ELWHA RIVER RESTORATION PROJECT: ECONOMIC ANALYSIS

FINAL TECHNICAL REPORT

Developed by the Elwha Project Human Effects Team

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A Report to:

The U.S. Bureau of Reclamation

The National Park Service

The Lower Elwha S'Klallam Tribe

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Executive Summary

This analysis compares four project alternatives to "No Action", discounting future benefits and costs from zero to 7 percent. The alternatives are:

* Retain Elwha and Glines Canyon dams with fishery mitigation.

* Remove Elwha dam and retain Glines Canyon dam.

* Remove Glines Canyon dam and retain Elwha dam.

* Remove both dams.

Costs substantially exceed benefits for the first three of these options - where limited benefits accrue to fisheries, tourism or recreation with one or two dams left in-river, while costs are substantial.

Benefits associated with removal of both dams are estimated to exceed costs by at least $25.2 billion. While net revenues to recreation, tourism and commercial fishing businesses are significant, the largest part of these estimated benefits are non-market values of United Staes residents associated with removal of the two dams. If the non-market component of benefits is valued at only one cent on the dollar, total benefits still exceed costs for the two dam removal alternative.

These findings are consistent with conclusions concerning impact on Tribal culture and material circumstances. The Elwha Valley is the homeland for members of the Lower Elwha S'Klallam Tribe. Elwha and Glines dams preempt fisheries secured by ancestors of the Tribe in its 1855 Treaty with the United States at Point No Point. Of the alternatives considered, only removal of both dams will have a substantial beneficial effect on Tribal culture and on presently adverse Tribal material circumstances.

It is presently estimated that between $50 million and $70 million, plus a $29.5 million acquisition cost would be spent to remove both dams. These expenditures are expected to generate between $40 million and $55 million in business activity in Clallam County over the 10 year period of deconstruction and river restoration - generating between $21 million and $29 million of personal income and 760 to 1,000 total jobs.

Within ten years of removal of the two dams, it is estimated that additional visits by recreators and tourists to see the restored river system will generate increased spending in Clallam County of $28.5 million per year - and support 446 additional local jobs. A summary of project net economic benefits and costs, discounted at 3 percent, is provided on the following page (iv).

Summary of the Net Present Value of Elwha River Project Benefits and Costs - at 3% Rate of Discount

Impact	2 Dams Remain +Mitigation	Only Glines Out	Only Elwha Out	Both Dams Out
	-------in millions of dollars-----			
Impact Costs:				
Project Acquisition	--	15.0[1]	14.5[1]	29.5
Construction-Est.1	--	37.3[2]	24.5[3]	44.6
-Est.2	--			62.4
Regional Energy Cost	196.7	281.6	187.6	171.9
Total Costs-Est.1	196.7	333.9	226.6	246.0
-Est.2				263.8
Impact Benefits:				
Commercial Fisheries (Tribal & Non-Tribal)	-3.7	9.5	5.2	30.1
Sport Fish Business	-1.0	2.1	0.4	4.5
Recreation and Tourism	--	--	--	132.6
Ediz Hook	--	--	--	0.9
Total Bus. Revenue	-4.7	11.6	5.6	163.6[4]
Non-Market Benefits	-2.8	5.9	1.2	30,651.9[5]
Total Project Benefits	-7.5	17.5	6.8	30,815.5

Notes: [1] These estimates will depend on negotiation. They are arbitrarily assigned between "Elwha only" and "Glines only" in this table to sum to the "both dams out" figure of $29.5 million.

[2] From FERC-93, p. 2-24.

[3] From FERC-93, p. 2-25.

[4] Excludes Sport Fish Business net revenue to avoid double counting.

[5] Includes $12.7 million of sport fishing nonmarket benefit.

I. Basic Approach to Valuing Benefits and Costs

Benefits and costs associated with the Elwha River Restoration Project are valued in real terms[1], rather than nominal terms, in the present analysis. This distinction is consistent with procedures followed by the Congressional Budget Office (CBO), the U.S. General Accounting Office (GAO) and the Office of Management and Budget (OMB), and avoids uncertainty and often arbitrary speculation concerning expected rates of inflation over the medium to long term. Real rates of price increase are employed where these have been empirically derived from other sources - and will be specified, as appropriate, in following impact sections. Real price changes beyond the Year 2014 cannot be specified from existing sources - and the convention applied in this document is to assume that all project impacts retain their real relative price position from 2015 forward.

Most federal projects construct capital structures which then deteriorate over time, producing project benefits and costs over some generally definable future period. The Elwha River Restoration Project differs from this norm, as it incurs cost to remove structures and restore fisheries over a relatively discrete time period, but produces benefits indefinitely. Consequently, a project period of one hundred years has been selected for analysis[2].

This technical Appendix discusses the discounting approach used in following Section II. Economic impacts by subject area are then presented sequentially.

II. Balancing Project Benefits and Costs Over Time by Use of Discounting

1. Framing the Discussion

Use of a discount rate in project evaluation reflects the general perception among economists that project benefits or costs which occur in the future may not have equivalent value with those that occur in the present - either because persons may prefer to consume goods and services "now" rather than "later" (social time preference), or because presently available funds could be invested to earn a future economic return (rate of return on capital).

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[1] Real prices are defined as present and expected future prices minus the effects of expected future inflation.

[2] Such an analytical period for longer lived projects is permitted by the Department of the Interior under its **Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies** (March 10, 1993: Section 1.4.12).

Economists usually **discount** future benefits or costs at a selected **rate** to adjust for this concern.

Issues associated with discounting have been extensively discussed in Lind, et. al. (1982)[3]; and by Hartman (1990)[4], Lind (1990)[5], Lyon (1990)[6] and Moore and Viscusi (1990)[7]. This paper summarizes conclusions from that literature, reports on and evaluates present discounting procedures of federal agencies in light of these conclusions, and develops an approach for discounting future benefits and costs of the Elwha River restoration project.

Authors of the four discounting papers in Journal of Environmental Economics and Management (JEEAM)[8] (1990) agree that there is no single discount rate that will apply in every project case. Howe (1990), chair of the special JEEAM session on discounting, has summarized consensus emerging from those four papers.

> All agree that discount rates, like all other prices, must be tailored to particular times, locations, types of projects and methods of financing. There seems to be general consensus that the benefit-cost procedures implied by the "shadow price of

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[3] Lind, Robert C., K.J. Arrow, G.B. Corey, P. Dasgupta, A.K. Sen, T. Stauffer, J.E. Stiglitz, J.A. Stockfish and R. Wilson, 1982. **Discounting for Time and Risk in Energy Policy**. Resources for the Future: Washington, D.C. John Hopkins University Press.

[4] Hartman, Robert W., 1990. "One Thousand Points of Light Seeking a Number: A Case Study of CBO's Search for a Discount Rate Policy", in, **Journal of Environmental Economics and Management**, 18, S-3 - S-7.

[5] Robert C. Lind, 1990. "Reassessing the Government's Discount Rate Policy in Light of New Theory and Data in a World Economy with a High Degree of Capital Mobility", in, **Journal of Environmental Economics and Management**, 18, S-8 - S-28.

[6] Randolph M. Lyon, 1990. "Federal Discount Rate Policy, the Shadow Price of Capital, and Challenges for Reforms", in, **Journal of Environmental Economics and Management**, 18 S-29 - S-50.

[7] Michael J. Moore and W.K. Viscusi, 1990. "Discounting Environmental Health Risks: New Evidence and Policy Implications", in, **Journal of Environmental Economic and Management**, 18, S-51 - S-62.

[8] See Notes 4 through 7.

capital" approach are most defensible theoretically. While the complexities and sensitivities of that approach are intimidating, the derivation of special, simplified cases seems hopeful. Under current U.S. conditions, a real rate of about 2% seems to have support, but analysis must remain sensitive to the effects of methods of financing and type of project on this figure. A defensible philosophical base for long term, intergenerational discounting has yet to be found.[9]

Discussion between authors of the 1990 JEEAM discounting papers focused principally on characterizing the effect on the discount rate from differing sources and costs of government project financing. Underlying this discussion was the economic perspective that project financing needed to demonstrate a rate of return that was at least equivalent to the opportunity cost of funds expended. Lind (1990) has identified five discounting cases useful to this discussion, and recommended discounting approaches for each[10].

i) Project Creates a Net Increase in the Government's Budget

The government's long term borrowing rate of 1% to 3% should be used for discounting in this case[11].

ii) Project Proceeds at the Expense of Another Government Project

Discounting at the rate of return from the marginal government project is preferred - but this procedure will not be valid for longer term projects. For longer term projects, Lind recommends use of the government's long term borrowing rate[12].

iii) Project Objectives are Agreed to and Analysis Seeks Most "Cost Effective" Method of Attainment

Projects financed purely by government financing should be discounted at the government's long term borrowing rate. If the project effects production of goods and services in the private sector, the rate of return on private capital should be utilized[13].

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[9] Charles C. Howe, 1990, "Introduction: The Social Discount Rate", in, **Journal of Environmental Economics and Management**, 18, S-2.

[10] Lind, 1990. Supra at S-22 - S-24.

[11] Supra at S-22 and S-24.

[12] Supra at S-23.

[13] Supra at S-23 - S-24.

iv) Government Mandates Private Sector Action (eg. Regulations)

Cost of regulation should be stated on an annual basis, using the private rate of return on capital[14].

v) Project Has a Very Long Time Frame

Current interest rates are not likely to be useful in discounting for such projects, and intergenerational discounting requires future work. The government's long term borrowing rate is a good first candidate for the discount rate in long-term intergenerational allocation problems[15].

Lind's "regulatory evaluation" typology (#iv) clearly does not apply to the Elwha River Restoration project. Further, while "cost effectiveness" analysis (Lind's #iii) may be required at some project juncture, it is not appropriate to the general display of benefits and costs targeted by the Elwha Human Effects Team. Lind's cases #i and #ii can be considered relevant to the Elwha River Restoration project, depending on one's view of the effect of government fiscal policy on the deficit, while case #v clearly is applicable for this project - which is predicted to produce benefits for 100 years and beyond. This focuses discussion on the appropriate opportunity cost of capital for government financed projects - and on intergenerational equity in discounting.

Moore and Viscusi (1990) develop a wage hedonic approach to discount rate determination, with explicit reference to health issues. While their analytical approach differs from that of Lind (1990), they reach a similar numeric conclusion - namely that the real discount rate approximates 2 percent[16].

Finally, the methodological discussion of discounting for the Elwha River Restoration project provided here distinguishes between nominal or current prices and discount rates on the one hand, and real prices and rates (defined as nominal prices/rates minus inflation) on the other. The Elwha Human Effects Team has adopted a convention of working with real values and rates in this analysis (see previous). Combining of nominal with real values and rates in a single analysis violates basic economic principle, will bias results obtained and is inappropriate.

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[14] Supra at S-24.

[15] Supra.

[16] Moore and Viscusi, 1990. Supra at S-51.

