will meet many of the requirements of the RPA in the NMFS 2000 Biological Opinion. The most significant BiOp requirement relevant to this program is the passage survival performance standard. The hydro standards, described in Table 9.2-3 of the NMFS BiOp, are the estimated juvenile and adult survival levels throughout the FCRPS that are expected to result from the numerous RPA actions. The Action Agencies are expected to meet these performance standards within the next ten years.

A. Implementation Plan Strategy

The Action Agencies have developed a Five-year Implementation Plan for meeting the NMFS BiOp requirements, including the passage survival performance standard. The Action Agencies' basic hydrosystem strategy is to make operational and structural fish passage improvements at FCRPS projects that will increase the survival of listed fish.

More specifically, the primary strategies are intended to:

- Improve project configuration and operations to increase adult and juvenile survival at dams.
- Improve juvenile survival in reservoirs.
- Improve adult survival.
- Improve water quality.

In addition, a number of related strategies are included:

- Manage available storage to improve survival in reservoirs and rivers.
- Seek opportunities to acquire additional water for improving fish survival.
- Transport juvenile fish where opportunities for improved survival exists.
- Protect bull trout and sturgeon from adverse effects of salmon operations through flows and ramping rates.
- Consider and address effects on cultural resources.

The hydro system strategy also includes a comprehensive research, monitoring, and evaluation program. The primary objectives of the RM&E component of the Implementation Plan are:

- Track the status of fish populations and their environment relative to required performance standards.
- Identify the physical and biological responses to management actions.
- Resolve critical uncertainties in the methods and data required for the evaluation of future population performance and needed survival improvements.

A disciplined and well coordinated RM&E program is needed to help confirm scientific assumptions, resolve key scientific uncertainties, and provide the basis for performance tracking and adaptive management. A coordinated program will maximize efficiencies, avoid duplication, and properly control experiments to minimize confounding factors or actions.

For Salmon and Steelhead, the strategy for RM&E includes the following principles:

- Maintain and modify ongoing RM&E efforts until a more structured and coordinated RM&E framework and plans are developed and approved,
- Expeditiously implement RM&E actions that address high priority needs,

Collaborate with the NMFS recovery planning and research programs, the Federal Caucus' Basinwide Salmon Recovery Strategy, the NWPPC subbasin planning, and State and Tribal planning efforts to develop a basin wide RM&E program and data management system. The Implementation Plan's proposed RME structure identifies five levels of monitoring that correspond with the four tiers of performance measures identified in the Implementation Plan.

Tier 1. Population Monitoring - assesses annual population growth (lambda).

Tier 2. Life-Stage Survival Monitoring - assesses egg-smolt survival, juvenile migration survival, estuary and ocean survival, and adult migration survival.

Tier 3(a). Biological Monitoring - assesses attributes such as presence/absence, distribution, abundance, straying, reproductive success, fecundity, habitat use, genetic variability, and fish condition factor, health, and growth.

Tier 3(b). Physical/Environmental Monitoring - assesses attributes associated with properly functioning condition (PFC), resource availability, temperatures, total dissolved gases, distribution and abundance of competitors and predators, and distribution and abundance of exotics.

Tier 4. Compliance Monitoring - assesses whether management actions have been implemented properly and maintained.

Each type of monitoring is further divided into three levels of monitoring:

- Status Monitoring - assesses the status of fish and their environment over time. Status monitoring is not designed to assess effects of management actions on fish and their environment. Rather they simply track trends over time.

- Effectiveness Monitoring - assesses the effects of management actions on fish and their environment. Here the purpose is to use valid studies to assess the success of management actions.
- Research - explores areas of critical uncertainty (e.g., delayed (extra) mortality, reproductive success of wild and hatchery fish, stray rates of wild fish).
- The structure described in this Plan spatially partitions RM&E within three geographic zones: (1) tributary habitat (2) hydropower corridor; and (3) estuary and nearshore ocean environment.

B. Implementation Plan to Meet Passage Performance Standards

The Corps' and Council's programs make up virtually all of the juvenile and adult passage improvements and corresponding research, monitoring, and evaluations within this region. Additionally, the Council's program provides most of the data that will be used to assess progress toward this performance standard. The passage-related actions needed to meet the performance standards in the NMFS 2000 BiOp include the following.

Action 10: The Action Agencies shall work with NMFS and others to promptly incorporate the results of recovery planning into annual Fish and Wildlife Program implementation funding, including support for incorporation of the results into the NWPPC's Fish and Wildlife Program.

Action 13: The Action Agencies shall issue annual reports to NMFS and USFWS on progress toward achieving the performance standards set out in this biological opinion, including comprehensive cumulative reviews in years 3, 5, and 8.

Action 14: The Action Agencies shall operate FCRPS dams and reservoirs with the intent of meeting the flow objectives (Table 9.6-1) on both a seasonal and weekly average basis for the benefit of migrating juvenile salmon.

Action 40: The Corps shall continue to transport all non-research juvenile salmonids collected at the Snake River collector projects. The Corps and BPA shall continue to implement voluntary spill at all three Snake River collector projects when seasonal average flows are projected to meet or exceed 85 kcfs.

Action 41: The Corps and BPA shall continue (pending results of the McNary Transport Evaluation) to bypass juvenile spring migrants collected at McNary Dam and shall provide the spring spill levels described for that project.

Action 42: The Corps and BPA shall operate the collector projects to maximize collection and transportation during the summer migration (i.e., no voluntary spill except as NMFS deems necessary for approved research).

Action 43: The Corps shall not initiate collection of subyearling fall chinook for transportation at McNary Dam until inriver migratory conditions are deteriorating (i.e., no longer spring-like).

Action 44: The Corps shall extend the period of barge transportation from the lower Snake River dams and McNary to further reduce reliance on trucking.

Action 45: By the end of 2001, the Corps shall develop, in coordination with NMFS and the other Federal, state, and Tribal salmon managers, a McNary Dam

transportation evaluation study plan specifically focusing on the response of UCR spring chinook and steelhead to transportation. Approved research should begin by 2002, if feasible.

Action 46: The Corps and BPA, in coordination with NMFS through the annual planning process, shall evaluate transport to inriver return ratios for wild SR yearling chinook salmon and steelhead. In addition, the Corps and BPA shall also evaluate the effects of transportation on summer-migrating subyearling SR chinook salmon.

Action 47: During all transport evaluations, the Corps and BPA, in coordination with NMFS through the annual planning process, shall include an evaluation of delayed mortality (D) of transported versus inriver migrating juvenile anadromous salmonids.

Action 48: The Corps and BPA shall evaluate the effects of prior transport as smolts on the homing of adults.

Action 49: The Corps shall evaluate strategies to enhance post-release survival of transported fish; examples of such strategies include timing releases so that fish arrival at the estuary corresponds to minimal interactions with predators and maximum availability of forage and locating releases so as to decrease passage time through areas of high predation.

