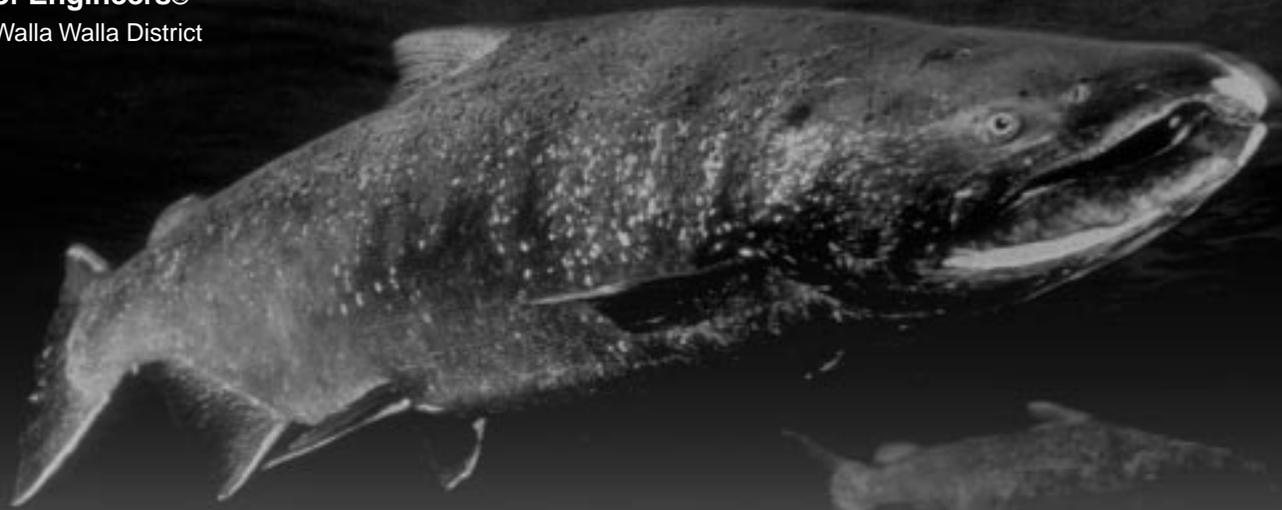




US Army Corps
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Walla Walla District



DRAFT
**Lower Snake River Juvenile
Salmon Migration Feasibility Report/
Environmental Impact Statement**

APPENDIX I
Economics

December 1999

FEASIBILITY STUDY DOCUMENTATION

Document Title

Summary to the Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement

Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement

Appendix A	Anadromous Fish
Appendix B	Resident Fish
Appendix C	Water Quality
Appendix D	Natural River Drawdown Engineering
Appendix E	Existing Systems and Major System Improvements Engineering
Appendix F	Hydrology/Hydraulics and Sedimentation
Appendix G	Hydroregulations
Appendix H	Fluvial Geomorphology
Appendix I	Economics
Appendix J	Plan Formulation and Decision Analysis Model
Appendix K	Real Estate
Appendix L	Lower Snake River Mitigation History and Status
Appendix M	Fish and Wildlife Coordination Act Report
Appendix N	Cultural Resources
Appendix O	Public Outreach Program
Appendix P	Air Quality
Appendix Q	Tribal Consultation/Coordination
Appendix R	Historical Perspectives
Appendix S	Snake River Maps
Appendix T	Biological Assessment
Appendix U	Clean Water Act, Section 404(b)(1) Evaluation

The documents listed above, as well as supporting technical reports and other study information, are available on our website at www.nww.usace.army.mil. Copies of these documents are also available for public review at various city, county, and regional libraries.

FOREWORD

This appendix is one part of the overall effort of the U.S. Army Corps of Engineers' (Corps) to prepare a Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement (FR/EIS).

Please note that this document is a DRAFT appendix and is subject to change and/or revision based on information received through comments, hearings, workshops, etc. After the comment period ends and hearings are concluded, a Final FR/EIS with Appendices is planned.

The Corps has reached out to other regional stakeholders (Federal agencies, tribes, states, local governmental entities, organizations, and individuals) during the development of the FR/EIS and appendices. This effort resulted in many of these regional stakeholders providing input, comments and even drafting work products or portions of these documents. This regional input provided the Corps with an insight and perspective not found in previous processes. An example of regional stakeholders drafting and authoring products can be found in this appendix.

This reach out effort resulted in the formation of the Drawdown Regional Economic Workgroup. The DREW study teams prepared numerous and detailed economic and social analyses, i.e. DREW Workgroup products. These products are the core technical information for this appendix. Some of these work products are still considered a work in progress and this appendix incorporates information from the latest versions available. Citations to these products can be found throughout this appendix and FR/EIS and can be found in full text on the Corps web page. A great deal of the information was subsequently included in the Draft FR/EIS and Appendices, therefore, not all the opinions and/or findings herein may reflect the official policy or position of the Corps.

STUDY OVERVIEW

Purpose and Need

Between 1991 and 1997, due to declines in abundance, the National Marine Fisheries Service (NMFS) made the following listings of Snake River salmon or steelhead under the Endangered Species Act (ESA) as amended:

- sockeye salmon (listed as endangered in 1991)
- spring/summer chinook salmon (listed as threatened in 1992)
- fall chinook salmon (listed as threatened in 1992)
- steelhead (listed as threatened in 1997)

In 1995, NMFS issued a Biological Opinion on operations of the Federal Columbia River Power System. The Biological Opinion established measures to halt and reverse the declines of these listed species. This created the need to evaluate the feasibility, design, and engineering work for these measures.

The U.S. Army Corps of Engineers (Corps) implemented a study after NMFS's Biological Opinion in 1995 of alternatives associated with lower Snake River dams and reservoirs. This study was named the Lower Snake River Juvenile Salmon Migration Feasibility Study (Feasibility Study). The specific purpose and need of the Feasibility Study is to evaluate and screen structural alternatives that may increase survival of juvenile anadromous fish through the Lower Snake River Project (which includes the four lowermost dams operated by the Corps on the Snake River—Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams) and assist in their recovery.

Development of Alternatives

The Corps completed an interim report on the Feasibility Study in December 1996. The report evaluated the feasibility of drawdown to natural river levels, spillway crest, and other improvements to existing fish passage facilities. Based in part on a screening of actions conducted in the interim report, the study now focuses on four courses of action:

- Existing conditions (currently planned fish programs)
- System improvements with maximum collection and transport of juveniles (without major system improvements such as surface bypass collectors)
- System improvements with maximum collection and transport of juveniles (with major system improvements such as surface bypass collectors)
- Dam breaching or permanent drawdown to natural river levels for all reservoirs

The results of these evaluations are presented in the combined Feasibility Report (FR) and Environmental Impact Statement (EIS). The FR/EIS provides the support for recommendations that will be made regarding decisions on future actions on the Lower Snake River Project for passage of juvenile salmonids. This appendix is a part of the FR/EIS.

Geographic Scope

The geographic area covered by the FR/EIS generally encompasses the 140-mile long lower Snake River reach between Lewiston, Idaho and the Tri-Cities in Washington. The study area does slightly vary by resource area in the FR/EIS because the affected resources have widely varying spatial characteristics throughout the lower Snake River system. For example, socioeconomic effects of a permanent drawdown could be felt throughout the whole Columbia River Basin region with the most effects taking place in the counties of southwest Washington. In contrast, effects on vegetation along the reservoirs would be confined to much smaller areas.

Identification of Alternatives

Since 1995, numerous alternatives have been identified and evaluated. Over time, the alternatives have been assigned numbers and letters that serve as unique identifiers. However, different study groups have sometimes used slightly different numbering or lettering schemes and this has led to some confusion when viewing all the work products prepared during this long period. The primary alternatives that are carried forward in the FR/EIS currently involve four major alternatives that were derived out of three major pathways. The four alternatives are:

Alternative Name	PATH ^{1/} Number	Corps Number	FR/EIS Number
Existing Conditions	A-1	A-1	1
Maximum Transport of Juvenile Salmon	A-2	A-2a	2
Major System Improvements	A-2'	A-2c	3
Dam Breaching	A-3	A-3a	4

^{1/} Plan for Analyzing and Testing Hypotheses

Summary of Alternatives

The **Existing Conditions Alternative** consists of continuing the fish passage facilities and project operations that were in place or under development at the time this Feasibility Study was initiated. The existing programs and plans underway would continue. Project operations, including all ancillary facilities such as fish hatcheries and Habitat Management Units (HMUs) under the Lower Snake River Fish and Wildlife Compensation Plan (Comp Plan), recreation facilities, power generation, navigation, and irrigation would remain the same unless modified through future actions. Adult and juvenile fish passage facilities would continue to operate.