2. A Range of Candidate Discount Rates for the Present Analysis

If the Elwha Human Effects Team followed the discussion provided by Lind, and by Moore and Viscusi, project benefits and costs would be discounted at a real rate of between 1% and 3% - having regard for both the opportunity cost of capital and for the long term nature of the Elwha River Restoration project (see preceding discussion). This range of rates is close to those generally used by the Congressional Budget Office (CBO). CBO's general approach was summarized by Hartman (1990).

> ...for analysis of government investment projects, the discount rate should be the yield on government securities - a 2% real rate. The volatility of interest rates is accommodated by having each study employ a sensitivity analysis, showing the results for +/- 2 percentage points around "the" rate, i.e., currently from 0% to 4% real.[17]

A further important point raised by Hartman is CBO's preference for discount rates based on longer term averaging - at least where expected project impacts are of significant duration.

> ...our interest rate projections had been volatile and frequently wrong. We sought for purposes of project evaluation a method for deriving a number that would change slowly and infrequently. We did not want to have to explain why the MX missile was a good idea last month, but not now.[18]

The basic approach to discounting used by the U.S. General Accounting Office (GAO) is similar to that recommended by CBO and by Lind (1990).

> GAO's base case discount rate should be the interest rate for marketable Treasury debt with maturity comparable to the program being evaluated. Sensitivity analysis should be used to address issues such as differing expectations about inflation and interest rates, private sector opportunity costs, and intergenerational effects of policies on human life.[19]

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[17] Hartman. Supra at S-4.

[18] Supra at S-4 - S-5.

[19] U.S. General Accounting Office, 1991. **Discount Rate Policy**. GAO/OCE-17.1.1. p. 7.

GAO clearly distinguishes between analysis in nominal or in real terms[20], and also indicates that intergenerational human effects may need to be discounted at very low rates[21].

Discounting approaches by the federal Office of Management and Budget (OMB) are more complex, and diverge somewhat from the authorities cited previously. OMB's base case instruction recommends benefit-cost analysis in constant dollar terms, together with use of a real rate of discount[22]. This advice specifically exempts "water resources projects"[23], which are covered by 1983 Principles and Guidelines of the (now defunct) U.S. Water Resources Council[24]. The Principles and Guidelines call for treatment of future benefits and costs in real terms, and specify that where an alternative procedure provides a more accurate estimate of benefit, the alternative estimate may be shown if the procedure is documented[25]. OMB provides annual advice on discount rates recommended for use in federal project analysis[26].

It is necessary to deal with an apparent anomaly of the OMB discount rate advisory procedure at outset. Economic theory and OMB Circular No. A-94 are in agreement that one cannot combine real and nominal discount rates and values in the same analysis.

> The proper discount rate to use depends on whether the benefits and costs are measured in real or nominal terms.
>
> (1) A real discount rate that has been adjusted to eliminate the effect of expected inflation should be used to discount constant-dollar or real benefits and costs. A real discount rate can be approximated by subtracting expected inflation from a nominal interest rate.

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[20] Supra.

[21] Supra at 9.

[22] Office of Management and Budget, 1992. **Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs.** Circular No. A-94, Revised Transmittal Memo No.64.

[23] Supra at 3.

[24] U.S. Water Resources Council, 1983. **Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies.**

[25] Supra at 19.

[26] See, for example, OMB Memorandum M-94-14. **1994 Discount Rates for OMB Circular No. A-94.**

(2) A nominal discount rate that reflects expected inflation should be used to discount nominal benefits and costs. Market interest rates are nominal interest rates in this sense.[27]

OMB provides both real and nominal discount rate advisories with respect to cost-effectiveness analysis[28] but provides only nominal advice on discounting with respect to federal water projects, even though analysis of benefits and costs is to be conducted in real terms[29]. Such a bifurcated procedure is inconsistent with economic theoretical requirements and with OMB's own overall approach to benefit-cost analysis. It has resulted in discounting recommendations upward to 10+%, and biases against projects with longer term benefit payouts. If OMB's recent circular M-94-14 on differential between real and nominal rates is indicative, this bias may be in the range of 3% per year.

OMB's failure to utilize a real discount rate for water resource projects masks two other fundamental issues that have been discussed in the literature - and that can be expected to result in discounting recommendations somewhat higher than those provided by either CBO or GAO. First, the recommended CBO and GAO real discount rates of 2% are based on the perception that the opportunity cost of government spending approximates the long term government borrowing rate. Conversely, the OMB procedure perceives that government project spending substantially displaces private domestic investment in the U.S. economy.

> OMB's 10% rate is consistent with an estimate of the pretax rate of return on private capital--also termed the opportunity cost of capital. The basic logic is that instead of investing in lower return public opportunities, a superior alternative would be to invest in higher return private projects.[30]

Lind points out that extensive inflows of foreign capital into the U.S. economy in recent years have likely softened the effect of federal deficit financing on private domestic capital displacement[31]. Under such conditions, it follows that failure to account for such inflows in the OMB recommendation can result in an overestimate of the opportunity cost of government spending.

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[27] Office of Management and Budget, 1992. Supra at 8-9.

[28] eg. Office of Management and Budget, M-94-14.

[29] Lyon, 1990. Supra at S-31.

[30] Supra at S-32.

[31] Lind, 1990. Supra at S-12 - S-16.

Second, the higher range of OMB recommended discount rates does not adjust for longer term projects having intergenerational human effects. This issue has been previously discussed, and can be illustrated by reference to following Table 1. This table illustrates the weight given, at alternative discount rates, to $1,000 of annual project benefits or costs occurring at 10, 25, 50, 75 and 100 years into the future. As such, it indicates the actual effect on assessment of feasibility for projects with longer term impacts from the range of discounting rates discussed here.

Table 1

Present Value of $1,000 of Annual Benefits or Costs, at Alternative Discount Rates

Discount Rate	Years Into the Future				
	10 Years	25 Years	50 Years	75 Years	100 Years
	in dollars				
0	1,000	1,000	1,000	1,000	1,000
1	905	780	608	474	370
2	820	610	372	226	138
3	744	478	228	109	52
4	676	375	141	53	20
7	508	184	34	6	1
10	386	92	9	1	--

3. Selecting a Discounting Procedure for the Elwha River Project

Cooperating parties involved in the Elwha River Restoration project include the National Park Service, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, other federal agencies, the Lower Elwha S'Klallam Tribe, and other non-federal entities. One agency, the Bureau of Reclamation, generally adheres to the U.S. Water Resources Council "Principles and Guidelines" for benefit-cost analysis. Other participating entities do not. Further, it is unclear whether this type of project, which "deconstructs" a water resources project, was envisioned when the Principles and Guidelines were developed more than 10 years ago. The Elwha Human Effects Team has consequently brought together several differing perceived responsibilities with respect to discounting the future benefits and costs of the Elwha River Restoration project. These differences mirror differences among federal oversight agencies.

Under these conditions, the Elwha Human Effects Team has developed the following procedure for discounting benefits and costs of the Elwha Restoration project.

i) Benefits and costs will be measured over a 100 year period.

ii) Benefits, costs and discount rates will be estimated in real terms.

iii) Benefits and costs will be discounted at annual rates of 1%, 2%, 3% and 4%, to determine whether any of these rates are decision critical with respect to project feasibility.

iv) A sensitivity analysis will be conducted at rates of 0% and 7% to accommodate separate calculations that may be subsequently required by any individual entity.

The central range of rates from 1% to 4% are considered the most reasonable, based on economic criteria. Some members of the Elwha Human Effects Team are less comfortable at the lower end of this range, others at the upper end. Our strategy is not to definitively resolve this issue, but to develop calculations across this range and determine whether differences are decision critical. This approach encompasses the discounting ranges recommended by CBO and GAO, and the recommendations of Lind (1990) with respect to intergenerational equity. The upper end of the range approximates a real rate of return inclusive of some degree of private domestic capital displacement in the U.S. economy - although government funding is still presumed to have significant access to foreign investors at this rate. Finally, considering requirements of economic theory, recent findings cited in the literature, and the particular intergenerational characteristics of this project, the Human Effects Team concludes that the discounting approach provided here will provide "a more accurate estimate of benefit", as permitted in Sect. I.2.1.1(b)(1) of the U.S. Water Resources Council's Principles and Guidelines[32].

Discounting at 0% provides a lower bound of sensitivity for calculations. It is consistent with the lower sensitivity bound used by CBO and is the most sensitive rate with respect to intergenerational equity concerns - weighting project impacts equally over the 100 year analytical period . It is the discount rate most consistent with the perspectives of the National Park Service and of the Lower Elwha S'Klallam Tribe.

Discounting at 7% provides an upper bound of sensitivity. This rate approximates recent rate recommendations made with respect to discounting in water resource project analysis by OMB. It can be observed from Table 1 that it provides little weight to project

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[32] U.S. Water Resources Council. Supra at 19.

benefits or costs which occur beyond 10 years - and is consequently the least sensitive to balancing of intergenerational effects of the range of rates discussed here.

III. Energy Costs and Benefits Associated with Elwha Restoration

1. Introduction

Data contained in analysis by the Federal Energy Regulatory Commission (1993) (hereafter FERC-93)[33], in referenced documents upon which it depends, and more recently in the Elwha Report[34], provide information with which to compare the relative power costs of alternatives respecting river restoration of the Elwha river. Those alternatives are:

1. Continue to operate Elwha and Glines dams as at present.
2. Operate Elwha and Glines dams with supplemental measures recommended by FERC-93 and The Elwha Report.
3. Remove Elwha Dam and continue to operate Glines Dam.
4. Remove Glines Dam and continue to operate Elwha Dam.
5. Remove both Elwha and Glines dams.

Further analysis is provided here for the following reasons:

i) Recent information from Bonneville Power Administration (BPA) provides important updated information relevant to cost estimation[35].

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[33] Federal Energy Regulatory Commission, 1993. Draft Staff Report, Volume I: Glines Canyon (FERC No.588) and Elwha (FERC No.2683) Hydroelectric Projects, Washington. Office of Hydropower Licensing, March.

[34] Department of the Interior, Department of Commerce and the Lower Elwha S'Klallam Tribe, 1994. The Elwha Report: Restoration of the Elwha River Ecosystem and Native Anadromous Fisheries. A Report submitted Pursuant to Public Law 102-495.

[35] Bonneville Power Administration, 1993. Wholesale Power and Transmission Rate Projections, 1993-2014, and Historical Wholesale Power Rates, 1939-1992. Bonneville Power Admin., 1994a. Business Plan in Brief. June. Bonneville Power Admin., 1994b. "Natural Gas Price Forecast Update. Final Analysis by B. Clark, June.

ii) FERC-93 and The Elwha Report estimated comparative energy costs in nominal terms. Such estimates are often used for budget forecasting and other purposes. However, they are overly sensitive to assumptions respecting future prices and interest rates, and are not recommended by OMB[36]. Further, while the assumptions underlying nominal analysis are understandable to economists, nominal results can mislead the non-technical reader. The Human Effects Team consequently follows the recommendations in OMB Circular A-94, and presents results in real dollars.