Action 50: BPA and the Corps shall install necessary adult PIT-tag detectors at appropriate FCRPS projects before the expected return of adult salmon from the 2001 juvenile outmigration.

Action 51: If results of Snake River studies indicate that survival of juvenile salmon and steelhead collected and transported during any segment of the juvenile migration (i.e., before May 1) is no better than the survival of juvenile salmon that migrate inriver, the Corps and BPA, in coordination with NMFS through the annual planning process, shall identify and implement appropriate measures to optimize inriver passage at the collector dams during those periods.

Action 52: The Corps shall identify and implement improvements to the transportation program.

Action 53: The Corps shall evaluate and implement structural and operational alternatives to improve juvenile transportation at the collector dams.

Action 54: The Corps and BPA shall implement an annual spill program, consistent with the spill volumes and TDG limits identified in Table 9.6-3, at all mainstem Snake and Columbia River FCRPS projects as part of the annual planning effort to achieve the juvenile salmon and steelhead performance standards.

Action 58: The Corps and BPA, in coordination with the Fish Passage Operations and Maintenance Coordination Team (FPOM), shall operate all turbine units at FCRPS dams for optimum fish passage survival.

Action 59: The Action Agencies, in coordination with the Regional Forum, shall determine the appropriate operating range of turbines equipped with minimum gap runners (MGRs) to increase survival of juvenile migrants passing through these new turbine designs.

Action 60: The Corps and BPA shall evaluate adult fallback and juvenile fish passage under daytime spill to the gas cap at Bonneville Dam in 2002 and 2003, after deflector optimization improvements allow for increased spill above current levels. Research results will be considered, in consultation with NMFS through the annual planning process, to determine implementation of additional changes in spill to further improve fish survival.

Action 61: The Corps shall complete the ongoing prototype powerhouse system surface collection evaluations at Bonneville First Powerhouse in 2000. The Corps shall compare the prototype with screened bypass systems and, if warranted, design and construct permanent facilities after full consideration and resolution of biological and engineering uncertainties, especially high-flow outfall investigations.

Action 62: The Corps shall complete Bonneville First Powerhouse prototype evaluations of extended submerged intake and gatewell vertical barrier screens, including an assessment of fry passage.

Action 63: The Corps shall complete the design of debris removal facilities for the Bonneville First Powerhouse forebay.

Action 64: The Corps shall continue the investigation of minimum gap runners at the Bonneville First Powerhouse.

Action 65: The Corps shall complete Bonneville Second Powerhouse post-construction evaluation of the new juvenile fish bypass outfall and address design and operational refinements as warranted.

Action 66: The Corps shall continue design development and construction of a Bonneville Second Powerhouse permanent corner collector at the existing sluice chute, pending results of high-flow outfall investigations. The Corps shall construct new facilities if, and as soon as, evaluations confirm the optimum design configuration and survival benefits.

Action 67: The Corps shall continue Bonneville Second Powerhouse investigations of measures to improve intake screen fish guidance efficiency and safe passage through the gatewell environment. This work shall include an assessment of fry passage.

Action 68: The Corps and BPA shall continue spill and passage survival studies at The Dalles Dam in 2001. Research results shall be considered, in consultation with NMFS through the annual planning process, to assess the need for additional changes in spill to further improve fish survival by 2002, if possible, but no later than 2005.

Action 69: The Corps shall continue design development and 2001 prototype testing of upper turbine intake occlusion devices at The Dalles, with a goal of increased non- turbine passage rates through either the sluiceway or the spillway. The Corps shall install occlusion devices across the entire powerhouse, as warranted.

Action 70: The Corps shall continue biological and engineering investigations and design of a composite ice and trash sluiceway outfall relocation and adult ladder auxiliary water system at The Dalles Dam and shall construct such devices as warranted.

Action 71: The Corps and BPA shall continue investigation of 24-hour spill at John Day Dam in 2001. Research results will be considered, in consultation with NMFS through the annual planning process, to determine implementation of daytime spill to further improve juvenile fish survival as needed for its contribution to the performance standard.

Action 72: The Corps shall continue design development of a prototype RSW and extended deflector for testing at John Day in 2002. The Corps should synthesize evaluation results, determine the fish survival benefits of one or more RSWs or a skeleton bay surface bypass, and install the units as warranted.

Action 73: The Corps shall continue John Day prototype development and investigations of extended submerged intake screens, gatewell vertical barrier screens, and, if necessary, orifices to optimize guidance and safe passage through the system, including a gatewell debris cleaning plan. This work shall include an assessment of fry passage. The Corps shall design and construct new screen systems for safe passage of juvenile salmonids, as warranted. Juvenile bypass outfall survival investigations shall also be conducted.

Action 74: The Corps shall continue evaluations to assess the need for improvements of the existing intake screens, gatewell vertical barrier screen cleaning system, and bypass facilities (including debris containment and removal systems, separation, sampling, loading, and outfall facilities) at McNary to determine where improvements are necessary to reduce problems experienced during the 1996 flood, increase fish survival, and resolve holding and loading facility problems, including raceway jumping by juvenile salmon and steelhead and debris plugging of bypass lines. Additionally, the Corps shall evaluate whether the existing juvenile bypass system outfall should be relocated.

Action 75: The Corps shall investigate a surface bypass RSW at McNary Dam, based on prototype results at other locations, and shall install the unit in multiple spillway bays, as warranted.

Action 76: The Corps shall investigate, design, and construct, as warranted, a new juvenile bypass outfall at Lower Monumental Dam. Investigations shall be conducted in conjunction with spillway deflector and spill pattern optimization studies.

Action 77: The Corps shall investigate surface bypass (e.g., RSW) at Lower Monumental Dam, based on prototype results at other locations, and install in multiple spillway bays, as warranted.

Action 78: The Corps shall initiate design development and testing of extended submerged intake screens and vertical barrier screens at Lower Monumental Dam and construct units as warranted.

Action 79: The Corps shall conduct a post-construction evaluation of the new debris containment boom at Little Goose to monitor populations and behavior of aquatic predators when debris accumulates at the log boom.

Action 80: The Corps shall continue the design development, fabrication/deployment, and testing of a prototype RSW at Lower Granite, in conjunction with the existing prototype powerhouse occlusion devices, including the forebay

behavioral guidance structure (BGS) and upper turbine intake occlusion devices. As warranted by prototype test results, the Corps shall install one or more permanent RSWs and occlusion devices at appropriate lower Snake hydro projects, in coordination with the annual planning process.

Action 81: The Corps shall complete design for new juvenile bypass facilities at Lower Granite Dam, including enlarged orifices and bypass gallery, open-channel flow bypass, improved separator for juvenile separation by size, and improved fish distribution flumes and barge-loading facilities and shall proceed to construction, as warranted.