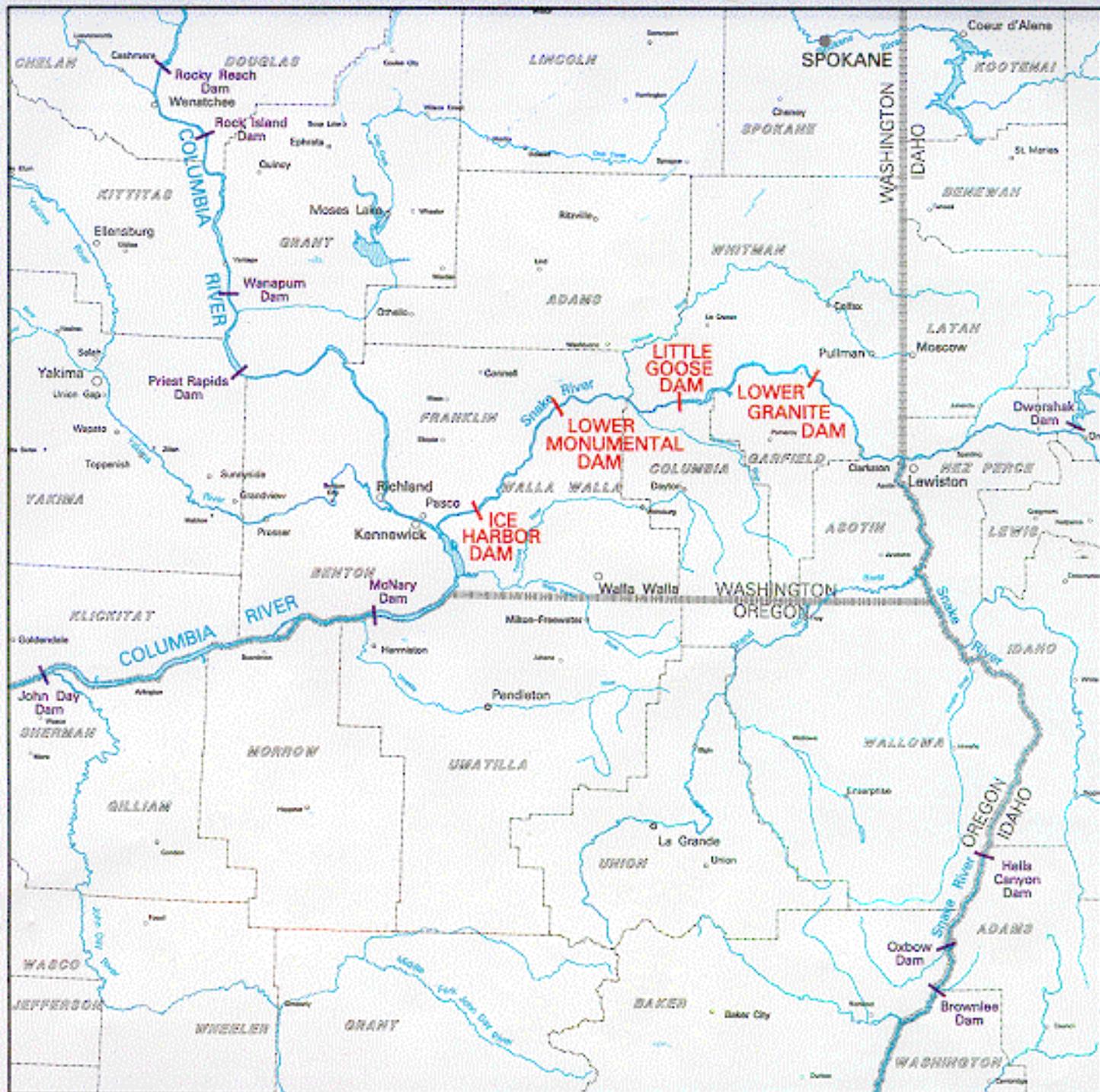
The **Maximum Transport of Juvenile Salmon Alternative** would include all of the existing or planned structural and operational configurations from the Existing Conditions Alternative. However, this alternative assumes that the juvenile fishway systems would be operated to maximize fish transport from Lower Granite, Little Goose, and Lower Monumental and that voluntary spill would not be used to bypass fish through the spillways (except at Ice Harbor). To accommodate this maximization of transport some measures would be taken to upgrade and improve fish handling facilities.

The **Major System Improvements Alternative** would provide additional improvements to what is considered under the Existing Conditions Alternative. These improvements would be focused on using surface bypass collection (SBC) facilities in conjunction with extended submersible bar screens (ESBS) and a behavioral guidance system (BGS). The intent of these facilities is to provide more effective diversion of juvenile fish away from the turbines. Under this alternative the number of fish collected and delivered to upgraded transportation facilities would be maximized at Lower Granite, the most upstream dam, where up to 90 percent of the fish would be collected and transported.

The **Dam Breaching Alternative** has been referred to as the “Drawdown Alternative” in many of the study groups since late 1996 and the resulting FR/EIS reports. These two terms essentially refer to the same set of actions. Because the term drawdown can refer to many types of drawdown, the term dam breaching was created to describe the action behind the alternative. The Dam Breaching Alternative would involve significant structural modifications at the four lower Snake River dams allowing the reservoirs to be drained and resulting in a free-flowing river that would remain unimpounded. Dam breaching would involve removing the earthen embankment sections of the four dams and then developing a channel around the powerhouses, spillways, and navigation locks. With dam breaching, the navigation locks would no longer be operational, and navigation for large commercial vessels would be eliminated. Some recreation facilities would close while others would be modified and new facilities could be built in the future. The operation and maintenance of fish hatcheries and Habitat Management Units (HMUs) would also change although the extent of change would probably be small and is not known at this time. Project development, design, and construction span a period of nine years. The first three to four years concentrate on the engineering and design processes. The embankments of the four dams are breached during two construction seasons at year 4-5 in the process. Construction work dealing with mitigation and restoration of various facilities adjacent to the reservoirs follows dam breaching for three to four years.

Authority

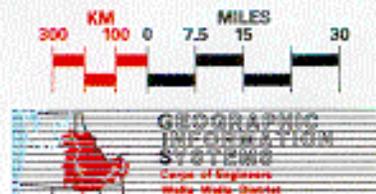
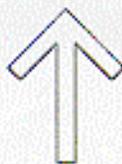
The four Corps dams of the lower Snake River were constructed and are operated and maintained under laws that may be grouped into three categories: 1) laws initially authorizing construction of the project, 2) laws specific to the project passed subsequent to construction, and 3) laws that generally apply to all Corps reservoirs.



BOUNDARIES

State

County



125,000 ACRES



1 : 1,900,800

DRAFT

Lower Snake River
 Juvenile Salmon Migration Feasibility Study

REGIONAL BASE MAP

1999

ABSTRACT

This is the Economics Appendix to the Lower Snake River Juvenile Salmon Migration Feasibility Study FR/EIS. This appendix was compiled by the U.S. Army Corps of Engineers from technical studies developed by the Drawdown Regional Economic Workgroup (DREW). Members of DREW include representatives of various Federal and regional agencies, tribal representatives, and other interested parties. This appendix measures the economic and social effects of the four proposed alternatives. Potential economic and social effects are addressed at three geographic scales — national, regional, and local. Local effects include those to Native American tribes and potentially affected communities.



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Draft

**Lower Snake River Juvenile Salmon
Migration Feasibility Report/
Environmental Impact Statement**

**Appendix I
Economics**

**Produced by
Foster Wheeler Environmental Corporation**

**Produced for
U.S. Army Corps of Engineers
Walla Walla District**

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December 1999

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ACRONYMS AND ABBREVIATIONS

AAEV	average annual equivalent value
AECO	Alberta Energy Company
AEI	Agricultural Enterprises, Inc.
AFEP	anadromous fish evaluation program
AGC	Automatic Generation Control
aMW	average megawatt
BCAM	Barge Cost Analysis Model
BGS	behavioral guidance system
BLMR	Blue Mountain Railroad
BOR	Bureau of Reclamation
BPA	Bonneville Power Administration
CB	contingent behavior
CC	cycle combustion turbine
CCC	Civilian Conservation Corps
CEAA	Canadian Entitlement Allocation Agreement
CEQ	Council on Environmental Quality
COI/PDCI	California-Oregon Intertie/Pacific Direct Current Intertie
Corps	U.S. Army Corps of Engineers
CRITFC	Columbia River Inter Tribal Fisheries Commission
CSRS	Columbia Snake River System
CT	combustion turbine
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CVM	Contingent Valuation Method
DGAS2	second phase of de-gasification construction project
DREW	Drawdown Regional Economic Workgroup
EIS	Environmental Impact Statement
EJ	Environmental Justice
EPA	U.S. Environmental Protection Agency
EQ	environmental quality
ESA	Endangered Species Act
ESBS	extended submerged bar screen
FCRPS	Federal Columbia River Power System
FEAM	fisheries economic assessment model
FELCC	firm energy load carrying capacity
FERC	Federal Energy Regulatory Commission
FR/EIS	Feasibility Report/Environmental Impact Statement
FY	Fiscal Year
HIT	Hydropower Impact Team
HMU	Habitat Management Unit
HP	horsepower
HQSACE	U.S. Army Corps of Engineers Headquarters
HYDROSIM	Hydro Simulation Program
HYSSR	Hydro System Seasonal Regulation Program