2. Method

Comparative costs are presented in **real 1996 dollars**. FERC-93 used 1996 as a base year for energy cost comparisons[37], and the Human Effects Team also consider this reasonable. **Real dollar estimates** account for cost differences between energy supply sources that may be required by the Northwest region energy supply portfolio over time, but do not speculate on the magnitude of any nominal price or interest rate changes subsequent to 1996. In any event, such nominal changes should affect the cost of energy alternatives considered here in a generally uniform manner.

The "own generation" cost estimates provided here for Alternative 2 are based on supplemental improvements recommended by FERC-93 plus cost estimates for standard fish screening mitigation measures at the two dams recommended in the Elwha Report[38]. Since the cost methodologies employed in FERC-93 and in this analysis are dissimilar, resulting estimates for the Elwha Report cost add-on are approximate[39].

Steps employed to calculate cost of purchased power follow.

i) Use 1996 and 1997 energy cost estimates from Table 2-18 in FERC-93, amended by cost data for standard fish screening from The Elwha Report, for Alternatives 1 through 4.

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[36] Office of Management and Budget, 1992. "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs". Circular No. A-94, October 29.

[37] Federal Energy Regulatory Commission (1993), Supra at 2-39.

[38] See pp. 31-32.

[39] These cost estimates are based on information published in FERC-93 and in the Elwha Report. They may not necessarily include all mitigation measures required under dam retention alternatives.

ii) Use 1996 through 2014 real priority firm power rate estimates from Bonneville Power Administration (1993), Table 1, as real cost of purchased energy for Alternative 5 - Local Costs[40][41].

iii) Assume BPA's "Tier 2" rate of approximately 32 mills is a reasonable estimate of current Regional Avoided Cost[42].

iv) Assume the estimated 2% annual increase in real cost of natural gas (Bonneville Power Administration, 1994b)[43], approximates the real increase in Regional Avoided Cost, 1994 through 2014[44]. Apply this rate of increase to the Regional Avoided Cost estimate from Step (3) to estimate real cost of purchased energy, for Alternative 5 through 2014.

v) Hold "own generation" costs[45] for energy constant after 1997 for Alternatives 2 through 4. Increase real costs of energy purchases for these three alternatives from 1998 forward at the 2 percent per year real rate from Step (4).

vi) Add cost of "own generation" and purchased energy for each alternative, (1) through (5).

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[40] Bonneville Power Administration (1994a) indicates that these real cost estimates may be slightly high - due to expectation of reduced or negative projected growth for some industrial customers and anticipated increased price competition from non-traditional energy supply sources.

[41] Estimated changes in real costs beyond 20 years are speculative, and not based on detailed empirical analysis. For example, historical data from Table 6 in Bonneville Power Administration (1993) indicate that real energy costs today are lower than in 1940, with substantial declines through 1979, sharp increases between 1979 and 1984 largely due to WPPSS nuclear cost retirement, and slight declines subsequent to 1984. The most responsible procedure is therefore to estimate real cost trends to the limit of empirically based analysis (2014), and then balance benefits and costs beyond that date within the overall project reporting framework.

[42] S. Buchanan, Manager for Power Business, Bonneville Power Administration. Personal communication. August 3, 1994.

[43] Bonneville Power Administration, 1994b. Supra at p. 1.

[44] S. Buchanan. Supra.

[45] "Own generation" costs are associated with dam operation, and not with "purchase" of replacement energy.

3. Estimated Energy Cost

Table 2 identifies the estimated real cost of purchased energy between 1996 and 2014, from Steps (2) through (4).[46]

Table 2

Estimated Real Cost of Purchased Energy - 1996 through 2014

Year	Local Cost	Regional Cost
	----in mills----	
1996	26.7	33.3
1997	27.7	34.0
1998	27.8	34.6
1999	28.7	35.3
2000	28.7	36.0
2001	28.7	36.8
2002	28.4	37.5
2003	28.9	38.2
2004	27.8	39.0
2005	27.3	39.8
2006	27.6	40.6
2007	27.4	41.4
2008	27.6	42.2
2009	27.6	43.1
2010	27.6	43.9
2011	28.5	44.8
2012	28.9	45.7
2013	28.1	46.6
2014	27.9	47.5

Table 3 identifies the amount of energy "generated" and "purchased" under each project alternative, to supply an annual total of 172 Gwh. These data are from FERC-93, Table 2-18, pp. 2-39 and 2-40.

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[46] Examination of information in Bonneville Power Administration, 1994a, would suggest that the estimated increases in regional avoided cost displayed in Table 1 may be too high, due to anticipated losses of BPA markets associated with cutbacks by large industrial customers, industrial cogeneration and energy conservation. However, unforseen requirements to provide instream flows may exert upward pressure on cost, and, on balance, the real cost escalation indicated in Table 1 is considered reasonable.

Table 3

Estimated Share of Annual Energy Generated and Purchased
-Elwha River Restoration Project-

Project Alternative	Own Generation	Purchase	Total Energy
	----------in Gwh----------		
1 - No Action	172	0	172
2 - Retain 2 Dams + FERC improvements.	160	12	172
3 - Remove Elwha	93	79	172
4 - Remove Glines	67	105	172
5 - Remove both Dams	0	172	172

Table 4 combines our procedural steps with the data from Tables (2) and (3) to estimate the total cost of "own energy" generation, plus purchase, for each of the five project alternatives.

Table 4

Estimated Total Annual Real Energy Cost - Alternatives for Elwha River Restoration - 172 Gwh of Annual Energy

Alternative	1996	1997	1998	1999	2000	2005	2010	2014
	----------millions of dollars----------							
A. Based on Local Cost of Purchased Power:								
1. No Action	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
2. Retain Dams +FERC Suppl. Measures.	10.7	8.1	8.1	8.1	8.1	8.1	8.1	8.1
3. Remove Elwha Dam	8.0	6.7	6.7	6.8	6.8	6.7	6.7	6.7
4. Remove Glines Dam	10.1	9.3	9.3	9.4	9.4	9.3	9.3	9.3
5. Remove both Dams	4.6	4.8	4.8	4.9	4.9	4.7	4.7	4.8
B. Based on Regional Avoided Cost of Purchased Power:								
1. No Action	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
2. Retain Dams +FERC Suppl. Measures.	10.7	8.1	8.1	8.1	8.2	8.2	8.2	8.3
3. Remove Elwha Dam	8.5	7.2	7.3	7.3	7.4	7.7	8.0	8.3
4. Remove Glines Dam	10.7	10.0	10.0	10.1	10.1	10.6	11.0	11.4
5. Remove both Dams	5.7	5.8	6.0	6.1	6.2	6.8	7.6	8.2

IV. Fishery Impacts from Elwha River Restoration

1. Increased Salmon Harvest Due to Elwha River Restoration

Salmon harvest rebuilding schedules and associated biological information for restoration of the Elwha river are provided by biologists associated with the Elwha Fisheries Team[47]. Projected harvests of chinook, coho and steelhead approximate full restoration estimates for all project alternatives in Federal

[47] Methods underlying these estimates are discussed in fishery sections of U.S. Department of the Interior, **Final Environmental Impact Statement: Elwha River Ecosystem Restoration** (forthcoming, 1995).

Energy Regulatory Commission (1993)[48]. Results are displayed, by species, in Tables 5 through 10. To adjust for construction-related disturbances in river, harvest is assumed to commence in project Year 1 for Option 1 (No Action), but is delayed by one year for Option 2 (Retain Dams + Mitigation), and by two years for other options.

Table 5

Estimated Additional Harvest of Chinook Salmon from the Elwha River System - Project Alternatives Compared to No Action

Project Year	(1) No Action	(2) Retain Dams +Mitigation	(3) Remove Elwha Only	(4) Remove Glines Only	(5) Remove Both Dams
	numbers of fish harvested				
1	8464	0	0	0	0
2	8464	0	0	0	0
3	8464	0	0	0	0
4	8464	0	0	0	0
5	8464	0	0	0	0
6	8464	505	0	0	0
7	8464	505	631	837	1215
8	8464	505	631	837	1215
9	8464	505	631	837	1215
10	8464	1148	631	837	1215
15	8464	2440	5740	8127	12715
20	8464	4996	8240	12271	18227
25	8464	6956	10401	15611	21782
30	8464	8719	11747	17300	23147
40	8464	8910	12718	18083	23617
50	8464	8923	12760	18097	23623
100	8464	8923	12764	18097	23623

[48] Federal Energy Regulatory Commission. Supra at 4-79.

Table 6

Estimated Additional Harvest of Coho Salmon from the Elwha River System - Project Alternatives Compared to No Action

Project Year	(1) No Action	(2) Retain Dams +Mitigation	(3) Remove Elwha Only	(4) Remove Glines Only	(5) Remove Both Dams
	numbers of fish harvested				
1	6619	0	0	0	0
2	6619	0	0	0	0
3	6619	0	0	0	0
4	6619	0	0	0	0
5	6619	968	0	0	0
6	6619	968	1069	1231	1361
7	6619	968	1069	1231	1361
8	6619	1735	1069	1231	1361
9	6619	1735	2123	2788	3276
10	6619	1735	2123	2788	3276
15	6619	4839	6830	12566	12962
20	6619	9352	11261	15572	21603
25	6619	10961	14240	18420	21728
30	6619	12235	14982	18976	21743
40	6619	12474	15123	19066	21745
50	6619	12486	15132	19071	21745
100	6619	12486	15172	19071	21745

Table 7

Estimated Additional Harvest of Steelhead from the Elwha River System - Project Alternatives Compared to No Action

Project Year	(1) No Action	(2) Retain Dams +Mitigation	(3) Remove Elwha Only	(4) Remove Glines Only	(5) Remove Both Dams
	numbers of fish harvested				
1	1808	0	0	0	0
2	1808	0	0	0	0
3	1808	0	0	0	0
4	1808	0	0	0	0
5	1808	3	0	0	0
6	1808	3	4	3	5
7	1808	3	4	3	5
8	1808	6	4	3	5
9	1808	6	8	7	14
10	1808	6	8	7	14
15	1808	21	33	36	81
20	1808	61	63	2006	2795
25	1808	1106	2264	2649	4208
30	1808	1359	2464	3030	4316
40	1808	1509	2578	3242	4361
50	1808	1546	2607	3291	4369
100	1808	1546	2611	3297	4370

Table 8

Estimated Additional Harvest of Pink Salmon from the Elwha River System - Project Alternatives Compared to No Action