Action 82: The Action Agencies, in coordination with NMFS through the annual planning process, shall investigate the spillway passage survival of juvenile salmonids at appropriate FCRPS dams. These investigations shall assess the effect of spill patterns and per-bay spill volumes on fish survival, across a range of flow conditions. The Action Agencies shall develop a phased approach (including costs and schedules) and set priorities, in consultation with NMFS in the annual planning process, to continue spillway passage survival studies in 2001 and future years.

Action 83: The Action Agencies, in coordination with NMFS through the annual planning process, shall evaluate the effect of spill duration and volume on spillway effectiveness (percent of total project passage via spill), spill efficiency (fish per unit flow), forebay residence time, and total project and system survival of juvenile steelhead and salmon passing FCRPS dams. Studies shall include both collector and non-collector projects. Adult passage considerations and potential adult fallback shall also be considered in study designs. Little Goose and Lower Granite dams shall be specifically considered for daytime spill studies. An overall phased study approach for spill evaluations will be determined in the 1- and 5-year implementation plans.

Action 84: The Corps shall continue high-flow outfall investigations to determine whether it is appropriate to modify bypass outfall criteria in the context of high-discharge bypass discharges.

Action 85: The Corps shall continue to develop and evaluate improved fish-tracking technologies and computational fluid dynamics (numerical modeling). The ability to integrate these technologies and fluid dynamics shall be assessed as a potentially improved means of determining fish responses to forebay hydraulic conditions.

Action 86: The Corps shall continue to investigate a way to increase entry rates of fish approaching surface bypass/collector entrances.

Action 87: The Corps and BPA shall assess less-intrusive, PIT-tag interrogation methods at FCRPS juvenile bypass systems with interrogation sites, including McNary, John Day, and Bonneville dams. The Corps and BPA shall also assess providing a similar detection capability for the Ice Harbor juvenile bypass system.

Action 88: The Corps and BPA, in coordination with the Fish Facility Design Review Work Group and the Fish Passage Improvement Through Turbines Technical

Work Group, shall continue the program to improve turbine survival of juvenile and adult salmonids.

Action 89: The Action Agencies shall investigate hydraulic and behavioral aspects of turbine passage by juvenile steelhead and salmon through turbines to develop biologically based turbine design and operating criteria. The Corps shall submit a report to NMFS stating the findings of the first phase of the Turbine Passage Survival Program by October 2001. Annual progress reports will be provided after this date.

Action 90: The Action Agencies shall examine the effects of draft tubes and powerhouse tailraces on the survival of fish passing through turbines.

Action 91: The Action Agencies shall remove all unnecessary obstructions in the higher velocity areas of the intake-to-draft tube sections of the turbine units.

Action 92: The Action Agencies shall consider all state-of-the-art turbine design technology to decrease fish injury and mortality before the implementation of any future turbine rehabilitation program (including any major repair programs, the ongoing rehabilitation program at The Dalles Dam, and any future program at Ice Harbor Dam). The Action Agencies shall coordinate within the annual planning process before making decisions that would preclude the use of fish-friendly technologies and to minimize any adverse effects of project downtime.

Action 93: The Action Agencies shall determine the number of adults passed through turbines, then, if warranted, investigate the survival of adult salmonid passage through turbines (including steelhead kelts).

Action 94: The Corps shall continue to evaluate the need for improvements of the existing intake screens, gatewell vertical barrier screens' cleaning system, and bypass facilities (including debris containment and removal systems, separation, sampling, loading, and outfall facilities) at the four lower Snake River hydropower projects.

Action 95: The Corps shall complete investigations of improved wet separator designs in 2002. The Corps shall design and construct a new wet separator at McNary, Lower Monumental, and Little Goose dams, as warranted.

Action 96: The Corps shall complete the extended submerged intake screen systemwide letter report and implement recommended improvements.

Action 98: By January 2003, the Action Agencies shall develop an analysis that compares the relative passage survival benefits of replacing existing standard-length intake screens with extended-length screens at the John Day Dam powerhouse to surface collection at one or more skeleton or spillway bays. Through the annual planning process, the Action Agencies shall then determine the need for, and the implementation priority of, these configuration alternatives.

Action 99: By January, 2003, the Action Agencies shall develop an analysis that compares the relative passage survival benefits of replacing existing standard-length intake screens with extended-length screens at the Lower Monumental Dam powerhouse turbines to a removable RSW surface bypass system.

Action 104: Recover PIT-tag information from predacious bird colonies and evaluate trends, including hatchery and wild depredation ratios, to support system survival evaluations.

Action 107: The Action Agencies shall conduct a comprehensive evaluation to assess survival of adult salmonids migrating upstream and factors contributing to unaccounted losses.

Action 108: The Corps and BPA shall conduct a comprehensive evaluation to investigate the causes of headburn in adult salmonids and shall implement corrective measures, as warranted.

Action 109: The Corps shall initiate an adult steelhead downstream migrant (kelt) assessment program to determine the magnitude of passage, the contribution to population diversity and growth, and potential actions to provide safe passage.

Action 110: The Corps shall use information from previous and ongoing investigations regarding the problem of adult steelhead holding and jumping in the fish ladders at John Day Dam, develop a proposed course of action, and implement it, as warranted.

Action 111: The Corps shall investigate and enumerate fallback of upstream migrant salmonids through turbine intakes at all lower Snake and lower Columbia River dams. The Corps shall implement corrective measures to reduce turbine mortality, as warranted.

Action 112: The Corps shall investigate ways to provide egress to adult fish that have fallen back into juvenile collection galleries and primary dewatering facilities at Ice Harbor and McNary dams. The Corps shall either install structural, or implement operational, remedies to minimize delay and injury of fish that fall back, as warranted.

Action 113: The Corps shall investigate measures to reduce adult steelhead and salmon fallback and mortality through the Bonneville Dam spillway. A final report shall be submitted to NMFS stating the findings of these investigations and recommending corrective measures. Potential remedies shall be included in the annual planning process.

Action 114: The Corps shall examine existing fish-ladder water temperature and adult radio- telemetry data to determine whether observed temperature differences in fishways adversely affect fish passage time and holding behavior. If non-uniform temperatures are found to cause delay, means for supplying cooler water to identified areas of warmer temperatures should be developed and implemented in coordination with the annual planning process.

Action 115: The Corps and BPA shall conduct a comprehensive depth and temperature investigation to characterize direct mortality sources at an FCRPS project considered to have high unaccountable adult losses (either from counts and/or previous adult evaluations).

Action 116: The Corps shall investigate adult fish delay and fallback at ladder junction pools and implement remedies to reduce this problem, as warranted.

Action 117: The Corps shall evaluate adult count station facilities and rehabilitate where necessary at all projects to either minimize delay of adults or minimize counting difficulties that reduce count accuracy.