ACRONYMS AND ABBREVIATIONS

IDC	interest during construction
IEAB	Independent Economic Advisory Board
INPFC	International North Pacific Fisheries Commission
IWR	Institute for Water Resources
kV	kilovolt
kWh	kilowatt-hours
LPMS	Lock Performance Monitoring System
LSR	lower Snake River
LSRFWCP	Lower Snake River Fish and Wildlife Compensation Plan
M&I	municipal and industrial
MAF	million acre-feet
MMBtu	million British thermal unit
MOA	Memorandum of Agreement
MOP	minimum operating pool
MOU	Memorandum of Understanding
mph	miles per hour
MW	megawatt
MWh	megawatt-hours
NED	National Economic Development
NEPA	National Environmental Policy Act
NEV	net economic value
NMFS	National Marine Fisheries Service
NPPC	Northwest Power Planning Council
NRCS	Natural Resource Conservation Service
NRSA	nominal range sensitivity analysis
NWPPC	
O&M	operation and maintenance
ODFW	Oregon Department of Fish and Wildlife
O,M,R,R&R	operation, maintenance, repair, replacement and rehabilitation
OR/WA	Oregon/Washington
OSE	Other social effects
P&G	Principles and Guidelines for Water and Related Sand Resources
PATH	Plan for Analyzing and Testing Hypotheses
PFMC	Pacific Fishery Management Council
PNCA	Pacific Northwest Coordination Agreement
PNW	Pacific Northwest
PST	Pacific Salmon Treaty
PSW	Pacific Southwest
PUD	Public Utility District
PV	present value
RCAM	Rail Cost Analysis Model
RED	regional economic development
RM	River Mile

ACRONYMS AND ABBREVIATIONS

ROD	Record of Decision
SBC	surface bypass collector
SOR	System Operation Review
SRP	PATH Scientific Review Panel
TAM	transportation analysis model
TCAM	Travel Cost Analysis Model
TCM	Travel Cost Method
UI	University of Idaho
UNCLOS	United Nations Convention on the Law of the Sea
URCS	Uniform Rail Costing System
USFWS	U.S. Fish and Wildlife Service
WCSC	Waterborne Commerce Statistics
WPPSS	Washington Public Power Supply System
WRC	U.S. Water Resources Council
WSCC	Western Systems Coordinating Council
WTP	willingness to pay
WY	water year

Executive Summary

ES.1 Introduction

This appendix measures the economic and social effects of the alternatives proposed under the Lower Snake River Juvenile Salmon Migration Feasibility Study. Section 102 of the National Environmental Policy Act (NEPA) and the Council on Environmental Quality (CEQ) guidelines, which interpret NEPA, require that the economic and social effects be identified. Evaluation of these effects is critical to decision makers and also important to others interested in the outcome of this study. The evaluation presented in this document uses economic measures to evaluate efficiency changes in the nation's production of goods and services. This evaluation is designed to identify the gains and losses to society as a whole. The effects that the proposed alternatives would have upon the region and on specific groups of individuals are also examined.

Actions taken to improve fish passage and survival along the lower Snake River could have economic and social effects on local communities, the Snake River region, the Pacific Northwest, and the nation, as a whole. The economic effects of actions related to the lower Snake River have been analyzed by numerous entities throughout the region. To reduce conflicting analyses and pool resources for a more efficient effort, the Corps convened the Drawdown Regional Economic Workgroup (DREW) to develop a combined economic analysis. Members of DREW include representatives of various Federal and regional agencies, tribal representatives, and other interested parties.

ES.1.1 Structure of Analysis

DREW conducted the necessary technical analyses to assess the potential economic and social effects of the four alternatives. These analyses address potential economic and social effects at three geographic scales — national, regional, and local. The overall structure of the economic and social analysis developed for the Lower Snake River Juvenile Salmon Migration Feasibility Study is based on the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies developed by the U.S. Water Resources Council (WRC) (WRC, 1983). These guidelines recommend that the evaluation and display of the effects of proposed alternatives be organized into four accounts:

- The national economic development (NED) account, which displays changes in the economic value of the national output of goods and services
- The environmental quality (EQ) account, which displays nonmonetary effects on significant natural and cultural resources
- The regional economic development (RED) account, which addresses changes in the distribution of regional economic activity
- The other social effects (OSE) account, which addresses potential effects from relevant perspectives that are not reflected in the other three accounts

The NED account is the only account required under the WRC guidelines. The guidelines recommend that other information that is required by law or that will have a material bearing on the decision-making process should be included in one of the other accounts (EQ, RED, or OSE) or in some other appropriate format. The four accounts and their relationship to this analysis are discussed in the following sections.

ES.1.1.1 National Economic Development (NED)

The NED account addresses the net effects of a proposed action upon the nation. NED analysis is concerned only with economic efficiency at the national level. Economic gains achieved by one region at the expense of another region are not measured as NED benefits. In most cases, this type of gain to one region is another region's loss, and the two effects represent a transfer of income that cancels out any net change. Regional impacts are addressed under the RED account.

Beneficial effects measured under the NED account include increases in the economic value of the national output of goods and services, the value of output resulting from external economies caused by the proposed alternative, and the value associated with the use of otherwise unemployed or under-employed labor resources. Adverse NED effects are usually the opportunity costs of resources used in implementing a plan. All resources are scarce, and we are forced to make choices when they are used. Choose more of one thing, and you are simultaneously choosing less of another.

The general measurement standard for the value of goods and services is defined as the willingness of users to pay for each increment of output associated with a proposed alternative. Since it is not usually possible to obtain actual willingness to pay values, alternative or proxy measures are used. These measures include actual or simulated market price, change in net income, cost of the most likely alternative, and administratively established values.

ES.1.1.2 Environmental Quality Account

The EQ account provides a means of displaying and integrating qualitative information on the effects of the proposed alternatives on significant resources and attributes of the human environment. Beneficial and adverse effects addressed in the EQ account include changes in the ecological, aesthetic, and cultural attributes of natural and cultural resources. The evaluation of tribal circumstances presented in this appendix may be considered part of this account.

ES.1.1.3 Regional Economic Development (RED)

The RED account addresses changes in regional economic activity that result from each alternative plan. Effects are addressed in terms of changes to regional business sales, employment, and income. The majority of effects associated with the proposed alternatives would occur in the lower Snake River region. Effects were modeled for the lower Snake River region and three subregions. Impacts, such as increased power rates, that could affect the entire Pacific Northwest were modeled at the state level.

ES.1.1.4 Other Social Effects (OSE)

The OSE account addresses potential effects from perspectives that are relevant to the evaluation process, but are not reflected in the other three accounts. Categories typically addressed as part of this account include community impacts; life, health, and safety factors; displacement; and long-

term productivity. The social analysis developed as part of this study addresses some of the likely social impacts on selected local communities.

ES.1.2 Study Assumptions

A 100-year period of analysis was used to assess all project impacts. The base year for the analysis was fiscal year (FY) 1998, but the 100-year period of analysis extends from the implementation year (FY 2005) through 2104. Benefits and costs incurred during the period of analysis are discounted to the beginning of this period (FY 2005) using selected interest rates. Implementation expenditures and other economic costs and benefits that would occur prior to FY 2005 are brought forward to that date by charging compound interest at the project discount rate from the date that the costs and benefits occur. These costs and benefits are then converted into 1998 dollars and annualized to provide an average annual value for each alternative.

Numerous agencies and interests were involved in developing this economic analysis. As a result, effects are presented using three different discount rates: 6.875 percent — the rate used in economic analyses by the Corps, 4.75 percent — the rate customarily used by BPA, and 0 percent — included on behalf of the tribes represented by CRITFC. While these different discount rates have been used to accommodate a variety of perspectives, the use of these rates had little effect on the ranking of the alternatives.

ES.1.3 Alternatives

The Lower Snake River Juvenile Salmon Migration Feasibility Study FR/EIS examines four alternatives. These alternatives are as follows:

Alternative 1, Existing Conditions. This alternative continues the fish passage facilities and project operations that were in place or under development at the time this Feasibility Study was initiated.

Alternative 2, Maximum Transport of Juvenile Salmon. This alternative includes all of the existing or planned structural and operational configurations from the Existing Conditions Alternative. However, this alternative assumes that the juvenile fishway systems would be operated to maximize fish transport from Lower Granite, Little Goose, and Lower Monumental and that voluntary spill would not be used to bypass fish through the spillways (except at Ice Harbor).