Project Year	(1) No Action	(2) Retain Dams +Mitigation	(3) Remove Elwha Only	(4) Remove Glines Only	(5) Remove Both Dams
	numbers of fish harvested				
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	501	0	1228
6	0	0	0	0	0
7	0	0	835	0	3333
8	0	0	0	0	0
9	0	0	1387	0	8920
10	0	0	0	0	0
11	0	0	2290	0	22987
13	0	0	3749	0	53876
15	0	0	6045	0	133274
17	0	0	9525	0	157340
19	0	0	14489	0	170201
21	0	0	20959	0	175709
23	0	0	28397	0	177802
25	0	0	35685	0	178556
27	0	0	41644	0	178823
29	0	0	45773	0	178917
31	0	0	48245	0	178950
41	0	0	50891	0	178968
51	0	0	50968	0	178968
99	0	0	50970	0	178968

Table 9

Estimated Additional Harvest of Chum Salmon from the Elwha River System - Project Alternatives Compared to No Action

Project Year	(1) No Action	(2) Retain Dams +Mitigation	(3) Remove Elwha Only	(4) Remove Glines Only	(5) Remove Both Dams
	numbers of fish harvested				
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	170	0	326
7	0	0	170	0	326
8	0	0	170	0	326
9	0	0	215	0	785
10	0	0	215	0	785
15	0	0	342	0	3869
20	0	0	427	0	13890
25	0	0	652	0	16723
30	0	0	957	0	17732
40	0	0	1532	0	18062
50	0	0	2118	0	18104
75	0	0	2938	0	18107
100	0	0	3027	0	18107

Table 10

Estimated Harvest of Sockeye Salmon from the Elwha River System
- All Project Alternatives -

Project Year	(1) No Action	(2) Retain Dams +Mitigation	(3) Remove Elwha Only	(4) Remove Glines Only	(5) Remove Both Dams
	number of fish harvested				
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	1997	0	1997
4	0	0	2245	0	2245
5	0	0	2465	0	2465
6	0	0	2651	0	2651
7	0	0	2804	0	2804
8	0	0	2915	0	2915
9	0	0	3018	0	3018
10	0	0	3089	0	3089
15	0	0	3247	0	3247
20	0	0	3279	0	3279
25	0	0	3285	0	3285
30	0	0	3286	0	3286
100	0	0	3286	0	3286

These estimated harvests are allocated between commercial tribal, commercial non-tribal and recreational fishing sectors using actual data for 1989 through 1993 for the general Puget Sound region from PFMC[49]. Allocation percentages are displayed in Table 11.

[49] Pacific Fisheries Management Council, 1994. **Review of 1993 Ocean Salmon Fisheries**, pp. B-41 - B-43.

Table 11

Allocation of Puget Sound Salmon between Commercial and Recreational Fisheries, 1989-1993

Species	Fishery	Average Percent of Harvest
Chinook	Commercial Non-Tribal	10.9
	Commercial Tribal	45.5
	Recreational	43.6
Coho	Commercial Non-Tribal	20.8
	Commercial Tribal	47.9
	Recreational	31.3
Pink (odd yrs)	Commercial Non-Tribal	46.1
	Commercial Tribal	52.2
	Recreational	1.7
Chum	Commercial Non-Tribal	46.9
	Commercial Tribal	53.1
Sockeye	Commercial Non-Tribal	46.3
	Commercial Tribal	53.7
Steelhead	Commercial Tribal	50.0*
	Recreational	50.0*

*Allocated at 50 percent to each fishery.

Average sizes of salmon, in pounds, for commercial harvest of Elwha chinook, coho, chum and pink salmon are available from Table 4-20 of FERC (1991)[50]. Average size for steelhead are from U.S. Fish and Wildlife Service estimates for the Elwha River contained in Meyer-Zangri (1982)[51]. Size estimates for sockeye are from the Cheewhat Lake system[52]. These average fish sizes are displayed in Table 12. These data somewhat overstate actual sizes that might

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[50] Federal Energy Regulatory Commission, 1991. **Draft Environmental Impact Statement: Glines Canyon (FERC No.588) and Elwha (FERC No.2683) Hydroelectric Projects, Washington**, p. 4-119.

[51] Meyer-Zangri Associates, 1982.**The Historic and Economic Value of Salmon and Steelhead to Treaty Fisheries in 14 River Systems in Washington, Oregon and Idaho.** A Report to the Bureau of Indian Affairs. Davis: CA., p. 236.

[52] Dr. K. Hyatt, Department of Fisheries and Oceans. July, 1992.

be expected under "no action" and "two dam retention with mitigation" options.

Table 12

Assumed Average Fish Sizes - Elwha River Salmon and Steelhead Restored Stocks

Species	Average Size -in pounds-
Chinook	27
Coho	12
Pinks	4
Chum	10
Sockeye	4
Steelhead	12

2. Revenue Generated for Commercial Fishery Sectors

Non-Treaty commercial fishing, processing and retail revenue generated by Elwha river restoration is estimated as follows.

For the **fishing sector**, gross revenue is estimated by applying average ex-vessel prices for the general Puget Sound region, provided by the Washington Department of Fisheries for the years 1988, 1989 and 1990[53], to the estimates of additional harvest due to Elwha restoration discussion in preceding Section 1.

In order to estimate net revenue to commercial fishermen, it is necessary to deduct any additional expenses associated with catching the Elwha-based increment of fish from gross revenues. Barclay and Morley (1977) estimated that a doubling of all stocks in the adjacent Canadian salmon fishery would result in increased harvest costs starting at 2 percent and eventually reaching 15 percent - with an average cost increase of approximately 9 percent[54]. Given the modest role that harvest increments from Elwha

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[53] These are the latest three years available in published form. A three year average is used as some species show significant year to year price variability.

[54] J.C. Barclay and R.W. Morley, 1977. **Estimation of Commercial Fishery Benefits and Associated Costs for the National Income Account.** Department of Fisheries and Oceans, Vancouver.

will play in overall commercial catches by Juan de Fuca fishermen, and chronic underutilization of vessels and gear due to longer term declines in Washington's commercial fisheries, cost increments associated with harvest increments from Elwha river restoration will be nominal. The lower 2 percent cost adjustment suggested by Barclay and Morley will be employed in this analysis.

Value added for the **salmon processing sector** has been estimated at 100 percent of fishermen gross value by Bonneville Power Administration (1986)[55]. The BPA estimate reviewed work by Oregon State University (1978)[56] which suggested a Puget Sound markup, fishing level to processing level, of between 84 percent and 113 percent, depending on assumptions used; and by Petry (1979)[57] suggesting a markup of 116 percent for Washington.

As with fishing, this estimate of gross revenue added by processing must be adjusted to account for associated cost of processing in order to obtain net economic impact estimates at the processing level. Historically, idle capacity is characteristic of the fish processing industry in the Pacific Northwest in most years. Because of annual fluctuations in catch, processors ensure adequate processing capacity for the good year, knowing that some of this capacity will lie idle in poorer catch years. More recently, due to downward trends in overall catch levels, idle processing capacity has been chronic. Considering these facts, and the relatively modest contribution of restored Elwha fisheries to regional fish processing, we assume that processors would experience increased variable costs, but not fixed costs, due to Elwha fish processing increments[58]. National data from Penn (1980)[59] indicate variable

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[55] Bonneville Power Administration, 1986.**Calculation of Environmental Costs and Benefits Associated with Hydropower Development in the Pacific Northwest.** Portland: DE-AC79-83BP11546, p. 42.

[56] Oregon State University, 1978. **Socio-Economics of the Idaho, Washington, Oregon and California Coho and Chinook Salmon Industry.** 2 vols. Corvallis.

[57] G.H. Petry, 1979. **Pacific Northwest Salmon and Steelhead Fishery Report - The Economic Status of the Oregon and Washington Non-Indian Salmon Gillnet and Troll Fishery.** 2 vols. Washington State University, Pullman.

[58] W. Jensen, 1982. Personal communication. West Coast Fisheries Development Foundation; R. Schwindt, 1982. **Industrial Organization of the Pacific Fisheries.** Commission on Pacific Fisheries Policy, Vancouver.

processing costs can range between 46 percent and 50 percent of the value added increment, exclusive of fish purchases. This analysis will utilize the mid-point of this range and deduct 48 percent of value added by processing to obtain the estimated net economic processing increment.

Bonneville Power Administration (1986) estimated a salmon value added markup from processing to retail levels of 107 percent[60]. Salmon retailers, whether stores, eating places or institutions, generally handle a wide variety of product beyond salmon, and the overcapacity assumptions applied at fish catching and processor levels are unlikely to apply at retail. Penn (1980) estimates a before tax profit margin at 20.9 percent of retail value added for chinook, coho, pink and chum, and 23.8 percent for sockeye. These percentages are treated as equivalent to net economic value at retail in the present analysis.

3. Revenue Generated for Businesses Servicing Sport Fishing

The Research Group (1991) used a comprehensive survey of Oregon sport fishermen to estimate associated expenditures of $43.13 per activity day. Oregon and Washington sport fishermen have similar characteristics, and this recent estimate seems reasonable for sport fishing in Washington as well. Updating using the U.S. Consumer Price Index, provides a 1992 expenditure estimate of $44.34 per fishing day for use in our analysis[61]. We then adjusted this expenditure per day estimate to an estimate of expenditure per salmon caught, by averaging sport catch per unit of effort data for the outside ocean (1.36:1) and for Puget Sound (0.33:1), contained in Bonneville Power Administration (1986)[62].

Where capital and labor in businesses servicing recreational fishermen are fully employed, net value will be substantially less than gross value. Frederickson, Kamine and Associates (1980)[63] estimated net economic impact on sport fishing businesses from

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[59] E. Penn, 1980. **Cost Analysis of Fish Price Margins, 1972-1977, at Different Production and Distribution Levels.** National Marine Fisheries Service, Washington, D.C.

[60] Ibid., pp. 45-46.

[61] The Research Group (1991), p. 37.

[62] Bonneville Power Administration (1986), p. 19.

[63] Frederickson, Kamine and Associates, 1980. **Proposed Trinity River Basin Fish and Wildlife Management Program.** Appendix A, Socio-Economic Analysis. A Report to the U.S. Bureau of Reclamation, Sacramento.

marginal changes in catch at 30 percent of gross revenue, in the Klamath river system in northern California. Lansche (1985) estimated that, at the margin, changes in levels of sales may result in net revenue changes between 40 and 60 percent[64] in Idaho. This analysis will utilize the mid-point of these estimates, and assess net economic benefit to businesses servicing recreational fishing at 45 percent of gross revenue increment.

4. Commercial Fishery Economic Benefits to Treaty Tribes

Dollar estimates of value comprise only a small part of the importance of salmon to Tribal peoples[65]. The importance of the Elwha river and its salmon resources to the Lower Elwha S'Klallam people is discussed more extensively in following Section VIII - which should be read in concert with this section to gain a fuller understanding of impacts on Tribal values and circumstances. With this qualification, an estimate of the future dollar revenue, that the Treaty Tribes could obtain from their share of additional commercial salmon catch only, under restoration alternatives for salmon stocks of the Elwha river is provided.