Action 118: The Corps shall develop and implement a program to better assess and enumerate indirect prespawning mortality of adult upstream-migrating fish. Such mortality may be due to, or exacerbated by, passage through the FCRPS hydro projects. If measures are identified which will reduce the unaccountable adult loss rate and/or the prespawning mortality rate, the Corps shall implement these measures as warranted. The program should also enhance efforts to enumerate unaccountable losses associated with tributary turnoff, harvest, or other factors in FCRPS mainstem reservoirs and upstream of FCRPS projects.

Action 119: The Corps shall ensure that alterations to fish ladders and adult passage facilities to accommodate Pacific lamprey passage do not adversely affect salmonid passage timing and success.

Action 120: The Corps shall develop improved operations for adult fishway main entrances at FCRPS dams so that the best possible attraction conditions are provided for adult migrants, both at the four Columbia River hydro projects and the four lower Snake hydro projects (where reservoir elevations are held near MOP). The Corps shall report the findings of fishway entrance flow-balancing investigations in a report to NMFS by the end of 2001 and shall continue to work through FPOM to evaluate and implement, as warranted, structural changes to satisfy fish passage plan fishway entrance criteria.

Action 121: The Corps shall develop and maintain an auxiliary water supply, emergency-parts inventory for all adult fishways where determined necessary, in coordination with NMFS.

Action 122: The Corps shall continue design development and, subsequently, construct an emergency auxiliary water supply system at The Dalles Dam's east ladder.

Action 123: The Corps shall continue to investigate alternatives to dewater adult auxiliary water system floor diffusers for inspection at The Dalles adult fishway powerhouse collection channel. The Corps shall implement design and construction of needed changes, as warranted.

Action 124: The Corps shall investigate methods to provide additional emergency auxiliary water to The Dalles Dam north fishway when the normal auxiliary water supply is interrupted.

Action 125: The Corps shall develop and implement an automated monitoring and alarm system at appropriate FCRPS projects, as determined in the NMFS Regional Forum, to monitor changes in head differential remotely between the primary auxiliary water supply conduits/channels and the adult collection channels and to minimize diffuser damage due to excessive differentials. The Corps shall ensure that diffuser gratings for all auxiliary water supply systems are securely fastened. The Corps shall work through FPOM to develop a monitoring program for inspecting diffuser gratings and grating fasteners.

Action 126: The Corps shall initiate an investigation and prepare a report on the Bonneville First Powerhouse Bradford Island and Cascade Island adult

fishway auxiliary water system by the end of 2001. In the report, the Corps shall identify measures that will improve or replace aging components, thereby enhancing current and long- term performance and reliability.

Action 127: The Corps shall continue its investigation of the Bonneville Second Powerhouse adult fishway auxiliary water system and shall identify measures to satisfactorily address emergency backup auxiliary water needs.

Action 128: The Corps shall initiate an engineering study to evaluate existing limitations relating to its inability to satisfy fish passage plan operating criteria at the John Day Dam north shore ladder.

Action 129: The Corps shall complete adult fishway auxiliary water supply evaluations at each lower Snake River hydro project and implement corrective measures as warranted.

Action 134: The Corps shall continue the spillway deflector optimization program at each FCRPS project and implement it, as warranted. The Corps and BPA shall conduct physical and biological evaluations to ensure optimum gas abatement and fish passage conditions. Implementation decisions will be based on the effect of spill duration and volume on TDG, spillway effectiveness, spill efficiency, forebay residence time, and total project and system survival of juvenile salmon and steelhead passing FCRPS dams.

Action 138: The Corps shall continue to investigate RSWs, in conjunction with extended spillway deflectors, as a means of optimizing safe spillway passage of adult steelhead kelts and juvenile migrants.

Action 144: The Corps, in coordination with the Regional Forum, shall maintain juvenile and adult fish facilities within identified criteria and operate FCRPS projects within operational guidelines contained in the Corps' Fish Passage Plan. The Corps shall coordinate with NMFS on the development of these criteria and operational guidelines before the start of each fish passage season (generally February 1).

Action 154: BPA shall work with the NWPPC to ensure development and updating of subbasin assessments and plans; match state and local funding for coordinated development of watershed assessments and plans; and help fund technical support for subbasin and watershed plan implementation from 2001 to 2006. Planning for priority subbasins should be completed by the 2003 check-in. The action agencies will work with other Federal agencies to ensure that subbasin and watershed assessments and plans are coordinated across non-Federal and Federal land ownerships and programs.

Action 185: The Action Agencies shall continue to fund and expand, as appropriate, fish marking and recapturing programs aimed at defining juvenile migrant survival for both transported and nontransported migrants and adult returns for both groups. These studies shall also compare the SARs of transported and nontransported fish to calculate the differential delayed mortality (D), if any, of transported fish.

Action 186: The Action Agencies and NMFS shall work within the annual planning and congressional appropriation processes to establish and provide the appropriate level of FCRPS funding for comparative evaluations of the behavior and

survival of transported and downstream migrants to determine whether causes of D can be identified for the reach between Bonneville Dam and the mouth of the Columbia River.

Action 187: The Action Agencies and NMFS shall work within the annual planning and congressional appropriation processes to establish and provide the appropriate level of FCRPS funding for studies and analyses to evaluate relationships between ocean entry timing and SARs for transported and downstream migrants.

Action 188: The Action Agencies and NMFS shall work within the annual planning and congressional appropriation processes to establish and provide the appropriate level of FCRPS funding for studies of PIT-tagged wild stocks from the lower river streams. The studies shall be used to contrast stock productivity and hydrosystem effects.

Action 189: The Action Agencies and NMFS shall work within the annual planning and congressional appropriation processes to establish and provide the appropriate level of FCRPS funding for studies to investigate the causes of discrepancies in adult return rates for juvenile salmonids that have different passage histories through the hydrosystem.

Action 190: The Action Agencies shall continue to fund studies that monitor survival, growth, and other early life history attributes of Snake River wild juvenile fall chinook.

Action 191: The Action Agencies shall continue to implement adult salmonid counting programs at FCRPS dams, but shall improve the reporting of these counts.

Action 192: As set out in Action 50 (Section 9.6.1.3.4), BPA and the Corps shall install necessary adult PIT-tag detectors at appropriate FCRPS projects before the expected return of adult salmon from the 2001 juvenile outmigration. These adult PIT-tag detectors shall be used as needed for calculating transport benefits, conversion rates, and SARs for listed salmon and steelhead.

Action 193: The Action Agencies shall investigate state-of-the-art, novel fish detection and tagging techniques for use, if warranted, in long-term research, monitoring, and evaluation efforts.

Action 195: The Action Agencies shall investigate and partition the causes of mortality below Bonneville Dam after juvenile salmonid passage through the FCRPS.