Alternative 3, Major System Improvements. This alternative provides additional improvements to those considered under the Existing Conditions Alternative. These improvements would be focused on using surface bypass collection (SBC) facilities in conjunction with extended submersible bar screens (ESBS) and a behavioral guidance system (BGS). The intent of these facilities is to provide more effective diversion of juvenile fish away from the turbines.

Alternative 4, Dam Breaching. This alternative involves significant structural modifications at the four lower Snake River dams, allowing the reservoirs to be drained and resulting in a free-flowing river that would remain unimpounded. Dam breaching would involve removing the earthen embankment sections of the four dams and then developing a channel around the powerhouses, spillways, and navigation locks. With dam breaching, the navigation locks would no longer be operational, and navigation for large commercial vessels would be eliminated. Some recreation facilities would close, while others would be modified, and new facilities could be built in the future.

ES.1.4 Biological Benefits

There are four species of fish in the lower Snake River system that have been listed as endangered by the National Marine Fisheries Service (NMFS) under the Endangered Species Act. These are spring/summer chinook, fall chinook, steelhead and sockeye. The effects of the proposed alternatives in improving the chances of recovery and survival of these species are considered the "benefits" or "output" of undertaking the study alternatives. This section briefly discusses the Plan for Analyzing and Testing Hypotheses (PATH) results and the development and application of the NMFS jeopardy standards.

PATH is a formal and rigorous program of formulating and testing hypotheses by using a series of model simulations to estimate both past and future trends in fish abundance for each of the selected stocks. The primary objective of PATH's modeling is to enhance the survival opportunities of the affected Evolutionary Significant Units (ESUs) by considering the stock's response to jeopardy standards, which were defined by the Biological Requirements Working Group (BRWG) and largely accepted by NMFS. (Source: **PATH Decision Analysis Report for Snake River Fall Chinook**, September 1999, Appendix I).

The jeopardy standards include both survival and recovery goals as defined below:

- Survival standards (which set the threshold for survival) are based on projected probabilities that the spawning abundance will exceed a pre-defined survival threshold over a 24 or 100 year simulation period. Survival standards are met when that probability is 70% or greater.
- Recovery standards (which are required to consider de-listing of the species) are based on probabilities of exceeding a recovery threshold in the last eight years of a 48-year simulation period. This standard is met when the probability is 50% or greater".

Table ES-1 presents a comparison of alternative results based upon data provided by NMFS and PATH using 1998 model results. None of the alternatives meets all of the jeopardy standards using 1998 PATH model results. Alternative 4, Dam Breaching, comes the closest to meeting all of the jeopardy standards for both spring/summer and fall chinook (i.e., this alternative meets five out of six standards). The other three alternatives come relatively close to meeting all of the jeopardy standards, with the exception of the 48-year recovery standard for fall chinook.

However, PATH is continuing to refine the model, using new information on key variables related to delayed mortality (the D factor), ocean conditions, and ocean harvests, among other variables. These modifications are having an effect on model results for fall chinook. According to the Peters et al., 1999 (September 1999):

- **All hydrosystem actions meet survival standards** (probabilities of exceeding survival escapement thresholds are greater than 0.7), regardless of what is assumed about the estuary/ocean survival rate of transported fish.
- **All drawdown actions meet recovery standards** (probabilities of exceeding recovery escapement thresholds are greater than 0.5) regardless of what is assumed about the estuary/ocean survival rate of transported fish. The drawdown action (A3 [named Alternative 4 in this FR/EIS]) exhibited the most robust response across those uncertainties considered to date, and produced

higher recovery probabilities (as well as higher average spawning escapements) than other actions. This conclusion is sensitive to assumptions about adult upstream survival.

- For each hypothesis about relative survival of transported fish, **there is a non-breaching action (actions which do not involve drawdowns of dams) that meets the recovery standard**, although there is no single non-breaching alternative option that meets recovery standards under all assumptions about the relative survival of transported fish. If transported fish are assumed to have high relative survival (i.e., high D), maximizing transportation will achieve recovery standards. If transported fish are assumed to have low relative survival (i.e., low D), then retaining current system configuration and allowing all smolts to migrate in-river achieves the recovery standards. **Non-breaching actions are not as robust to the current level of uncertainty in relative survival of transported fish as are drawdown actions.** (Page 8)

The 1999 PATH model results are not available in the same format as the 1998 model results reported in Table ES-1.

Table ES-1. Ability to meet the NMFS Jeopardy standards for survival and recovery based upon 1998 PATH model results (median values presented)

Biological Benefits	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Spring/Summer Chinook				
Survival in 24th year (standard is 0.70)	0.67	0.65	0.66	0.69
Recovery in 48th Year (standard is 0.50)	0.48	0.45	0.46	0.84
Survival in 100th year (standard is 0.70)	0.79	0.78	0.79	0.89
Fall Chinook				
Survival in 24th year (standard is 0.70)	0.85	0.85	0.81	0.93
Recovery in 48th Year (standard is 0.50)	0.22	0.22	0.28	1.00
Survival in 100th Year (standard is 0.50)	0.83	0.83	0.78	0.98

Source: NMFS, PATH

ES.2 National Economic Development

National Economic Development (NED) costs and benefits are the decrease or increase in the value of the national output of goods and services expressed in dollars. NED figures reflect costs and benefits to the nation and not to a particular region. The NED analysis conducted for this study addresses power, recreation, transportation, water supply, commercial fishing, tribal circumstances, flood control, and implementation/avoided costs. These resource areas are addressed in turn in the following sections.

ES.2.1 Power

The four lower Snake River dams are part of an integrated system of hydroelectric facilities located throughout the Columbia River Basin. This system provides a number of products and services, including firm and non-firm energy; peak, and sustained capacity; daily load-following capacity; and other attributes that contribute to the reliability of the regional power system. Changing system hydropower operations affects the ability of the regional power system to generate electricity and the cost of generating that electricity. Changing hydropower operations also affects system reliability and capability, transmission, and ancillary services.

Changes in the regional power system's ability to provide energy and capacity, and the cost of providing these products, form the core of the power system impact analysis conducted by the DREW Hydropower Impact Team. The overall goal of the DREW Hydropower Impact Team study was to develop an estimate of the net economic effects associated with the changes in hydropower under each of the alternatives. This involved a number of steps. The first step involved using system hydro-regulation studies to estimate how much hydropower generation would occur under the different alternatives and under different water conditions. This information was then incorporated into three different power system models to estimate how changes in hydropower generation would affect generation from other more costly power resources. The effects of these hydropower changes on the market price of electricity over time were also estimated.

The range of net economic effects that was estimated based on the different power system models and different assumptions of future conditions is shown for the three project discount rates in Table ES-2. The point estimates used in the NED analysis are the midpoints between the minimum and maximum values.

Alternative 1, Existing Conditions, is considered the base condition for this analysis. The results of the analysis for the other alternatives are compared with this condition. The DREW Hydropower Impact Team analysis evaluated Alternative 2, Maximum Transport of Juvenile Salmon, and Alternative 3, Major System Improvements, as one cumulative alternative. The minor differences in generation that might occur between the two alternatives were not addressed in the DREW Hydropower Impact Team analysis. This combined alternative would result in increases in system hydropower generation. It is not expected that the transmission system would be impacted with this alternative, and the changes in ancillary services are considered to be minimal. The point estimate of average annual net economic benefits is \$9 million.

Under Alternative 4, Dam Breaching, the four hydropower facilities would no longer be operated, natural river levels would exist, and no hydropower generation would occur at the four lower Snake River dams. The analysis of this alternative did not include any hydropower impacts that may occur with changes in irrigation withdrawal from the lower Snake River reservoirs. The point estimate of average annual net economic costs consists of three components: 1) the point estimate of system costs is \$238 million, 2) the point estimate of transmission reliability costs is \$25 million, and 3) the estimate of ancillary service costs is \$8 million. This results in annual total net economic costs of \$271 million.

Table ES-2. Power - Average Annual Net Economic Effects by Discount Rate
(1998 Dollars) (\$1,000s)

Benefits/Costs	6.875 % Discount Rate		4.75 % Discount Rate		0.0 % Discount Rate	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Alternatives 2 and 3						
System	10,000	7,000	10,000	7,000	9,000	7,000
Transmission Reliability	0	0	0	0	0	0
Ancillary Services	0	0	0	0	0	0
Total	10,000	7,000	10,000	7,000	9,000	7,000
Total Point Estimate		8,500		8,500		8,000
Alternative 4						
System	(221,000)	(255,000)	(220,000)	(256,000)	(217,000)	(260,000)
Transmission Reliability	(22,000)	(28,000)	(19,000)	(24,000)	(16,000)	(18,000)
Ancillary Services	(8,000)	(8,000)	(8,000)	(8,000)	(8,000)	(8,000)
Total	(251,000)	(291,000)	(247,000)	(288,000)	(241,000)	(286,000)
Total Point Estimate		(271,000)		(267,500)		(263,500)

ES.2.2 Recreation and Tourism

A measure of the direct economic value of goods and services, including recreation activity, is the willingness-to-pay (WTP) of users. For goods that are sold in a market, the WTP is the amount actually paid to obtain the good, plus an additional amount that an individual would have been willing to pay over and above the amount actually paid. In the case of valuing recreation, the amount charged for the activity is generally small or non-existent. Since there is no well-established market for the exchange of recreation goods, non-market approaches need to be employed to develop demand curves to estimate consumer surplus. The recreation and tourism analysis conducted by the DREW Recreation Workgroup employed the Travel Cost Method (TCM) to calculate net WTP for existing recreation activities and a hybrid TCM approach known as “contingent behavior” to estimate the value of river recreation under Alternative 4, Dam Breaching.