By Treaty, the Tribal share of salmon is set, overall, at 50 percent of harvest, although actual catch varies somewhat from year to year and by species. At present, Tribal catch occurs principally via commercial fisheries. In this Tribal commercial revenue calculation, we apply the same values for catching, processing and retailing as for non-Tribal commercial fishermen and processors (see previous methodological discussion)[66]. It should be noted that the processing and retailing benefits identified with Tribal commercial catch will likely benefit both Indians and non-Indians.

5. Estimated Net Economic Impact of Alternatives to Restore Elwha River Fisheries

In this section, the economic methodology discussed in prior sections IV.2 through IV.4 is applied to the projected fish harvests under each Elwha project alternative from Tables 5 through

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[64] J.M. Lansche, 1985. **The Contribution of Outfitting and Guiding to the Idaho Economy**. A Report to the Idaho Outfitters and Guides Association and the Idaho Travel Council.

[65] See, for example, Central Washington University, 1991. **Potential Effects of OCS Oil and Gas Exploration and Development on Pacific Northwest Indian Tribes: Final Technical Report**. U.S. Minerals Management Service OCS Study MMS 91-0056.

[66] The sockeye commercial value is utilized as a proxy for steelhead.

10. These calculations are displayed in Table 13, and estimate the annual commercial net economic benefits from commercial fish-based and sport fish-based business enterprise - for the full fish restoration potential identified under each project alternative. It should be noted from Tables 5 - 10 that, disregarding the "no action" option which assumes continuation of present harvest levels, these annual benefits will occur earliest for the "remove both dams" option, and latest for options which retain one or both dams - due to differential rates of recovery of fish stocks. Project alternatives are numbered as in Tables (5) through (10).

Table 13

Estimated Annual Net Business Benefits from Elwha Fish Restoration - After Rebuilding is Completed

Species	Fishery	Alt.1	Alt.2	Alt.3	Alt.4	Alt.5
		-----in millions of dollars-----				
Chinook	:Commercial Non-Tribe.	0.09	0.10	0.13	0.20	0.25
	:Commercial Tribal.	0.38	0.39	0.57	0.81	1.06
	:Sport Bus.	0.09	0.10	0.13	0.19	0.24
Coho	:Commercial Non-Tribe.	0.05	0.09	0.12	0.14	0.16
	:Commercial Tribal.	0.11	0.22	0.26	0.33	0.38
	:Sport Bus.	0.05	0.09	0.12	0.14	0.16
Pink	:Commercial Non-Tribe.	--	--	0.08	--	0.29
	:Commercial Tribal	--	--	0.09	--	0.32
	:Sport Bus.	--	--	0.02	--	0.07
Chum	:Commercial Non-Tribe.	--	--	0.02	--	0.13
	:Commercial Tribal.	--	--	0.03	--	0.15
Sockeye	:Commercial Non-Tribe.	--	--	0.03	--	0.03
	:Commercial Tribal.	--	--	0.04	--	0.04
Steelhead	:Commercial Tribal.	0.05	0.05	0.07	0.10	0.13
	:Sport Bus.	0.02	0.02	0.03	0.04	0.05
Total Annual Benefits		**0.84**	**1.07**	**1.57**	**1.97**	**3.46**

V. Impacts on Recreation and Tourism

The Olympic Peninsula is Washington state's most popular vacation destination[67]. Clallam County offers approximately 1200 hotel/motel rooms and over 2800 campsites[68]. Olympic National Park alone hosted 3.5 million visits in 1993, and Park visitation has grown at an annual average rate of 1.2 percent over the last decade[69]. Dean Runyan Associates estimate that travellers spent $131 million in Clallam County in 1993[70].

Loomis (1995) has produced survey-based estimates of increased recreation/tourism visitation to the Elwha River drainage area, should the river be fully restored[71]. Using conservative estimating procedures[72], Loomis' results are displayed in Table 14.

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[67] Washington State Tourism Division, 1987. **Olympic Peninsula Profile.**

[68] White, William, D. Stalheim and R. James, 1992. **Clallam County Profile.** Clallam County Department of Community Development, p. 50.

[69] Based on data supplied by H.C. Warren, Chief Naturalist, Olympic National Park.

[70] Dean Runyan Associates, 1994. **Washington 1991-1993: Economic Impacts of Travel and Visitor Volume.** A Report to Washington Department of Community, Trade and Economic Development. p. 19.

[71] Loomis, John, 1995. **Measuring the Economic Benefits of Removing Dams and Restoring the Elwha River: Results of a Contingent Valuation Survey.** Colorado State University, Fort Collins, Colorado.

[72] Loomis reduced estimated increase in visitation considerably from levels indicated in his raw data, to discount for a small visitation data subset in his sample of U.S. residents living outside Washington state.

Table 14

Estimated Increased Recreation/Tourism with Full Restoration of the Elwha River Drainage

Home Residence of Visitors	Annual Visitors	Annual Visitor Trips
Clallam County	2,073	10,112
Other Washington State	178,321	293,531
U.S. outside Washington State	120,864	203,441
Total U.S. Visitors*	301,258	507,084

*This estimate does not include increased visitation by persons living outside the United States.

Dean Runyan Associates (1994) report an average hotel/motel stay in Washington of 3.15 days, and an average campground stay of 3.85 days[73]. Unpublished campground visitation data for Olympic National Park[74] is generally consistent with the State of Washington campground figure. Visitors who only drive or are bussed to some specific feature such as Hurricane Ridge likely spent less time in the general area. For this analysis, the following conservative assumptions are applied to develop a total visitor profile (Table 15). Visitor data in Column (1) is prorated from the results displayed in Table 14.

[73] Dean Runyan Associates, Supra at 40.

[74] See Note 67.

Table 15

Profile for Increased Visits to the Elwha River Area

Residence of Visitor	Number of Visits	Nights of Stay	Total Visitor Nights
Clallam County:			
:Day Visits	8,090	--	--
:Camping	2,022	2	4,044
:Hotel/Motel	--	--	--
Rest of Washington State:			
:Day Visits	97,844	--	--
:Camping	97,844	2	195,688
:Hotel/Motel	97,843	2	195,686
U.S. Outside Washington:			
:Day Visits	67,814	--	--
:Camping	67,814	3	203,442
:Hotel/Motel	67,813	2	135,626
Total - All Visitors:			
:Day Visits	173,748		--
:Camping	167,678		403,174
:Hotel/Motel	165,656		331,312
Total - All Types of Visit	507,082		734,486

These estimates were groundtruthed against existing camper and hotel/motel accommodations in Clallam County. It is assumed that visitation would build incrementally over a 10 year period to the levels shown in Table 15, as river restoration proceeds. On this basis, it is estimated that demand for accommodation in Clallam County would increase between 4 percent and 8 percent per year over that period, depending on mode of visitor accommodation.

Finally, we apply estimates of average expenditure per visitor day of travel to the recreation day totals from Table 15 to obtain estimated annual increases in recreation/tourism expenditure in the Elwha area due to restoration of the Elwha River (Table 16). Examination of data from Beyers (1970)[75] and of contemporary recreation spending data in Washington state[76], suggests that an

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[75] Beyers, William B. 1970. **An Economic Impact Study of Mt. Ranier and Olympic National Parks.** A Report to the National Park Service. University of Washington.

[76] eg. Southwick Associates, 1992. **The Economic Impacts of Hunting, Sport Fishing and Non-Consumptive Recreation in Washington.** A Report to the Washington Department of Wildlife.

estimated expenditure of $7 per visitor per day, for persons who do not stay in the area overnight, is very conservative. Estimated expenditures for overnight camping and hotel/motel guests are developed from Dean Runyan Associates (1994)[77].

Table 16

Estimated Annual Expenditure in the Elwha River Area from Recreation and Tourism Associated with Elwha River Restoration

Visitor Type	Visitor Days	Expenditure/Day	Total Expenditure
		---in dollars---	
Day visitor	173,748	7.00	1,216,236
Camper	403,174	18.96	7,644,179
Hotel/Motel Guest	331,312	59.36	19,666,680
Annual Totals	908,234		28,527,095

Businesses servicing ocean fishermen and hunters on the Olympic Peninsula have been facing chronic circumstances of overcapacity - due to dwindling supplies of fish and game, so that a substantial portion of any revenue increment may be assigned as net profit (see earlier discussion of sport fishing business). For recreation/ tourism as a whole, initial profit increments on the Olympic Peninsula would also be substantial, due to adverse business effects in timber and tourism economic sectors over the past several years. For the longer term, profit margins may be somewhat lower. Considering both these immediate term and longer term conditions, a net profit estimate of 20 percent will be applied in this section. This results in an estimate of annual net economic business benefit from recreation/ tourism of $5,705,419.

VI. Non-Market Impacts from Elwha River Recreation

1. Non-Market Economic Impacts - Removal of Both Dams

Economic analysis identifies that consumers of both private and public goods and services often enjoy satisfaction over and above the amount they pay. Economists describe such public goods surpluses as non-market value. Loomis (1995)[78] has developed an estimate of additional total non-market economic value associated

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[77] Dean Runyan Associates, Supra.

[78] Loomis, 1995. Supra.

with project Alternative 5 - removal of both dams - based on a contingent value survey of Clallam County, Washington state and United States respondents.

Contingent valuation is a standardized and widely used method for estimating the willingness to pay of citizens for recreation, option, existence and bequest values[79]. It is recommended for use by federal agencies for performing benefit-cost analysis[80] and for valuing natural resource damages[81]and has been upheld by the federal courts[82]. Randall and Stoll (1983)[83] have defined total non-market economic value as the sum of recreation values, option value[84], existence value[85]and bequest value[86]. Such values have been quantified in a number of other recent studies[87].

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[79] Mitchell, Robert and R. Carson, 1989. **Using Surveys to Value Public Goods: The Contingent Value Method.** Resources for the Future, Washington, D.C.

[80] U.S. Water Resources Council, 1983. Supra.

[81] U.S. Department of the Interior, 1986. **Natural Resource Damage Assessments; Final Rule.** Federal Register 51. Washington, D.C.

[82] U.S. District Court of Appeals (for the District of Columbia). **State of Ohio v. U.S. Department of Interior.** Case No. 86-1575. July 14, 1989.

[83] Randall, Alan and John Stoll, 1983. "Existence Value in a Total Valuation Framework", in, **Managing Air Quality and Scenic Resources at National Parks and Wilderness Areas.** Westview Press: Boulder, CO.

[84] The value of keeping opportunities available for the future.

[85] Values associated with knowing that a resource is preserved, irrespective of use.

[86] Value associated with protecting resources for future generations.

[87] eg. Walsh, Richard, J. Loomis and R. Gillman, 1984. "Valuing Option, Existence and Bequest Demand for Wilderness", **Land Economics**, 604: 14-29; Sanders, Larry, R. Walsh and J. Loomis, 1990. "Toward Empirical Estimation of the Total Value of Protecting Rivers", **Water Resources Research** 26(7): 1345-1358; Olsen, Darryll, J. Richards and D. Scott, 1991. "Existence and Sport Values for Doubling the Size of Columbia River Basin Salmon and Steelhead Runs", **Rivers**, 2(1): 44-56.