Action 199: The Action Agencies shall implement the specific research/monitoring actions outlined in Appendix H, which include:

Research Action 900: Research to determine the relative survival of migrating juvenile salmonids passing through the spillway of The Dalles Dam. Run-of-the-river fish, including ESA-listed fish, will be collected at John Day Dam and/or obtained from the smolt monitoring program. Study fish will be handled (anesthetized and sorted) and released or PIT-tagged, transported to The Dalles Dam, held for up to 24 hours, and released at selected locations. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.4.5 and 9.6.1.4.6.

Research Action 946: Research to assess the migration timing and relative survival of transported and inriver juvenile chinook salmon migrating volitionally from Bonneville Dam to the mouth of the Columbia River. Run-of-river fish, including ESA-listed juvenile fish, will be observed/harassed while they pass through a PIT-tag interrogation net or captured, anesthetized, examined for PIT-tags and the degree of descaling, allowed to recover from the anesthetic, and released. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.3.3 and 9.6.5.3.5.1.

Research Action 994: Research to assess the passage success of migrating adult salmonids at the eight dams and reservoirs on the lower Columbia and the lower Snake rivers, to evaluate specific flow and spill conditions, and to evaluate measures to improve adult anadromous fish passage. Adult salmonids will be captured at Bonneville, Ice Harbor, and/or Lower Granite dams, anesthetized, fitted with radio transmitters and identifier tags, allowed to recover from the anesthetic, transported, and released. Once the fish are returned to the river, the movement and migration timing of each fish will be recorded at fixed-site and mobile receiver stations as the fish migrate upstream. The primary benefits of the research will be identifying problematic areas in the migration corridor for adult passage and determining the proportion of salmonids that ultimately pass the upstream dams and enter tributaries to spawn, that enter hatcheries, that are taken in fisheries, or that are losses. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.2.6, 9.6.1.6.2, and 9.6.1.7.2.

Research Action 996: Research to monitor the effects of the juvenile fish bypass system at Ice Harbor Dam on the Snake River in Washington. Run-of-the-river juvenile fish, a proportion of which will be ESA-listed fish, will be collected from the bypass system at the dam, anesthetized, handled, allowed to recover from the anesthetic, and released. The primary purpose of the sampling is to ascertain fish condition and, thereby, to certify that the bypass system functions correctly. Some adult fish, including ESA-listed adult salmon, are expected to fall back through the juvenile bypass system and be captured and handled in the effort to return them to the river. The research is necessary to satisfy elements of the RPA described in Section 9.6.1.4.5.

Research Action 1036: Research to document the growth, migration timing, survival, and SARs for wild juvenile fall chinook salmon migrating from the Snake River to the mouth of the Columbia River. Wild fall chinook salmon will be collected along the Hells Canyon Reach of the Snake River and PIT-tagged. The results will be used to monitor the effects of supplementation, to forecast passage at Lower Granite Dam to help plan summer flow augmentation, and to assess the relative impacts due to predation. Observed migration timing and survival will be used to evaluate the effectiveness of summer flow augmentation. If feasible, one group of PIT-tagged fish will be transported from Lower Granite Dam, and another group will be allowed to

continue inriver migration. The research consists of six assessment tasks for which ESA-listed fish will be taken: 1) life cycle, 2) food and growth, 3) predation, 4) temperature response, 5) migratory behavior, and 6) race and residualism. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.2.1, 9.6.1.2.6, 9.6.1.3.3, 9.6.1.5.2, 9.6.1.7.2, 9.6.2.1, and 9.6.5.3.5.

Research Action 1058: Research designed to monitor and evaluate adult returns of hatchery-origin fall chinook salmon released as juveniles above Lower Granite Dam on the Snake River. Information on ESA-listed, natural-origin fish is needed to assess the impacts of fish management (e.g., hatchery supplementation) and other human activities (e.g., regulated river flows) on wild fish populations. The research has two components: 1) radio-tagging returning adult salmon at Lower Granite Dam to document the movements and spawning distribution of known natural-origin fall chinook salmon above the dam and 2) collecting data and scale or tissue samples from spawned-out adult fish in the Snake River and tributaries above Lower Granite Dam to augment information on spawning distribution collected from the radio-tagged fish. The research is necessary to satisfy elements of the RPA described in Section 9.6.1.6.2.

Research Action 1130: Research to determine the movement, distribution, and passage behavior of radio-tagged juvenile salmonids at Bonneville, The Dalles, and John Day dams on the lower Columbia River. The results will be used to assess fish passage efficiency at John Day and The Dalles dams and to increase bypass efficiency for juvenile salmonids at the dams by designing and positioning prototype surface bypass/collection structures. ESA-listed fish will be acquired from smolt-monitoring program personnel at Bonneville, John Day, and/or McNary dams, implanted with radio transmitters, transported, held for as long as 24 hours, released, and tracked electronically. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.4.5 and 9.6.1.4.6.

Research Action 1136: Research to compare the biological and physiological indices of wild and hatchery juvenile fish exposed to stress from bypass, collection, and transportation at the dams on the lower Snake and Columbia rivers. The goal is to provide information that can be used to improve outmigrating juvenile salmonid survival by determining the effects of manmade structures and management activities on the fish. ESA-listed juvenile fish will be captured at Lower Granite and Little Goose dams on the lower Snake River and at Bonneville, John Day, and McNary dams on the lower Columbia River, or acquired from smolt-monitoring-program personnel. The captured juvenile fish will be examined and released or tagged with radio transmitters, released, and tracked electronically. A lethal take of ESA-listed juvenile fish will also occur. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.3.3, 9.6.1.3.4, and 9.6.1.4.6.

Research Action 1193: Research to produce information on migrational characteristics of Columbia and Snake river basin salmon and steelhead. The smolt monitoring program produces information on the migrational characteristics of the various salmon and steelhead stocks in the Columbia and Snake River basins and provides management information for implementing flow and spill measures designed to improve fish passage conditions in the mainstem lower Snake and Columbia rivers. The smolt-monitoring sites include tributary monitoring at the Whitebird trap on the Salmon River, the lower Grande Ronde River trap, and the Lewiston (Snake River) trap. The program also includes monitoring at Lower Granite, Little Goose, Lower Monumental, McNary, and John Day dams and at Bonneville Dam First and Second Powerhouses. Monitoring, including tagging actively migrating smolts with PITs at the tributary traps, yields information on migration timing to FCRPS dams, travel time, and relative survival data from release to Lower Granite Dam, the first dam encountered by outmigrating Snake River salmonids. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1 and 9.6.5.3.5.1.

Research Action 1194: Research to develop and evaluate adult PIT-tag interrogation systems for future installation at mainstem FCRPS facilities on the lower Columbia and Snake rivers. Studies will evaluate the ability of new PIT-tag detection technology to detect and read tag codes in orifices of fish ladders and to evaluate the effects of the detection system on the behavior of adults as they approach the system and pass through. Initial efforts will provide information about adult salmonid behavior during passage through Bonneville Dam and will help evaluate fish passage at other hydropower dams in the future. The new technology will allow tag readings from a greater distance than is currently feasible to allow data collection in a more natural fishway environment. The study is directed at nonlisted adult hatchery fish, but authorization is provided for ESA-listed adult hatchery fish because they often cannot be distinguished while collecting run-of-the-river fish. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.3.3, 9.6.1.3.4, and 9.6.5.3.5.2.