Five recreation-use surveys were conducted as part of this study by the DREW Recreation Workgroup. Four of these surveys were designed to identify and value current recreation use. Based on these surveys, existing reservoir use and annual benefits involved 500,172 trips worth \$33,254,000 a year. Total existing recreation use identified through these surveys involved 640,685 trips worth \$38,524,000 a year (Table ES-3).

The DREW Recreation Workgroup also surveyed a much larger sample of Washington, Idaho, Oregon, western Montana, and California residents to identify the type and number of recreation users who would visit the lower Snake River if the dams were breached. The survey described the new recreation conditions and asked whether the respondent would visit and, if so, how many times a year. Respondents were also asked the distance, travel cost, and travel time to the spot on the river

Table ES-3. Existing Recreation Surveys, Number of Trips, and Annual Benefits
(1998 Dollars)

Survey	Number of Completed Surveys	Response Rate (%)	Number of Trips	Willingness to Pay per Trip (\$)	Annual Benefits (000s of dollars)
Reservoir Angler	537	59	57,388	29.23	1,676
Reservoir General Recreation (excludes Angling)	408	65	442,834	71.31	31,578
Upriver Angler	247	72	11,437	35.71	408
Central Idaho Angling	257	na	129,026	37.68	4,862
Total	1,449	na	640,685	na	38,524

Note:

The number of trips and the WTP per trip were estimated based on each survey. The surveys asked how many trips each individual takes a year and how much each trip costs. This travel cost is used to compute an individual's WTP for recreation. Annual benefits are calculated by multiplying the number of trips by the WTP per trip.

that they would be most likely to visit. A total of 4,780 completed surveys were returned for a response rate of 54 percent. The survey findings were then applied to all Washington, Idaho, Oregon, western Montana, and California residents. The results of this survey indicate that a large percentage of total river recreation trips would come from more distant areas such as Portland, Seattle, and California. This differs from current conditions where a large proportion of outdoor recreationists and anglers reside within 50 miles of the four reservoirs.

Four different demand estimates and two estimates of WTP per trip were generated for Alternative 4, Dam Breaching. Annual trips to a free-flowing lower Snake River were estimated to range from 245,338 to 1,756,193 by the tenth year following breaching. Recreation use following dam breaching would be phased in over time as the natural river system recovered from breaching. Use would also be constrained by existing facilities — developed campgrounds, dispersed campgrounds, and boat ramp capacity. Facilities were, however, projected to increase over time as river conditions stabilized. Salmon and steelhead fishing demand would be constrained by the availability of fish, and only a small fraction of projected angler demand would be met.

The average annual effects are presented for Alternatives 2 through 4 in Table ES-4. These values, presented in 1998 dollars, represent the net change from Alternative 1, Existing Conditions. These data indicate that there are significant recreation benefits associated with breaching the dams. The data also indicate that the majority of these benefits would be associated with recreation activities other than fishing. However, benefits associated with fishing alone would replace a large portion of the reservoir recreation benefits that would be lost under this alternative. There would also be benefits associated with small projected gains in salmon and steelhead fishing under Alternatives 2 and 3.

The low estimates presented for Alternative 4, Dam Breaching, are consistent with values in the literature for general recreation, while the high estimates are consistent with literature for river angling. As a result, the Corps believes that the most likely point estimates would be a composite of the low and high estimates. These composite values are presented as the point estimates in Table ES-4.

ES.2.3 Transportation

Alternative 4, Dam Breaching, would have significant effects upon navigation because barges would no longer be able to operate. Commodities currently transported by barge on the lower Snake River would need to be shipped by rail or truck. The DREW Transportation Workgroup conducted a transportation analysis as part of this study to identify and quantify the direct economic effects resulting from disruption of the existing transportation system. This analysis was designed to measure the effect that breaching the four lower Snake River dams would have on the costs of transporting products that are currently shipped on the Columbia-Snake Inland Waterway.

The economic effects of the loss of navigation are addressed in terms of costs associated with both current and projected future traffic volumes. Alternative routings for existing and projected lower Snake River shipments were identified based on origin and destination data compiled for each shipment. Commodities could, in most cases, either be rerouted via truck to river elevators located on McNary pool or shipped by rail directly to export elevators on the lower Columbia River. Where rail access is currently available at country elevators, grain could either shift to rail direct from these locations, or be moved by truck to a rail distribution point where unit trains could be assembled. The costs of transportation, storage, and handling were calculated for the alternative routings of each affected origin-destination pair.

The DREW Transportation Workgroup analysis measured direct economic effects in terms of opportunity costs rather than market rates. In other words, the costs developed in this analysis assume a perfectly competitive market and do not take into account possible increases in rail and truck transportation rates that may occur in the absence of navigation. It was also assumed that current and projected levels of exports from the region would continue under the dam breaching scenario.

The average annual effects are presented for Alternative 4, Dam Breaching, in Table ES-5. These values, presented in 1998 dollars, represent the net change from Alternatives 1 through 3, which serve as the base case for this analysis. These data indicate that the majority of the average annual cost increase—about 83 percent—would be associated with grain.

ES.2.4 Water Supply

The DREW Water Supply Workgroup addressed the effects of the dam breaching alternative on agricultural water users, municipal, industrial, and other uses, and privately owned wells. Only Alternative 4, Dam Breaching, would directly affect the operation of river pump station and wells used for irrigation and other uses. Approximately 37,000 acres of irrigated farmland currently rely on water pumped from Ice Harbor Reservoir. Additional farmland is irrigated by private wells. The cost of modifying the Ice Harbor pumping stations to provide current water supplies following dam breaching would be more than twice the value of the land they currently irrigate. The value used for this analysis is the change in the value of the land if it were no longer irrigated.

Table ES-4. Recreation and Tourism - Average Annual Economic Effects by Discount Rate, (1998 Dollars) (\$1,000s)

	6.875 % Discount Rate		4.75 % Discount Rate		0.0 % Discount Rate	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Alternative 2						
Reservoir Recreation	0	0	0	0	0	0
River Recreation	0	0	0	0	0	0
Recreational Fishing	2,030	2,030	1,990	1,990	1,420	1,420
Total	2,030	2,030	1,990	1,990	1,420	1,420
Total Point Estimate		2,030		1,990		1,420
Alternative 3						
Reservoir Recreation	0	0	0	0	0	0
River Recreation	0	0	0	0	0	0
Recreational Fishing	2,080	2,080	1,970	1,970	1,180	1,180
Total	2,080	2,080	1,970	1,970	1,180	1,180
Total Point Estimate		2,080		1,970		1,180
Alternative 4						
Reservoir Recreation	-31,600	-31,600	-31,600	-31,600	-31,600	-31,600
River Recreation	36,180	150,120	38,100	158,300	44,000	182,600
Recreational Fishing	6,746	32,916	8,220	37,440	12,750	52,220
Total	11,326	151,436	13,246	159,616	19,146	183,916
Total Point Estimate		82,000		86,000		102,000

Notes:

1. Benefits are presented net of Alternative 1, Existing Conditions, which is considered the base case for this analysis.
2. The recreational fishing category includes mainstem salmon, resident, and steelhead species and tributary salmon and steelhead species.

Table ES-5. Transportation - Average Annual Economic Effects by Discount Rate, (1998 Dollars) (\$1,000s)

Alternative 4	6.875 % Discount Rate	4.75 % Discount Rate	0.0 % Discount Rate
Grain	(22,566)	(22,731)	(23,156)
Non-Grain Commodities	(4,624)	(4,710)	(4,904)
Total	(27,190)	(27,441)	(28,060)
Adjusted Total ^{1/}	(23,804)	(25,008)	(028,060)

^{1/} The DREW Transportation Workgroup analysis used 2007 as the base year. These are the first set of average annual values. The adjusted totals discount the same stream of costs back to 2005 to allow comparability with other elements of the study.

The Municipal and Industrial (M&I) pump stations that withdraw from the lower Snake River are all located on the Lower Granite Reservoir. Uses include municipal water system backup, golf course irrigation, industrial process water for paper production, and concrete aggregate washing. The values used for this analysis are based on the costs required to modify these systems. There is a range of costs because it is unknown what modifications would be necessary for the Potlatch Corporation's Lewiston facility. There are also approximately 209 functioning wells within 0.6 km (1 mile) of the lower Snake River. The Corps estimates that about 40 percent, or 95, of these wells would require modification if dam breaching were to occur.