Since restoration of the Elwha River in Olympic National Park and increases in salmon populations are public goods available to all members of society, Loomis measured total non-market economic benefits using Clallam County, Washington state and national samples. The number of usable responses obtained, together with the response rate for each jurisdiction, are presented in Table 17. The overall response rate was 65 percent, above average for this type of survey.

Table 17

Survey Numbers and Response Rate:
Loomis (1995) Study of Total Non-Market Economic Value
Associated With Restoration of the Elwha River

	Clallam County	Rest of State of Washington	Rest of United States
Usable responses	363	523	482
Response Rate (%)	77.2	67.8	55.2

The survey applied a "dichotomous choice" bidding format[88]. This format mimics an actual vote, by asking the respondent whether he or she would vote (eg. pay) for an item if it cost the household a particular dollar amount. The key question asked respondents by Loomis was:

> If an increase in federal taxes for the next 10 years costs your household $____ each year to remove the two dams and restore both the river and fish populations would you vote in favor?

Results of the Loomis study, for Clallam County, the rest of Washington State, and the rest of the U.S., are displayed in Table 18. These values apply each year for the first 10 years of the project. Since they "capitalize" value over all future years, no project total non-market values should be counted subsequent to this 10 year period. Loomis presented an estimate based on "mean response", as well as a "lowest bound estimate" based on the presumption that persons not responding to the sample survey would have answered "zero" to the "willingness to pay taxes" question.

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[88] This "dichotomous choice" format is the recommended by a recent "blue ribbon" panel convened by NOAA and led by two Nobel laureate economists. See, Arrow, Kenneth, Robert Solow, P. Portney, E. Leamer, R. Radner and H. Schuman, 1993. "Report of the NOAA Panel on Contingent Valuation", **Federal Register** 58(10): 4602-4614.

Both results are reported here - although only the lowest of these estimates is used in subsequent present value calculations (Section X). The percent of respondents, in each referent area, who would pay some positive amount in tax increase to restore the Elwha River is also reported.

Table 18

Total Annual Non-Market Economic Value Associated With Restoration of the Elwha River

Referent Area	Would Pay $1 or more %	Value Per Household $	Total Annual Non-Market Value Mean ----$ million----	Reduced Mean
Clallam County	52.3	59	1.3	1.0
Rest of Washington	74.1	73	136.8	93.0
Rest of U.S.	80.4	68	6,137.1	3,375.4
Total United States			6,275.2	3,469.4

2. Non-Market Value Associated with Recreation Use - Removal of Both Dams

Non-market values associated with recreational use in the study area are included in the totals displayed in Table 18. However, a general estimate of the magnitude of non-market value associated with increased recreation use, considered separately, can also be estimated. Bonneville Power Administration (1986)[89] surveyed analyses of nature-based non-market values for their service area, inclusive of the Olympic Peninsula. Considering only those estimates directly related to Washington state, and updating to 1993 dollars, an estimated non-market value of $66.11 per day is obtained for increased nature-based recreation. Walsh, Johnson and McKean (1992) conducted a similar review over a broader area of the western United States, to report an average recreation day value of $41.45, when updated to 1993 dollars[90]. Applying the lesser of these two non-market figures to the estimate of total increase in recreation days from Table 16 results in an annual estimate of the

[89] Bonneville Power Administration, 1986. Supra at 55-56.

[90] Walsh, Richard, D. Johnson and J. McKean, 1992. "Benefit Transfer of Outdoor Recreation Demand Studies", Water Resources Research. Vol.28, No.3, pp. 707-713.

recreational use component of total economic value (Table 19)[91]. This total does not incorporate any estimate of increased enjoyment by present users of the Elwha River area.

Table 19

Estimated Annual Non-Market Value from Increased Recreation Use Associated with Restoration of the Elwha River

Visitor Days (from Table 8)	908,234
Non-Market Value per Day	$41.45
Recreation Non-Market Value	$37,646,299

3. Non-Market Value Associated With Other Alternatives

The total non-market value estimated by Loomis does not apply to other project alternatives, which fall well short of full river restoration. However, increased sport fishing enabled by project alternatives (2) through (4), would result in increased non-market value. Again referencing Bonneville Power Administration (1986)[92], and using the calculating sequences described in prior section IV.3 to shift from value per day to value per fish, a non-market value per sport caught fish of $64.31 is obtained. Applying this value to increased sport catch from Tables 5 through 10, additional annual non-market benefits for alternatives (2) through (4), over and above the "No Action" base case, are obtained (Table 20).

Table 20

Estimated Additional Non-Market Benefits Associated with Project Alternatives (2) through (4) - Compared to the "No Action" Base Case

Alternative	Annual Benefit -$'millions-
Alternative 2 - Retain Both Dams with Mitigation	0.1
Alternative 3 - Remove Elwha/ Retain Glines Canyon	0.5
Alternative 4 - Remove Glines Canyon/ Retain Elwha	0.6

[91] Recall that the total non-market value figures in Table 18 capitalize the future stream of value into 10 annual increments. Consequently, annual value estimates from Table 18 and 19 are not directly comparable.

[92] Bonneville Power Administration, 1993. Supra.

VII. Economic Impacts on Clallam County

1. Impacts Associated With Project Expenditures

Scoping of estimated project cost continues at this date. The present analysis assumes total cost benchmarks of $130 million, $70 million and $50 million, all excluding costs of $29.5 million to acquire the existing dams. Detailed local impact estimates were prepared for the $130 million cost benchmark, corresponding to Sediment Management Option #5 in the Elwha Report[93], and then prorated downward for the other two cost benchmarks. Impacts are assessed in aggregate over the 10 year project period, but over 80 percent of impacts will occur in the initial 5 years of deconstruction and restoration.

This economic impact analysis for Clallam County uses a regional (single county) Input-Output (I-O) model termed the IMpact analysis for PLANing (IMPLAN)[94]. I-O models are used to estimate changes in employment and income brought on by changes in outputs or in final demand. I-O analysis is based on the interdependence of producing and consuming sectors in a regional economy. Industries must purchase inputs from other industries in order to produce outputs which are sold to other industries or to final consumers. Thus, a set of I-O accounts can be thought of as a "picture" of an impact area's economic structure.

The I-O analysis for Clallam County applied the 91-F version of IMPLAN to state and county 1990 economic data files to model intersectoral economic linkages within the county. Specific elements of project cost were delineated as either "spent in county" or "spent out of county". Then, direct and indirect Clallam County impacts on gross business revenue, income and employment from "within county" project spending were estimated using the county linkages specified by the basic IMPLAN model. Resulting impacts on Clallam County over the 10 year project period, based on the three project cost benchmarks, are displayed in Table 21.

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[93] Department of the Interior, Department of Commerce and the Lower Elwha S'Klallam Tribe, 1994. Supra at p. 140.

[94] For further detail on this model, see C. Borda and P. Engel, 1995. **Clallam County Regional Economic and Tax Revenue Impact Analysis**. U.S. Bureau of Reclamation, Denver, CO.

Table 21

10 Year Economic Impact on Clallam County
From Elwha Restoration Project Expenditures

Project Cost	Business Output	Income	Employment
-------millions of dollars------			-jobs-
50	40.0	21.4	763
70	56.0	29.4	1,067
130	104.0	55.6	1,981

Tax revenues in Clallam County will be affected by these impacts. Construction expenditures are subject to sales, use, fuel and hotel/motel taxes. Sales tax revenues are also generated through expenditure of project-related earnings. Tax effects from the same IMPLAN-based project expenditures analysis are presented in Table 22.[95]

Table 22

Clallam County 10-Year Tax Impacts Associated with
Project Expenditures to Restore Elwha River

Sales and Use Taxes	$410,000
Hotel/Motel Tax	1,230
Indirect Tax	8,500
Total Tax Revenues	$419,730

2. Impacts Associated with Increased Recreational Visits to the Elwha Area

Dean Runyan Associates (1994) provides data on Clallam County travel expenditures, and related payroll, employment and local taxes for 1993[96]. Applying these ratios to estimated recreation/ tourism expenditures in Clallam County if the Elwha River is

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[95] County property taxes would decline by $230,000 per year due to loss of tax base associated with the two dams. At the same time, the local power utility would receive a substantial additional power payment surcharge.

[96] Dean Runyan Associates, 1994. Supra at 19. These data are based on a model developed independently from that used for construction-based local impacts in this report.

restored (from Table 16) yields the following longer term impact estimates for the county (Table 23).

Table 23

Estimated Annual Economic Impacts in Clallam County from Increased Recreation/ Tourism Expenditure Associated with Elwha River Restoration

Annual Increase in Recreation/Tourism Expenditure	$28,527,095
Associated Clallam County Impacts:	
- Payroll	$4,640,906
- Local Taxes	295,922
- Employment (jobs)	446

VIII. Impacts on Tribal Value and Circumstance

While restoration of Elwha river fisheries will provide substantial economic income to the Lower Elwha S'Klallam Tribe (Section IV), such non-Tribal economic measures of impact are substantially deficient for full description of the effect of Elwha river restoration on this Tribe[97].

Analysis of Tribal circumstances, values and impacts cannot be easily compartmentalized - either by separating history from the present and the future - or by separating activity, from social intercourse, from culture. In Tribal society, each is closely related to the other.

> ... it is critical in sociocultural systems description and analysis that categories true to the Native point of view be sought. Also, as categories of persons, objects and activities begin to emerge, it is the relations of these categories over time and at any one point in time that must be seen to characterize the sociocultural system.[98]

Similarly, Chambers defines culture as:

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[97] This section is substantially indebted to anthropologists Barbara Lane and Karen James for some of the information reported here.

[98] Fienup-Riordan, A. 1982. **Navarin Basin Sociological Systems Analysis.** Alaska OCS Socioeconomic Program Technical Report Number 70, p. 23.

> ... a group of people who share standards of behavior and have common ways of interpreting the circumstances of their lives.[99]

Consequently, discussion of Lower Elwha S'Klallam Tribal linkages with Elwha River restoration must consider both historic and present values, activities and circumstances.

The Elwha River Valley has been the home of the Elwha S'Klallam people for as long as anyone knows. There are place names in the S'Klallam language for sites along the river from its mouth upstream into the Olympic Mountains. Among these are several sacred sites including the Creation site where the ancestors of the present day Elwha S'Klallam people are said to have originated.

The fisheries of the Elwha River provided a staple food for the native people whose permanent villages and seasonal camps were located along the main stem of the Elwha and on its tributaries. Villages at the mouth of the river and at the river's confluence with Indian Creek were situated at prime fishing locations.

The Elwha drainage provided a variety of game and plant resources in addition to the fish. Plants used for food, medicines and basketry and mats grew along the river banks. Deer and small game were hunted along the river. Elk hunters travelled to the higher elevations and brought large game back to the settlements via the river corridor.

The river was the focus of native life in the Elwha Valley. Habitation sites were situated along the river. Hunting, fishing and gathering centered along the river. Travel, transport and communication were focused along the river corridor.