Research Action 1212: Research consisting of four studies at the hydropower dams on the lower Snake and Columbia rivers. Study 1 will provide up-to-date survival estimates of juvenile salmonids as they migrate past McNary Dam. Study 2 will identify specific trouble areas in the juvenile fish bypass system at Lower Monumental Dam. Study 3 will compare the performance of juvenile salmonids tagged with sham radio-transmitters with the performance of juvenile salmonids PIT-tagged at Lower Granite Dam. The use of radio tags reduces research fish requirements, but the larger tag size could affect fish behavior. If survival studies can be conducted with radio-tagged juveniles, handling of ESA-listed species for important research would be significantly reduced. Study 4 will determine the tailrace residence times and behavior of radio-tagged hatchery chinook salmon under various operational conditions at

Lower Monumental Dam and will identify spill conditions that maximize fish passage efficiency at Ice Harbor Dam. The research will be used to develop corrective measures to improve juvenile fish passage at the dams. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.4.5, 9.6.1.4.6, and 9.6.5.3.5.1.

Research Action 1224: Research to evaluate the conversion rates (i.e., survival through the FCRPS), travel times, and passage routes of adult steelhead that have spawned (kelts) and are emigrating past hydroelectric facilities on their migration back to the ocean. Fish will be obtained from smolt-monitoring-program personnel at John Day and McNary dams on the lower Columbia River, anesthetized, handled (examined for spawning condition, length, fin condition, and descaling), and released, or they will be obtained from smolt-monitoring-program personnel, tagged/marked (tagged with PIT, radio-telemetry, or visual implant tags), and released. Fish migrating past downstream dams and reservoirs will be monitored by aerial and underwater telemetry arrays. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.6.2 and 9.6.5.3.5.2.

Research Action 1240: Research to provide fishery managers with detailed information on the response of outmigrating juvenile anadromous salmon to operation of a prototype surface bypass structure (removable spillway weir) at Lower Granite Dam. Juvenile fish for the study will be collected at preselected trap sites operated by smolt monitoring program personnel. ESA-listed juvenile fish may also be collected by purse seine in Lower Granite reservoir or from smolt monitoring program personnel at Lower Granite Dam. The fish will then be transported as necessary, anesthetized, implanted with radio transmitters, allowed to recover, transported to an upstream release site, released, and tracked electronically. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.4.5 and 9.6.1.4.6.

Research Action 1241: Studies to provide fishery managers with data on the timing, passage, and survival of outmigrating juvenile salmonids in relation to the operations of John Day, The Dalles, and Bonneville dams. Fish for the study will be collected from the juvenile fish bypass facilities at Bonneville, John Day, and/or McNary dams on the lower Columbia River by smolt monitoring program personnel. The fish will then be transported as necessary, anesthetized, implanted with radio transmitters, allowed to recover, transported to an upstream release site, released, and tracked electronically. Some research tasks will result in lethal takes of ESA-listed juvenile fish. Those tasks are designed to 1) statistically evaluate the survival rates of juvenile salmonids through John Day, The Dalles, and Bonneville dams and 2) evaluate the stress of juvenile salmonids that pass through the new bypass outfall pipe at Bonneville Dam Second Powerhouse DSM by measuring physiological indices (blood cortisol and lactate concentrations). For item 1), above, fish will be acquired from smolt monitoring program personnel at the

dams, exposed to a lethal dose of anesthetic, and released in paired groups with the live radio-tagged fish to test the potential for dead research fish to be mistaken for live research fish. For item 2), run-of-the-river fish will be netted from the sampling flume at Bonneville Dam to acquire the target fish; ESA-listed juvenile fish will be captured, handled, and released, or captured and sacrificed. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.4.5 and 9.6.5.3.5.1.

Research Action 1242: Research to evaluate inriver migration survival versus transportation survival from Lower Granite Dam to below Bonneville Dam. Whether the transportation of depressed anadromous fish species should be maximized to enhance recovery is one of the most controversial and critical questions before fisheries managers today. Among other work, this research is designed to provide definitive information on this important question. ESA-listed juvenile fish will be captured at Lower Granite Dam, handled (checked for condition), and released, or they will be captured at Lower Granite Dam, PIT-tagged, and returned to the river below the dam. Study fish will be tracked downriver as juveniles, and when they return to the Snake River basin as adults, by using automated PIT-tag detectors at the mainstem FCRPS dams. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.3.3 and 9.6.1.3.4.

Research Action 1243: Research to evaluate juvenile fish survival through the Ice Harbor Dam spillway on the Snake River. Survival estimates for juvenile chinook salmon that migrate through the reservoirs, hydroelectric projects, and free-flowing sections of the Snake and Columbia rivers are essential for developing effective strategies to recover depressed stocks. Recent survival studies have evaluated passage through various routes at all of the dams on the lower Snake River except Ice Harbor Dam. ESA-listed juvenile fish will be collected at Lower Monumental Dam on the Snake River by smolt-monitoring-program personnel. The fish will then be tagged with radio transmitters and/or PITs, transported to Ice Harbor Dam, held for recovery, and released into the spillway or transferred to a small barge, transported, and released into the tailrace. Tagged fish will be tracked downriver as juveniles, and later when they return to the Snake River as adults, using automated PIT-tag detectors at FCRPS dams. The research is necessary to satisfy elements of the RPA described in Section 9.6.1.4.5.

Research Action 1244: Six research studies to evaluate juvenile fish collection/bypass facilities at selected Snake and Columbia river FCRPS dams. Problems associated with juvenile fish passage through mainstem FCRPS facilities are major factors in the decline of ESA-listed anadromous fish species. Based on the results of bypass studies, guidance devices and bypass system components can be redesigned, modified, or deployed using specific configurations to improve juvenile fish passage. ESA-listed juvenile fish will be collected at Ice Harbor Dam on the Snake River (study 1) and at

McNary (studies 2 and 3) and Bonneville dams (studies 4, 5, and 6) on the Columbia River. Once collected, the fish will be routed to holding tanks, handled (checked for fish condition and fork length), and released or routed to holding tanks, tagged/marked (with PITs, radio transmitters, and/or fin clips), and released. For study 4, artificially propagated chinook salmon juveniles will be PIT-tagged at the Idaho Department of Fish and Game's McCall Hatchery in Idaho. Tagged fish will be tracked downriver as juveniles, and later when they return to the Columbia and Snake river basins as adults, using automated PIT-tag detectors at FCRPS dams. Lethal takes of ESA-listed juvenile fish will occur for studies 2, 4, and 5. For study 4, previously PIT-tagged hatchery yearling chinook salmon will be collected at Bonneville Dam, held in artificial seawater for extended periods, and ultimately sacrificed for physiological characteristics and disease profiles. For study 5, ESA-listed juvenile fish that are not guided by intake screens will be collected in fyke nets as a way to estimate the number of unguided fish during the FGE research on submersible traveling screens at that dam. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.4.5 and 9.6.5.3.5.1.