The total cost of modifying these existing water withdrawal systems is summarized by category in Table ES-6. Average annual costs would range from \$13,919,500 to \$16,927,800 using a 6.875 percent discount rate. Using a 0.0 percent discount rate would result in average annual costs that range from \$2,021,900 to \$2,458,900.

Table ES-6. Water Supply - Summary of Economic Effects and Average Annual Economic Effects by Discount Rate, 1998 Dollars (\$1,000s)

Alternative 4 Water Supply Category	Economic Effect	Average Annual		
		(6.875% Discount Rate)	Average Annual (4.75% Discount Rate)	Average Annual (0.0% Discount Rate)
Loss of Irrigated Farmland Value	(134,240)	(9,241.1)	(6,438.1)	(1,342.4)
Municipal and Industrial Pump Stations	(11,514) to (55,214)	(792.6) to (3,800.9)	(552.2) to (2,648.1)	(115) to (552)
Privately Owned Wells	(56,447)	(3,885.8)	(2,707.2)	(564.5)
Total	(202,201) to (245,901)	(13,919.5) to (16,927.8)	(9,697.5) to (11,793.4)	(2,021.9) to (2,458.9)

ES.2.5 Anadromous Fish

The anadromous fish analysis conducted by the DREW Anadromous Fish Workgroup identified the net economic costs associated with changes in commercial and ocean recreational anadromous fish harvest. Projected changes in fish harvest are based on preliminary data developed through the committee-based process Plan for Analyzing and Testing Hypotheses (PATH). PATH provided data for seven index stocks for Snake River spring/summer chinook, a comprehensive review of Snake River fall chinook, and a narrative description evaluating the correlation between Snake River spring/summer chinook and steelhead. In order to analyze the economic effects of future harvests under the different alternatives, the DREW Anadromous Fish Workgroup expanded the PATH results to represent all Snake River wild and hatchery stocks. This economic analysis considered commercial and recreational harvesting of wild- and hatchery-originating fish and also sales of hatchery returns for egg, carcass, and food fish. Commercial and ocean recreational harvests were allocated to user groups and geographic areas based on existing U.S. and Indian tribal agreements. Fish available after these obligations are met were distributed based on historical harvest distributions. Commercial economic values are based on ex-vessel values, while the recreational fishery value is based on a value per angler day.

The changes in NED values associated with changes in anadromous fish harvest are calculated as annual average values over a 100-year period of analysis and presented net of the base case (Alternative 1, Existing Conditions). These average annual values are presented for Alternatives 2 through 4 using three different discount rates presented in Table ES-7. Using a 6.875 percent discount rate, NED benefits range from \$0.16 million for Alternatives 2 and 3 to \$1.59 million for Alternative 4, Dam Breaching. If a zero discount rate is used, the average annual benefits may be as high as \$3.49 million. Most of the totals shown here would be generated from the in-river treaty fishery contributed by fall chinook. There would also be significant NED benefits associated with the in-river recreational fishery. These benefits are included in the analysis conducted by the DREW Recreation Workgroup (see Section 2.2). In-river recreational fishing values are not included in the totals presented in Table ES-7.

Table ES-7. Anadromous Fish - Average Annual Economic Effects by Discount Rate, (1998 Dollars) (\$1,000s)

		6.875 %	4.75 %	0.0 %
		Discount Rate	Discount Rate	Discount Rate
Alternative 2				
Commercial	Ocean	0	0	0
	Inriver	159.77	175.53	197.63
Recreational	Ocean	0	0	0
Total		159.77	175.53	197.63
Alternative 3				
Commercial	Ocean	12.34	14.98	23.1
	Inriver	145.53	154.95	158.79
Recreational	Ocean	3.46	4.21	6.49
Total		161.33	174.14	188.38
Alternative 4				
Commercial	Ocean	380.65	476.98	735.9
	Inriver	1105.8	1452.7	2543.08
Recreational	Ocean	106.95	134.01	206.76
Total		1593.4	2063.69	3485.74

ES.2.6 Tribal Circumstances

There are 14 Native American tribes and bands in the region that potentially could be affected by the actions taken to improve fish passage and survival along the lower Snake River. They are as follows:

Confederated Tribes of the Colville Indian Reservation	Confederated Tribes of the Warm Springs Reservation of Oregon
Confederated Tribes of the Umatilla Indian Reservation	Kalispel Indian Community of the Kalispel Reservation
Confederated Tribes and Bands of the Yakama Nation	Kootenai Tribe of Idaho
Nez Perce Tribe	Northwestern Band of the Shoshoni Nation
Wanapum Band	Shoshone-Bannock Tribes of the Fort Hall Reservation
Burns Paiute Tribe	Shoshone-Paiute Tribes of the Duck Valley Reservation
Coeur d'Alene Tribe	The Spokane Tribe of the Spokane Reservation.

Five of these tribes — the Nez Perce Tribe (Nez Perce), the Confederated Tribes of the Umatilla Reservation (Umatilla), the Yakama Indian Nation (Yakama), the Confederated Tribes of the Warm Springs Reservation of Oregon (Warm Springs), and the Shoshone-Bannock Tribes (Shoshone-Bannock) — were selected for specific input because of their close cultural and economic links to the salmon. A Tribal Circumstances and Perspectives Report was prepared by a private consultant in association with the Columbia River Inter-Tribal Fisheries Commission (CRITFC) (Meyer Resources, 1999). According to this report, the ancestors of these five tribes (referred to as the study tribes) historically valued the salmon first for cultural and spiritual purposes — and then to feed their people. Salmon were also traded and exchanged for other valued goods, both within each tribe, and with peoples from other tribes.

As the salmon have declined, the surpluses available to the tribes for trading and commercial sale — after ceremonial and subsistence needs are met — have declined toward zero. The Tribal Circumstances and Perspectives Report notes that even ceremonial needs are not met for most of the study tribes.

The study tribes emphasize that while revenue obtained from commercial sales of salmon provides important income to tribal peoples it does not represent the greatest part of value that tribal peoples associate with salmon. The study tribes consider dollar revenue to be a severely limited indicator of tribal value that can provide a distorted impression of full impact to the tribes. Tribal circumstances are, as a result, addressed qualitatively in this analysis (see Section 4 of this summary). Dollar values are, however, assigned to tribal commercial fish harvest as part of the NED economic analysis conducted by the DREW Anadromous Fish Workgroup (see Section 2.5 of this summary).

ES.2.7 Flood Control

Flood control benefits are not currently provided by the lower Snake River dams. Flood control benefits would also not be provided if dam breaching were to occur. As a result, there are no NED costs or benefits associated with this resources area.

ES.2.8 Implementation/Avoided Costs

Implementation costs considered in the following discussion include all project-related construction and acquisition costs and operation, maintenance, repair, replacement and rehabilitation costs (O,M,R,R&R) associated with construction and operation activities required under each alternative. The major cost categories include:

- Construction costs for fish-improvement projects and/or breaching the dams. Construction costs associated with the dam breaching alternative include mitigation costs, such as wildlife mitigation and cultural resources protection and mitigation, at each of the four dams
- Interest during construction (IDC), which reflects compound interest at the applicable borrowing rate, on construction costs incurred during the period of installation
- Anadromous fish evaluation program (AFEP)

- O,M,R,R&R costs associated with the new fish improvement projects (e.g., purchase of water from the Bureau of Reclamation (BOR) and the O&M costs associated with the screen bypass system proposed under Alternative 3, Major System Improvements).

Average annual costs are presented in Table ES-8. These costs vary depending upon which discount rate is used but the ranking of the alternatives remains constant. Alternative 2, Maximum Transport of Juvenile Salmon, is the lowest cost alternative, while Alternative 4, Dam Breaching, is the highest cost alternative, under all discount rates.

Table ES-8. Implementation Costs - Average Annual Economic Effects, 1998 Dollars (\$1,000s)

	6.875 % Discount Rate	4.75 % Discount Rate	0.0 % Discount Rate
Alternative 2			
Investment Cost	1,604	1,087	214
AFEP Cost	1,853	1,469	449
O.M.R.R & R Cost	0	0	0
Total	3,457	2,556	663
Alternative 3			
Investment Cost	(4,818)	3,402	731
AFEP Cost	(420)	333	101
O.M.R.R & R Cost	(693)	641	558
Total	(5,931)	4,376	1,390
Alternative 4			
Investment Cost	(48,982)	(35,525)	(8,218)
AFEP Cost	3,028	2,401	733
O.M.R.R & R Cost	(2,833)	(2,374)	(813)
Total	(48,787)	(35,498)	(8,298)

The avoided costs associated with each alternative include those costs that would no longer be required to operate and maintain the lower Snake River dams and associated lands. These costs are calculated by comparing the continued operation of the four lower Snake River lock and dams under Alternative 1, Existing Conditions, with Alternatives 2 through 4. Costs required under Alternative 1 that are not required under the other alternatives are considered avoided costs.