In 1854-1855, the United States entered into land cession treaties with native tribes and bands in Washington Territory in order to extinguish native title to the land. The Elwha S'Klallam were a party to such a treaty - at Point No Point - , signed by the Tribes on January 26, 1855. In return for the ceding of these lands to the United States, the Tribes secured to themselves the fishing, hunting and gathering activities at their usual and accustomed places upon which they depended, as well as reserved lands upon which to live[100]. The intent of all treaty parties with respect to fishing has been recently summarized by the federal court.

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[99] Chambers, E. 1985. **Applied Anthropology**. Englewood Cliffs, N.J.: Prentice-Hall Inc., p. 4.

[100] A long struggle by the Lower Elwha S'Klallams to secure reservation land within their Elwha River homeland was completed in the 1960's.

> The one significant promise for purposes of this litigation is the promise by the United States to the Indians that they would enjoy a permanent right to fish as they always had. This right was promised as a sacred entitlement, one which the United States had a moral obligation to protect. The Indians were repeatedly assured that they would continue to enjoy the right to fish as they always had, in the places where they had always fished.[101]

Prior to passage of the Indian Homestead Act of 1875, there was no way that the Indians of the Elwha Valley could obtain title to land directly from the federal government. Most of the Indian homesteads in the valley were taken up under the second Indian homestead act, passed in 1884. In following years, the Indian homesteaders continued to fish, while adapting to altered circumstances by clearing land, selling pulpwood, planting crops and orchards and raising livestock - all for home use and for sale to merchants and others in Port Angeles and the surrounding region. Despite difficulties in securing land, the Indian homesteaders of this period were successful fishermen and farmers and significant contributors to the local economy.

In 1911, the greatest part of the salmon resource secured to the Lower Elwha S'Klallam by the Treaty of Point No Point was preempted by the start of construction of Elwha dam. During the construction phase, the dam broke, inundating the Indian homestead properties located immediately downstream.

Today, members of the Lower Elwha S'Klallam Tribe continue to depend principally on fishery resources, taking each species in its season[102]. The Tribe continues to operate a salmon hatchery on the lower Elwha river - producing 63,000 pounds of salmon in 1987. However, reduction in the number of species that can now be commercially harvested, and in quantities available to the harvest, limits Native fishermen commercial catch to Elwha coho, primarily in the September-November period. Some Tribal fishermen also fish other fisheries, principally in July and August - but Elwha catches provide the core resource for Lower Elwha Tribal fishermen - contributing between 20 percent and 40 percent of total fishing revenue, 1982 through 1988[103]. Approximately half of registered Tribal fishermen had annual gross fishing incomes of less than

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[101] United States of America, et al. v. State of Washington, et al. 1994. No. CV 9213, Sub-proceeding No. 89-3. Memorandum Opinion and Order, Dec. 20, 1994. pp. 23-24.

[102] Central Washington University, Supra at 161.

[103] Lower Elwha S'Klallam Tribe, 1993. Department of Fisheries.

$1,000 during this period[104].

These adverse circumstances are reflected in statistics from the U.S. Bureau of the Census (Table 24). These data, taken from the 1990 Census, indicate that members of the Lower Elwha S'Klallam Tribe are in a far more adverse material position than Clallam County residents in general.

Table 24

Comparative Statistics on Tribal Economic Status

	Lower Elwha S'Klallam Tribe	Clallam County	Washington State
Per capita income	$5,000	$12,755	$14,923
Percent in Poverty	35.0%	9.5%	7.8%
Percent unemployed	35.0%	8.0%	5.7%

Source: 1990 Census.

These data underestimate Tribal unemployment for some months, when unemployment may rise as high as 80 percent[105]. Preemption by Elwha and Glines Canyon dams of the fisheries secured to the Tribe in the Treaty of Point No Point has combined with an almost total lack of effective access to alternative economic opportunity to cause this condition - leaving Tribal people today as the most economically disadvantaged group in Clallam County.

Lower Elwha S'Klallam social circumstances reflect economic difficulty experienced by Tribal members. Tribal society exhibits significant support for its members, particularly on-reservation and through extended families[106]. However, Bachtold, specifically referencing the Lower Elwha S'Klallam and other northwest Tribes, reports strong linkages between level of economic wellbeing, health and self-worth - and concludes that continuing economic deprivation creates overwhelming stress among Tribal members[107].

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[104] Supra.

[105] Federal Energy Regulatory Commission, 1993. Supra at 3-99.

[106] Central Washington University, Supra at 232.

[107] Bachtold, L.M. 1982. "Destruction of Indian Fisheries and Impact on Indian Peoples", in, **The Historic and Economic Value of Salmon and Steelhead to Treaty Fisheries in 14 River Systems in Washington, Oregon and Idaho**. Meyer-Zangri Associates: Bureau of Indian Affairs, pp. 17-33.

Health data from the state of Washington supports this observation.

> Currently, the health status of Native Americans is very poor, with high rates of mortality, infectious disease and limitation of major activities due to chronic health problems.[108]

These statewide conclusions apply to the Lower Elwha S'Klallam Tribe[109] - and are predictable from the analysis by Bachtold[110].

Despite damage to Tribal secured resources of the Elwha river, Elwha fisheries continue to play a central role in Tribal activity, culture and ceremony - and offer hope for a better Tribal future.

> Our Tribe has lived along the Elwha River for countless generations. The River and the salmon are at the center of our way of life. At a site presently located under the Elwha Hydroelectric Project, the Creator made the S'Klallam people out of the river rock.
>
> In 1855, our ancestors signed a treaty with the United States which exchanged extensive landholdings on the Olympic Peninsula for a number of promises by the federal government, including its undertaking to protect our fisheries and provide us with a safe place to live.[111]
>
> I hate to think of the future, especially for our children, if our resources aren't there - the fish, the nature, the wildlife, the plants - which have all been provided to us.
>
> Our ancestors were raised to protect the river. They raised us to protect the river. We must be even stronger in the future - protecting what was given us for our children, and for our children's children - and valuing what we have.[112]

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[108] Washington State Department of Health, 1992. **People of Color.** p. 51.

[109] Manning, Mark. 1994. Health Director, Lower Elwha S'Klallam Tribe. **Letter** to P. Meyer, August 15.

[110] Bachtold, L.M., 1982. Supra.

[111] Elofson, Carla, 1992. (former) Chairperson, Lower Elwha S'Klallam Tribe. Testimony before the Senate Committee on Energy and Natural Resources, on S.2527, "The Elwha River Ecosystem and Restoration Act". June 4.

[112] Charles, Francis, 1994. Chairperson, Lower Elwha S'Klallam Tribe. **Personal communication**, at Elwha, December 15.

> Our Creator gave us the fish to live on ... and we cherished it, and we respected it... we didn't waste it, we used every bit of it... I may not see the abundance of fish come back in my lifetime, but I would like to see it come back for my grandchildren, my great-grandchildren, and the rest of my people, the following generations to come. It was a gift from our Creator, it was our culture and heritage.[113]

In sum, project options which retain one or both dams will continue to preempt the treaty fisheries upon which the Lower Elwha S'Klallam Tribe depends, continuing the severe economic conditions the Tribe is presently experiencing. Conversely, removal of Elwha and Glines dams would substantially improve Tribal material circumstance, elevate overall levels of wellbeing for Tribal members, and strengthen the basis for Tribal culture.

IX. Other Impacts of the Elwha River Project

1. Flood Protection

Flood protection measures associated with project alternatives are designed to ensure no reduction in present levels of flood protection. Costs associated with these measures are included in cost estimates developed for each project alternative. Consequently, for this analysis, identified costs are assigned to each alternative, while it is assumed that there is no significant change in flood protection benefits under any project option.

2. Impact on Ediz Hook

Ediz Hook is spit of sand and other sediment extending west to east along the foreshore of Port Angeles. It provides the only protection for Port Angeles harbor.

> Simply put, loss of the Hook means loss of the Coast Guard Station, loss of the recreational and industrial land use the Hook affords, and ... loss of the harbor.[114]

In the early part of the century, the Hook received about 15 percent of its sediment replenishment from the Elwha river and about 85 percent from erosion of cliff faces in the Port

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[113] Beatrice Charles, Elder. Lower Elwha S'Klallam Tribe, in **The Elwha Report**, January, 1994, p. 110.

[114] David Schuldt, U.S. Army Corps of Engineers, in, "The Hook", **Pacific Northwest Sea**. National Oceanic and Atmospheric Administration, p. 5.

Angeles area[115]. With completion of Elwha dam, an estimated 50,000 cubic yards per year of bed load material were lost as a feeder source for the Hook[116]. Subsequently, anti-erosion measures applied to the sea cliffs around Port Angeles reduced sediment potentially available to the Hook even further. Taken together, Elwha dam and these anti-erosion measures have reduced materials nourishing the Hook by about 75 percent[117].

As a result of these changes, U.S. Army Corps of Engineers analysis has indicated that, if left to natural forces, the Hook would have an annual net sediment deficit - losing 180,000 more cubic yards of material to wave action each year than it receives - and would eventually disappear[118]. As a result, the U.S. Army Corps of Engineers periodically expends funds to protect and maintain Ediz Hook. These expenditures average out to approximately $100,000 per year[119].

For this analysis, it is assumed that removal of Elwha and Glines Canyon dam would reduce the annual net sediment deficit at Ediz Hook from 180,000 cubic yards to 130,000 cubic yards (see previous discussion) - with a consequent 28 percent reduction in maintenance cost, or $28,000 per year.

3. Impact on Shellfish

Impact on shellfish from removal of Elwha and Glines Canyon dams will enhance some nearshore and intertidal species while adversely affecting others. The net effect on shellfish harvest is expected to be positive[120], but quantified estimates are presently unavailable. These estimates have consequently not been quantified in this economic analysis.

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[115] M. Scuderi, 1995. U.S. Army Corps of Engineers. **Personal Communication**. February 3.

[116] National Oceanic and Atmospheric Administration. **Supra** at 6.

[117] Supra.

[118] Supra.

[119] M. Scuderi. Supra.

[120] G. Ging, 1994. U.S. Fish and Wildlife Service. **Personal Communication**. December 22.

X. A Summary of Benefits and Costs Associated with Restoration of the Elwha River

This section applies the procedures developed in Sections I and II to estimated economic impacts discussed in Sections III through VI. Total economic effects for each major impact area over the full 100 year period of analysis are displayed in present dollar terms. The rate(s) of increase in real value (r) applied for the first 20 years of analysis, are identified, by impact sector, in Table 25.

Table 25

Rates of Annual Increase in Value (r), by Impact Sector
-Initial 20 Years of Present Value Calculation-

Impact Sector	Annual Increase in Real Value -in percent-
Electrical energy	2.0[121]
Commercial fishing	0.8[122]
Recreation and Tourism	0.5[123]

[121] See discussion in Section III.