Research Action 2000: Research at several mainstem FCRPS dams (Lower Granite, Little Goose, Lower Monumental, and McNary dams) to identify and enumerate adult steelhead kelts that pass through associated juvenile fish bypass facilities by using mark-recapture methods. Corps project personnel will remove ESA-listed adult steelhead from the juvenile fish separators during their downstream emigration, examine them using ultrasound, treat them for parasites, mark them (with Floy anchor tags, radio transmitters, or PITs), and release them into the tailrace through the flume used to remove adults from the wet separator. Alternatively, the fish will be held for up to 3 days, transported, and released below Bonneville Dam. A small (0.5 cm 2) piece of fin tissue will be excised. Up to 5 ml of milt will be collected from a maximum of 60 wild male steelhead that 1) are positively identified by ultrasound as kelts, 2) are in good condition, and 3) are readily able to express milt. The samples will be useful in future population restoration efforts, in conjunction with the population of origin identification provided by DNA analysis. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.6.2 and 9.6.5.3.5.2.

Research Action 2001: Research to collect relevant information for lower Columbia River fall chinook and chum salmon so that recommendations can be made for configuration and operation of the FCRPS to protect and/or enhance mainstem spawning populations. Additional studies are planned to characterize stranding of juvenile fish associated with fluctuating stream flows (due to FCRPS operations). The project will provide baseline data to properly manage natural spawning fall chinook and chum salmon in the mainstem Columbia River downstream of McNary Dam. Research will also evaluate the effects of fluctuating flows and power system load on fall chinook and chum salmon and their habitat as outlined in NWPPC (1994). The research is

necessary to satisfy elements of the RPA described in Sections 9.6.1.2.1, 9.6.1.2.3, and 9.6.5.3.3.

Research Action 2002: Research to evaluate modifications to the juvenile fish PIT-tag diversion systems at Lower Granite and Little Goose dams on the Snake River. The evaluation will include fish condition (descaling, injury, and mortality rates), travel time, detection efficiency, and relative survival for PIT-tagged fish. In addition, primary bypass survival will be compared with PIT-tag bypass survival, and a new three-way, diversion sampling system will be evaluated at Little Goose Dam. If injuries, descaling, or mortalities for PIT-tagged fish passing through the modified PIT-tag diversion systems are observed, additional PIT-tagged fish will be released at various locations along the passage route to determine where injuries or descaling occur. The research is necessary to satisfy elements of the RPA described in Section 9.6.1.4.5.

Research Action 2003: Research to compare SARs of marked yearling and subyearling chinook salmon and steelhead juveniles transported from McNary Dam to below Bonneville Dam with the SARs of marked inriver migrating juveniles of these species released into the tailrace of McNary Dam. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.3.3 and 9.6.1.3.4.

The Corps funds many of these actions through their Columbia River Fish Mitigation Program and their Anadromous Fish Evaluation Program. More specifically the Corps has fully performed and/or will likely continue to fully perform actions 44, 45, 52, 53, 60-81, 84-86, 91, 94-96, 98-99,109-129, 134, 138, 144, and 191. Some of the passage-related actions (10, 13, 14, 40-43, 51, 54, 154, 185-189) must be completed by the Action Agencies internally, in concert with the region's fisheries management agencies, and are not likely in need of funding through the Council's Fish and Wildlife Program.
The remaining passage-related actions need to be completed jointly by BPA and the Corps. These actions may need continued or future funding through the Council's program, as described in the Future Needs section.

IV. Future Needs

A. Meet NMFS BiOp Performance Objectives

The needs of the juvenile and adult passage program are significant. As stated in the Implementation Plan to Meet FCRPS BiOp Requirements, the Action Agencies fully intend to meet the biological performance standards, including the standard for passage survival that is most applicable to this program summary. Many of the BiOp RPA actions needed to meet the performance standard require BPA funding through the Council's Fish and Wildlife Program. Specifically, BPA needs to fund the following actions.

1. **Evaluate transportation and delayed mortality. (RPA actions 45-49, 186)** The Corps funds the majority of the transportation and delayed mortality research. The Council's program could support this research by doing the following critical tasks:
    - **a.** Rear fish for the transportation research. Obtaining sufficient numbers of fish for this research has been and continues to be a major obstacle. A Council project to rear fish specifically for this research could be of great benefit. The downside of rearing fish specifically for the research, instead of using a more representative sample population, needs to be weighed against the benefits.
    - **b.** Obtain extra mortality information. Experiments and analyses are needed to determine the causes of extra mortality. Extra mortality is mortality that is not accounted for by estimates of spawner-recruitment productivity parameters, estimates of direct mortality of in-river juvenile migrants, or estimates of additional delayed mortality of transported fish relative to in-river fish. A few hypotheses have been developed regarding extra mortality suggesting that the cause may be the Lower Snake dams, disease, long-term changes in ocean climate, or a lack of carcass-derived nutrients. Research should be performed to test these hypotheses.
    - **c.** Tag wild fish for the transportation evaluation. The transportation studies to date primarily use hatchery fish. The effects of transportation on wild fish also need to be evaluated as well.

2. **Evaluate spillway passage survival, spillway efficiency, spillway effectiveness, forebay residence time, and total project and system survival for different spill discharges and durations. (RPA actions 82-83)** The Corps covers the necessary project-specific research and evaluations. BPA needs to perform the system survival evaluations through the Council's Program. These system survival evaluations are the primary means for measuring progress toward BiOp performance objectives. As such, BPA and the Council need to ensure that all research needed for the system-survival analysis is identified and funded, as necessary, in coordination with the Corps' work.

3. **Install adult PIT detectors, develop less-intrusive PIT detection in juvenile bypass systems, and continue to investigate new tagging techniques for RM&E. Use the data from these systems to evaluate transport benefits, conversion rates, SARs, etc. (RPA actions 50, 87, 192, 193)** The Council's program needs to continue supporting the installation of adult PIT detection systems, which are funded jointly with the Corps. Adult PIT-tag detection systems should be installed at The Dalles, John Day, Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams within the next few years with Council funding for the electronic portion of the system and Corps funding for the infrastructure. The Council program also needs to continue supporting the development of new

tagging techniques and detection systems, including the small-stream detection systems and high-flow detection systems.