Avoided costs include:

- Costs of construction or major upgrades that would occur with Alternative 1, Existing Conditions, but not under other alternatives. These include major powerhouse system upgrades and specific additional major improvements to fish bypass, collection, and passage systems
- O&M costs incurred under Alternative 1, Existing Conditions, but not under other alternatives. These include future annual O&M costs and additional annual repair costs.

Disposition of equipment that could be surplus if the dams were breached represents a third type of cost included in this analysis. This represents a reduced opportunity cost for other Federal agencies seeking this type of property and may, therefore, be considered a form of avoided costs.

The avoided costs associated with Alternative 4, Dam Breaching, are approximately \$29 million per year over the life of the study, under all three discount rates, as shown in Table ES-9.

Table ES-9. Avoided Costs - Average Annual Economic Effects, 1998 Dollars (\$1,000s)

	6.875 % Discount Rate	4.75 % Discount Rate	0.0 % Discount Rate
Alternative 2			
Turbine Rehabilitation	0	0	0
Non-Project Related O.M.R.R & R Cost	0	0	0
Surplus Property	0	0	0
Total	0	0	0
Alternative 3			
Turbine Rehabilitation	0	0	0
Non-Project Related O.M.R.R & R Cost	(7)	(23)	(477)
Surplus Property	0	0	0
Total	(7)	(23)	(477)
Alternative 4			
Turbine Rehabilitation	4,800	4,579	3,871
Non-Project Related O.M.R.R & R Cost	23,350	24,048	25,030
Surplus Property	1,028	716	149
Total	29,178	29,343	29,050

ES.2.9 Summary

The total NED costs and benefits identified in this analysis are presented in Table ES-10. These costs presented net of Alternative 1, Existing Conditions, were calculated for a 100-year period of analysis extending from 2005 to 2104. The values presented in this table were discounted using a 6.875 percent discount rate and converted into 1998 dollars.

NED costs are:

- Implementation costs for fish-related improvements (Alternatives 3 and 4)
- Cost increases associated with the shift from hydropower to more expensive forms of replacement power
- Transportation cost increases associated with the shift of barge-transported commodities to more costly truck and rail systems
- Costs incurred as a result of impacts to users presently withdrawing water from the lower Snake River reservoirs

Table ES-10. Summary - Average Annual Economic Effects, 1998 Dollars
(\$1,000s of dollars)

Costs	Alternative 2	Alternative 3	Alternative 4
Implementation Costs	-	(5,931)	(48,787)
Power	-	-	(271,000)
Transportation	-	-	(24,034)
Irrigation/Water Systems	-	-	(15,424)
Total Costs	-	(5,931)	(359,245)
Benefits			
Avoided Costs	-	-	29,178
Recreation	2,030	2,080	82,000
Anadromous Fish	160	161	1,593
Implementation Costs	3,457	-	-
Power	8,500	8,500	-
Total Benefits	14,147	12,982	112,771
Total Costs — Benefits (net)	14,147	4,810	(246,474)

Notes:

1. These costs and benefits, calculated for a 100-year period of study extending from 2005 to 2104, are discounted using a 6.875 percent discount rate and converted to 1998 dollars.
2. Costs and benefits are presented for Alternatives 2 through 4 net of the base case (Alternative 1).
3. A positive monetary value indicates that the alternative being evaluated has a lower cost or greater benefit than Alternative 1. A negative monetary value indicates that the evaluated alternative has a higher cost or lower benefit than Alternative 1. Positive monetary values, therefore, represent benefits, while negative values represent costs.

NED benefits are:

- Costs incurred under Alternative 1, Existing Conditions, that would be avoided under the other alternatives. These include operations, maintenance, repair, and replacement costs, as well as the costs associated with the rehabilitation of existing infrastructure
- Recreation benefits from increased fish runs and the shift to a free-flowing river
- Commercial fishing benefits from increased fish runs
- Implementation costs for fish-related improvements (Alternative 2)
- Power benefits (Alternatives 2 and 3)

This summary indicates that Alternative 4, Dam Breaching, has significantly higher average annual net costs than the other alternatives. Alternatives 2 and 3 are actually less costly than Alternative 1. This is mainly because of increased power benefits. The largest NED average annual cost component associated with Alternative 4, Dam Breaching, is the cost associated with power replacement (\$271 million). The second largest average annual costs, implementation costs, are lower than 20 percent of the average annual power costs. Significant in-river average annual recreation benefits (\$82 million) are also associated with this alternative.

ES.3 Passive Use Value Estimates

Economists generally recognize that there is a benefit associated with knowing that the resource exists, even if no use is made of it. These values are typically referred to as passive use, non-use, or existence values. There are, however, disagreements about how to measure passive use values. Although DREW originally requested that a passive-use survey be conducted by the DREW Recreation Workgroup, the passive-use analysis conducted for this study used a benefit transfer approach. It should be noted that passive-use values are not NED benefits.

The passive use value estimates for salmon were calculated on a per fish basis based on the preliminary PATH results, as extended by the DREW Anadromous Fish Workgroup. Values were calculated for Alternatives 2 through 4 net of Alternative 1. Using the 1998 model results, the average annual return of wild salmon is less under Alternatives 2 and 3 than under Alternative 1, Existing Conditions. This resulted in negative passive use values for these alternatives. The passive use value associated with Alternative 4, Dam Breaching, was estimated to range from \$66 million to \$879 million per year, with a middle range between \$142 and \$508 million per year. The passive use value of a free flowing lower Snake River was estimated at \$420 million per year.

Using the 1999 PATH model results would reduce the difference among Alternatives 1 through 3 and Alternative 4, Dam Breaching. This would lower the estimated passive use value for Alternative 4, which, as noted above, is calculated net of Alternative 1, Existing Conditions. However, the passive use values associated with the free flowing river would not change.

ES.4 Tribal Circumstances and Perspectives

This section pulls information from a number of sources. One specific source of tribal information is the Tribal Circumstances and Perspectives Report (Meyer Resources, 1999). The Tribal Circumstances and Perspectives Report focuses on input from specific tribes and sets forth their perspectives. The specific tribes which participated are the Nez Perce, Umatilla, Yakama, Warm Springs, and Shoshone-Bannocks.

The Tribal Circumstances and Perspectives Report assesses impacts to tribal circumstances in terms of: tribal ceremonial, subsistence, and commercial harvests of salmon and steelhead and tribal access to flooded lands valuable to tribes. The analysis of salmon recovery and harvest levels presented in the Tribal Circumstances and Perspectives Report is based on preliminary numbers.

PATH measured the effect of the proposed alternatives on seven index salmon stocks for Snake River spring/summer chinook, a comprehensive review of Snake River fall chinook, and a narrative description evaluating the correlation between Snake River spring/summer chinook and steelhead.

The following discussion of alternatives presented below is based on preliminary PATH data weighted by PATH's panel of independent experts and extended by the DREW Anadromous Fish Workgroup to represent all Snake River wild and hatchery stocks. The Tribal Circumstances and Perspectives report presents tribal harvest recovery rates based on this preliminary PATH data and converts these rates into pounds, assuming average weights of 20.1 pounds per salmon for spring and summer chinook, 19.1 pounds per salmon for fall chinook, and 8.5 pounds per fish for steelhead. Results were evaluated at the 30-year and 50-year benchmarks. Due to concerns associated with the weighting process, unweighted PATH results were used in all other analyses for this feasibility study.

The Tribal Circumstances and Perspectives Report asserts that Alternatives 1 and 2 offer limited hope of salmon recovery within a timeframe considered reasonable by the five represented tribes. The report does not address Alternative 3, but the impacts for this alternative are likely to closely match those for Alternative 2. There would be no change in tribal land use under any of these alternatives.

According to the Tribal Circumstances and Perspectives Report, Alternative 4, Dam Breaching, would produce 2.4 times more tribal harvest of Snake River wild salmon and steelhead stocks than Alternative 1 (2.6 times more harvest than Alternative 2). At the 50-year benchmark, estimated tribal wild and hatchery harvest would increase by about 1.7 million pounds. The Tribal Circumstances and Perspectives Report concludes that only this alternative would redirect river actions toward significant improvement of the cultural and material circumstances of the tribes.

Approximately 14,000 acres of previously inundated land would be exposed under Alternative 4. The Tribal Circumstances and Perspectives Report states that the tribes would benefit greatly from implementation of this alternative by gaining access to lands once used for cultural, material, and spiritual purposes.

ES.5 Regional Economic Development (RED)

The regional economic analysis (RED) developed for this study addresses the regional economic impacts of changes in spending projected by various DREW workgroups. These impacts, evaluated in terms of business sales, employment, and income, were estimated using input-output models, which model the interactions among different sectors of the economy. Eight models were constructed to address the potential regional effects associated with the alternatives. Models were developed for Washington, Oregon, Idaho, and Montana, three subregions — the downriver, reservoir, and upriver subregions, and the lower Snake River study area, which consists of the three subregions. In addition, the DREW Anadromous Fish Workgroup estimated the economic impacts of changes in anadromous fish harvests. These impacts were evaluated for the Pacific Northwest states, Alaska, and British Columbia, Canada.

Construction activities resulting directly and indirectly from breaching of the four lower Snake River dams would generate increased business sales of \$2,263 million, 20,790 temporary jobs, and \$676.7 million in personal income in the lower Snake River study area. These changes would occur within 10 years of dam breaching and would fluctuate from year to year. In the long run, the lower Snake River study would experience a net decrease in business sales of \$33.7 million, a loss of 711 jobs, and a decrease of \$46.1 million in personal income. Short- and long-term changes in lower Snake River study area employment are presented by resource area and study region in Tables ES-11 and ES-12.

Impacts would also occur throughout the Pacific Northwest, throughout a state, or in an area of a State outside a subregion. These impacts include reductions in business sales, employment, and personal income associated with increased electricity bills. Positive impacts would be associated with replacement power plant construction and operations in the Puget Sound region, construction of tidewater rail care storage in Oregon, and increases in commercial and ocean recreation harvest of anadromous fish in the Pacific Northwest states, Alaska, and British Columbia, Canada.

Table ES-11. Short-Term Employment Effects (Jobs)^{1/}

	Upriver	Reservoir	Downriver	Total Lower Snake River Study Area^{2/}
1995 Employment	75,081	92,535	151,124	318,740
Power Plant Construction ^{3/}	0	0	5,572	5,572
Transmission Line Construction	0	0	2,080	2,080
Rail Construction ^{4/}				872
Road Construction ^{4/}				1,972
Facilities Construction ^{4/}				6,982
Well Modification	0	916	259	1,175
Pump Modification	844	0	0	844
Implementation	259	517	517	1,293
Total Change^{5/}	1,103	1,433	8,428	20,790
Change as % of 1995 Employment	1.47	1.55	5.58	6.52

1/ Midpoints are shown when only lower and upper bounds were available from other DREW workgroups. Averages are shown when the effects vary by year over a number of years. Many impacts have a wide range of variation depending on the magnitude of construction and the length of the time period.

2/ The three subregions comprise the lower Snake River study area. Employment change in this area includes the sum of employment change across the three subregions. Some of the projected Study Area impacts were not distributed by subregion.

3/ The DREW Hydropower Impact Team (DREW Hydropower Impact Team) assumed that a total of six replacement power plants would be built. The exact locations of these plants are unknown, but DREW Hydropower Impact Team assumed that three would be located in the downriver subregion, with the other three most likely located in the Puget Sound region. Construction of each power plant is estimated to generate 2,786 short-term jobs. The estimates shown in this table are the maximum number of these jobs that would be generated in any one year—5,572 in the downriver subregion, where two plants would be constructed simultaneously.

4/ These effects would occur in the lower Snake River study area, but it is unknown how they would be distributed among the subregions.

5/ The upriver, reservoir, and downriver subtotals do not sum to the total lower Snake River study area figure because some of the projected Study Area impacts were not distributed by subregion.

Table ES-12. Long-Term Employment Effects (Jobs) ^{1/}

	Upriver	Reservoir	Downriver	Total Lower Snake River Study Area^{2/}
1995 Employment	75,081	92,535	151,124	318,740
O&M Spending on Replacement Power Plants & New Transmission Lines	0	0	884	884
Recreation (incl. angling) ^{3/}				1,393
Total Long-Term Employment Gain^{4/}	0	0	884	2,277~
Reduction in Irrigated Lands	0	(1,105)	(474)	(1,579)
Avoided Costs (Reductions in Corps' Spending)	(133)	(1,060)	(133)	(1,326)
Reduced Cruise Ship Operations	(83)	0	0	(83)
Total Long-Term Employment Loss	(216)	(2,165)	(607)	(2,988)
Net Long-Term Employment Change ^{4/}	(216)	(2,165)	277	(711)
Net Change as a % of 1995 Employment	(0.29)	(2.34)	0.18	(0.22)

1/ Midpoints are shown when only lower and upper bounds were available from other DREW workgroups. Averages are shown when the effects vary by year over a number of years.

2/ The three subregions comprise the lower Snake River study area. Employment change in this area is the sum of employment change across the three subregions. Some of the projected Snake River study area impacts were not distributed by subregion.

3/ These effects would occur in the lower Snake River study area, but it is unknown how they would be distributed among the subregions.

4/ The upriver, reservoir, and downriver subtotals do not sum to the total lower Snake River study area figure because some of the Study Area impacts were not distributed by subregion.

ES.6 Social Analysis

The DREW Social Analysis examined nine focus communities — Clarkston, Colfax, Kennewick, Pasco, and Pomeroy in Washington; Lewiston, Orofino, and Riggins in Idaho; and Umatilla in Oregon. These communities were selected to capture a range of positive and negative impacts across different types of communities located throughout the region. These nine focus communities are divided evenly over the three subregions that comprise the lower Snake River study area. The following discussion addresses potential impacts that are likely to be common to other communities located in their respective subregions.

Alternative 1, Existing Conditions, is considered the base case for this analysis. Alternatives 2 and 3 would have little effect on the existing social and economic environment for most of the communities located in the lower Snake River region. Some communities, particularly those located upriver (e.g., Lewiston, Orofino, and Riggins), could be adversely affected by lower probabilities of salmon recovery. Uncertainty about the future of the four lower Snake River dams may also have negative social effects on some communities.

Breaching the four lower Snake River dams would change the physical and economic environment of the Lower Snake River study area. Communities in the upriver region (e.g., Lewiston, Orofino, and Riggins) would likely experience net employment gains as a result of expected increases in recreation and tourism associated with a free-flowing river, and to a lesser extent increased fish runs. The extent of the effects upon Lewiston and Orofino are, however, uncertain because the possible effects that the loss of river navigation could have upon the forest products industry have not been completely analyzed. Detailed industry studies would be needed to fully evaluate the extent of these effects. The effects of increased transportation costs to farmers would be most significant for communities located in the upriver subregion. Communities in Latah, Nez Perce, Idaho, and Lewis counties in Idaho would experience the largest increases in transportation costs.

Communities located in the reservoir subregion (e.g., Pomeroy, Colfax, and Clarkston) would likely experience a net decrease in employment due to reductions in Corps' employment and increased pressure on family farms caused by increased transportation, storage, and handling costs for agricultural products. This added pressure to an already depressed agricultural sector may lead to an increased rate of farm consolidation for those farms with a high debt to equity ratio.

Communities located in the downriver subregion (e.g., Pasco, Kennewick, and Umatilla) would likely experience employment loss if farms presently irrigated from Ice Harbor reservoir go out of business. These losses could be partially offset by expected increases in transportation- and power-generation-related employment.

Overall adverse community impacts associated with Alternative 4, Dam Breaching, that were identified by the DREW Social Analysis Workgroup include:

- Decreased net farm income and increased financial pressure on dryland farmers throughout the region, particularly those farms located close to the lower Snake River
- Risk of increased consolidation of family farms and a decrease in rural farm population

- Decreased county property tax base in 20 regional counties from decreased farm land value and potential loss of irrigated lands
- Dislocated full-time and seasonal workers from Ice Harbor irrigated agricultural lands and a loss of a source of local school revenue for communities close to the reservoir
- Realignment of communities' economic bases and changed potential for future growth

Communities would likely adjust to these changes. New individuals and businesses seeking new opportunities may replace those that have been displaced. Displaced human and capital resources may be employed in their next best use within the community. This type of adjustment does, however, take time and would vary by community. Community size has been identified as a critical factor affecting a community's ability to adapt to change, with smaller, less diverse communities tending to respond less favorably.

ES.7 Uncertainty

Uncertainty is inherent in any future-oriented planning effort. The period of analysis for this economic study is 100 years. Considerable uncertainty surrounds any attempt to forecast results 100 years into the future. In general, elements of uncertainty affect everything we do. It is the reality of inadequate information. When information is imprecise or absent, that is uncertainty. From this perspective, uncertainty is present in all aspects of the lower Snake River Juvenile Salmon Migration Feasibility Study. The plan formulation, the biology, and the economics all have elements of uncertainty in their analyses. Uncertainty of this type surrounds key study assumptions, methodology, and data collection in all resource areas.

The economic analysis presented in this appendix addresses the role of uncertainty in two ways. First, each study team was asked to address risk and uncertainty issues in their analyses. Second, an overall risk and uncertainty assessment of the economic and social analyses presented here was conducted as a separate part of the DREW process. The primary source of information for this risk and uncertainty assessment was information provided by the DREW study teams.