4. **Improve turbine survival of juvenile and adults by developing biologically-based turbine designs and operating criteria. (RPA actions 88-90, 92-93)** The Corps' Turbine Survival Program plans to addresses most of the turbine-related passage improvements. Additionally, the Corps' and BPA's McNary Modernization Program is attempting to identify and install a turbine design that provides higher passage survival. With these efforts toward turbine design improvements already under way, the Council program could focus on operational improvements. The Council program could perform biological index testing to determine the safest turbine operation for fish passage at the existing Kaplan turbines in the mainstem projects. The limited turbine passage survival data available for the mainstem projects indicates that there can be an appreciable difference between the peak passage survival and the survival at peak efficiency. With the appropriate research, a passage survival benefit can potentially be achieved at all of the mainstem projects by simply adjusting the turbine operations to maximize survival. While the research could be very costly, the information from this research could be immediately implemented to gain a passage survival benefit operationally without requiring structural modifications.

5. **Recover PIT-tag information from predacious bird colonies and evaluate trends, including hatchery and wild depredation ratios, to support system survival evaluations. (RPA Action 104)** The recovery of PIT-tag codes at bird colonies, such as at Rice Island, East Sand Island, and Crescent Island, can account for a significant percentage of PIT-tagged fish that would otherwise be an unaccounted loss. This action requires Council support and BPA funding in support of system survival evaluations.

6. **Evaluate adult survival and identify causes of unaccounted losses and headburn. Implement corrective actions. (RPA actions 107-108)** The Corps currently plans to evaluate causes of headburn. BPA, through the Council Program, needs to focus on identifying causes of unaccounted losses and implementing corrective actions. One means of quantifying unaccounted losses will be to employ radio tracking to evaluate the detection capabilities of the adult PIT detection systems from one dam to another.

7. **Study survival, growth, and other early life history attributes of Snake River wild fall chinook. (RPA action 190)** BPA, through the Council program, needs to continue studying early life stages of Snake River wild fall chinook, as this information has management applications for Snake River flow augmentation. The Corps is not involved in this research.

8. **Research as necessary to complete numerous objectives. (RPA action 199 & Appendix H of the NMFS BiOp)** The Corps' programs are the primary means

for meeting these research needs. The Council program needs to continue providing support to the operation and maintenance of PIT-tag detection systems and data. The PIT-tag data and/or improvements to some PIT-tag-related systems are critical for meeting many of the required research objectives.

The above list of eight main passage-related needs is limited to those needs that are in the NMFS BiOp and require BPA funding. By funding some or all of these actions, while coordinating closely with the other action agencies, BPA will fulfill the commitment to meet the passage-related performance standard.

As noted throughout the list of future needs, BPA and the Corps work jointly to meet many of the needs listed above. Projects that are funded by BPA through the Council's program will require close coordination with the Corps to ensure that efforts are complementary and not redundant.

B. Mitigate FCRPS Effects on Other Species

Passage improvements and passage-related actions that are not a part of the NMFS BiOp may need funding as well. The Council's program is supposed to mitigate for effects of the hydrosystem on all fish and wildlife species. However, the passage needs of many other species have not been identified. Lamprey passage needs are addressed in the lamprey program summary, but passage-related needs have not been defined for any other species in the mainstem.

C. Prioritization - Making the Best Use of Available Resources

The Action Agencies' Implementation Plan explains BPA's intention of meshing hydro system priorities and ESA project solicitations with the rolling provincial review process. BPA strives to make the best use of available resources to meet ESA obligations and fund the Council's Fish & Wildlife Program. The most effective way of meeting fish and wildlife obligations is to integrate objectives and priorities as much as possible. The recommendations in this program summary provide a first step toward merging the Implementation Plan and the Council's program into one unified strategy to provide fish and wildlife mitigation and meet ESA obligations. The implementation plan identifies four criteria for prioritizing hydro system actions. They are as follows:

Criteria 1. Stock Status: Actions to benefit stocks with lowest populations and the highest rate of required population growth to avoid jeopardy have high relative priority. For example, upper Columbia spring chinook and steelhead have the highest rate of improvement needed. Actions to help these fish could occur in the middle and lower Columbia River as juveniles of these stocks pass through these geographic areas. Actions that would improve juvenile passage survival, reservoir survival, or adult passage in the middle and lower Columbia River, would be beneficial to upper Columbia stocks and therefore receive special attention.

Criteria 2. System Survival: Ultimately, we are seeking overall improved survival of juvenile and adult fish through the hydro corridor. Consequently, attention is given to those actions that have the highest estimated or potential improvement to the most fish and to the most ESU's within the hydro corridor.

Criteria 3. Dam Passage Survival: The best available information indicates that the lowest survival percentages consistently occur at Bonneville, The Dalles, and Lower Monumental dams. Actions to improve survival at these dams are of higher priority than dams that already have relatively high passage survival.

Criteria 4. Reservoir Passage Survival: Priority would be given to actions that target reservoirs determined to have the lowest rates of juvenile survival. For example, data consistently shows the lowest reservoir survival rates occur in the pool between McNary and John Day dams. John Day reservoir survival improvement actions (e.g. predator control) are relatively high in priority.

Criteria for prioritizing actions for non-listed species within the juvenile and adult passage program need to be identified as well.

D. Recommendations

After applying the prioritization criteria to the future needs identified in this document, recommendations can be made for new and existing projects to be funded by BPA through the Council's juvenile and adult passage program under the Mainstem and System-wide Province. The Council and BPA need to develop and refine criteria for prioritization of the passage-related work in conjunction with all of the other work under the Mainstem and System-wide Provincial Review before any meaningful recommendations can be made.

Appendix A: Memo from Michele DeHart, February 6, 2002, RE: Mainstem Summary – Juvenile and Adult Passage section

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MEMORANDUM

TO: Jann Eckman, CBFWA
Tom Iverson, CBFWA

Michele DeHart

FROM: Michele DeHart

DATE: February 6, 2002

RE: Mainstem Summary – Juvenile and Adult Passage section

Participants from National Marine Fisheries Service, the University of Washington, Bonneville Power Administration, and the US Army Corps of Engineers have worked since December developing multiple versions of this section of the main stem summary. The multiple versions resulted from various interpretations of the purpose of the main stem summary.

The Bonneville Power Administration, BPA, in consultation with the US Army Corps of Engineers developed the attached version of the main stem summary. BPA developed this version reflecting their understanding that the mainstem summary was a request for proposals to implement the Biological Opinion research, monitoring, and evaluation actions and the Federal Agencies Implementation Plan. The COE met with BPA and determined areas of gap between the COE and BPA programs. Those areas are identified in the Future Needs section. The COE did not provide additional specific comments on the BPA document. The COE does not consider itself to be involved in the CBFWA Provincial Review Process. However, the COE participation in the development of parts of this document was to avoid major overlap areas in the solicitation process.

Submittal of this draft should not be interpreted as agreement of all parties to the BPA document.

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