[122] From U.S. Forest Service, 1990. **Resource Pricing and Valuation Procedures for the Recommended 1990 RPA Program.** p. 28.

[123] Based on average from estimates in U.S. Forest Service, 1990. Supra at 32; and, Loomis, John and R. Walsh, 1991. "Future Economic Values of Wilderness", in **The Economic Value of Wilderness.** U.S. Forest Service General Technical Report SE-78.

1. Present Value of Construction Costs

Total project construction costs are scaled at $155 million, $100 million and $80 million respectively - inclusive of $29.5 million for project acquisition[124]. Costs are distributed over 17 years, according to the cost schedule for 1996 forward, indicated for Sediment Option #5 in the Elwha Report[125]. The present value of total project construction and acquisition costs was calculated according to formula (1).

$$(1)\quad PV(\text{Construction}) = \sum_{n=1}^{17} \frac{C}{(1+d)^n},$$

where: PV = the present value of construction costs;

C = the construction cost in each year;

d = the discount rate(s) (0, .01, .02, .03, .04, and .07);

n = the number of years costs are incurred (1 through 17).

2. Present Value of Electric Energy Costs

Annual increase in real energy costs has already been built into the cost estimates in Section III of this report. Using those data, the present value of energy supply costs, for each project alternative are calculated using Equation (2).

$$(2)\quad PV(\text{Energy Cost}) = \sum_{n=1}^{100} \frac{E}{(1+d)^n},$$

where: PV = the present economic value of energy costs;

E = the cost of energy in each year;

d = the discount rate(s) (SAME as in Equation 1);

n = the number of years (1 through 100).

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[124] Department of the Interior, et al. 1994. Supra at p. 140; Meyer, Philip, 1995. **Memorandum** to Bob Hamilton, USBR. January 11.

[125] Department of the Interior, et al., 1994. Supra at Table 15, p. 140.

3. Present Value of Fishery Benefits

Four categories of fishing benefit are calculated: tribal commercial benefits; non-tribal commercial benefits; business benefits associated with sport fishing; and non-market benefits associated with sport fishing. For the project option involving removal of both Elwha and Glines Canyon dams, non-market benefits associated with sport fishing are presumed to be principally, if not totally, included in the total non-market benefits estimated by Loomis (1995) (see subsequent Equation 7) and are not double counted. Further, estimates of increased net business benefits associated with sport fishing for the "two dam removal" option are likely, at least in part, duplicative of the estimates of increased recreation/ tourism visitation estimated by Loomis (1995). We therefore calculate and display business benefits associated with sport fishing, but adopt the conservative convention of not adding them to our final balancing presentation respecting benefits and costs for the "two dam removal" project alternative.

$$(3)\quad PV(\text{Commercial}) = \sum_{n=1}^{100} \frac{(N_n)(V)(1+r)^n}{(1+d)^n},$$

where: PV = the present net economic value of tribal and non-tribal commercial fish harvest;

N_n = the number of fish caught (of each species) in each year;

V = the value of a commercial fish, by each species, in dollars;

r = annual real increase in commercial value over the first 20 project years = .08%;

d = the discount rate(s) (SAME as Equation 1);

n = number of years of catch (1 through 100).

$$(4)\quad PV(\text{Sport Fish Business}) = \sum_{n=1}^{100} \frac{(N_n)(S)(1 + r)^n}{(1 + d)^n},$$

where: PV = the present net economic value of sport fishing business revenue, in dollars;

N_n = the number of sport fish of all species caught in each year;

S = the net economic value to sport fishing businesses of each fish caught;

r = annual real increase in commercial value over the first 20 project years = .05%;

d = the discount rate(s) (SAME as Equation 1);

n = number of years of catch (1 through 100).

$$(5)\quad PV(\text{Sport Non-Market}) = \sum_{n=1}^{100} \frac{(N_n)(L)(1 + r)^n}{(1 + d)^n},$$

where: PV = the present net non-market economic value associated with sport fishing, in dollars;

N_n = the number of sport fish of all species caught in each year;

L = the net non-market economic value of each sport fish caught;

r = the annual real increase in non-market value of sport fishing over the first 20 project years = .05%;

d = the discount rate(s) (SAME as Equation 1);

n = number of years of catch (1 through 100).

4. Present Value of Business Benefits Associated with Recreation and Tourism

Estimated present net economic value of recreation and tourism to associated businesses, for the option which removes both dams, is based on data developed from Loomis (1995), and is estimated by Equation (6). As noted, the somewhat conservative assumption that this estimate includes business net benefits from enhanced sport fishing is employed in our

final display of benefits and costs. Benefits are assumed to be zero for the first six years of project life, and are then assumed to increase in 10 even increments to the benefit levels displayed in Section V. Options which retain one or both dams are not expected to appreciably affect recreation and tourism - save for sport fishing. Impacts on sport fishing, for these options, are dealt with via Equations (4) and (5).

$$(6)\quad PV(\text{Recreation/ Tourism}) = \sum_{n=1}^{100} \frac{(T_0)(1 + r)^n}{(1 + d)^n} ,$$

where: PV = the present net economic value for businesses servicing recreation and tourism;

T^n = the net economic return from tourism in each year;

r = the annual real increase in recreation/ tourism value = .05 percent.

d = the discount rate(s) (SAME as Equation 1).

n = the number of years of recreation/ tourism benefit (1 through 100).

5. Present Value of Total Non-Market Benefits

For the project option which removes both dams, Loomis (1995) has estimated total non-market benefits, capitalized into 10 annual tax payments. Present value associated with these estimates are developed by Equation (7).

$$(7)\quad PV(\text{Total Non-Market}) = \sum_{n=1}^{10} \frac{(K)(1 + r)^n}{(1 + d)^n} ,$$

where: PV = present value of total non-market benefits;

K = the annual tax residents of the United States would be willing to pay to restore the Elwha river drainage = $3.5 billion;

r = annual rate of increase in real value = .05%;

d = the discount rate(s) (SAME as Equation 1);

n = the number of years of capitalized total non-market benefit (1 through 10).

6. Present Value of Sediment Recruitment to Ediz Hook

The present value of annual benefits from increased sediment recruitment to Ediz Hook are calculated using the basic formula displayed in previous Equation (1).

7. Summary of Benefits and Costs - Project Alternatives for Elwha River Restoration

Applying the formulae of this section to data developed in previous sections, the present value of economic benefits and costs associated with each project alternative - calculated over 100 years of project life - are displayed for each level of discounting in Tables 26 through 31. The magnitude of net benefits or costs are displayed **relative to the "No Action" alternative**. For example, the figure of $29.5 million in the first line (Project Acquisition) of Table 26 represents costs over and above those related to taking "No Action" - and similarly for all other numbers in the table. Direct construction costs of dam removal for "only Elwha out" and for "only Glines out" alternatives are taken from FERC-93[126]. If construction activity takes more than one year, these figures, held constant in the following tables, may overstate costs slightly for higher rates of discount.

[126] Federal Energy Commission, 1993. Supra at 2-24 and 2-25.

Table 26

Summary of the Net Present Value of Elwha River Benefits and Costs - at 0% Rate of Discount -

Impact Element	2 Dams Remain +Mitigation	Only Elwha Out	Only Glines Out	Both Dams Out
	-------in millions of dollars-------			
Impact Costs:				
Project Acquisition	--	14.5[1]	15.0[1]	29.5
Construction-Est.1	--	24.5	37.3	50.5
-Est.2				70.5
-Est.3				125.8
Regional Energy Cost	620.5	609.7	914.9	584.6
Total Costs-Est.1	620.5	648.7	967.2	664.6
-Est.2				684.6
-Est.3				739.9
Impact Benefits:				
Commercial Fishery	10.7	49.7	66.4	150.7
Sport Fish Business	1.9	8.3	15.3	25.5
Recreation & Tourism	--	--	--	514.4
Ediz Hook	--	--	--	2.8
Total Bus. Net Revenue	12.6	58.0	81.7	667.9[2]
Non-Market Benefits	5.0	22.7	41.4	35,977.1[3]
Total Project Benefits	17.6	80.7	123.1	36,643.7

Notes: [1] Negotiations with respect to acquisition of a single dam have not taken place. Estimates for acquisition of "Elwha only" or "Glines only" are arbitrarily assigned, and total the $29.5 million amount negotiated for acquisition of both dams.

[2] This figure excludes the estimated net revenue for "sport fish business" to avoid double counting.

[3] This figure includes sport fishing non-market benefits estimated at $69.5 million.

Table 27

Summary of the Net Present Value of Elwha River Benefits and Costs - at 1% Rate of Discount -

Impact Element	2 Dams Remain +Mitigation	Only Elwha Out	Only Glines Out	Both Dams Out
	--------in millions of dollars-------			
Impact Costs:				
Project Acquisition	--	14.5[1]	15.0[1]	29.5
Construction-Est.1	--	24.5	37.3	48.3
-Est.2				67.6
-Est.3				120.7
Regional Energy Cost	391.4	381.2	572.1	360.7
Total Costs-Est.1	391.4	420.2	624.4	438.5
-Est.2				457.8
-Est.3				510.9
Impact Benefits:				
Commercial Fishery	2.4	24.9	33.8	84.3
Sport Fish Business	0.2	3.9	7.9	14.0
Recreation & Tourism	--	--	--	306.6
Ediz Hook	--	--	--	1.8
Total Bus. Net Revenue	2.6	28.8	41.7	392.7[2]
Non-Market Benefits	0.3	10.5	21.5	34,061.0[3]
Total Project Benefits	2.9	39.3	63.2	34,453.7

Notes: [1] Same as Table 26.

[2] Same as Table 26.

[3] This figure includes sport fishing non-market benefits estimated at $38 million.

Table 28

Summary of the Net Present Value of Elwha River Benefits and Costs - at 2% Rate of Discount -

Impact Element	2 Dams Remain +Mitigation	Only Elwha Out	Only Glines Out	Both Dams Out
	--------in millions of dollars-------			
Impact Costs:				
Project Acquisition	--	14.5[1]	15.0[1]	29.5
Construction-Est.1	--	24.5	37.3	46.4
-Est.2				64.9
-Est.3				145.9
Regional Energy Cost	268.0	258.3	387.8	240.7
Total Costs-Est.1	268.0	297.3	440.1	316.6
-Est.2				335.1
-Est.3				386.1
Impact Benefits:				
Commercial Fishery	-1.8	12.1	18.4	49.3
Sport Fish Business	-0.7	1.7	4.1	7.9
Recreation & Tourism	--	--	--	195.6
Ediz Hook	--	--	--	1.2
Total Bus. Net Revenue	-2.5	13.8	22.5	246.1
Non-Market Benefits	-1.8	4.4	11.3	32,290.4
Total Project Benefits	-4.3	18.2	33.8	32,536.1

Notes: [1] Same as Table 26.

[2] Same as Table 26.

[3] This figure includes sport fishing non-market benefits estimated at $21.7 million.

Table 29

Summary of Net Present Value of Elwha River Benefits and Costs - at 3% Rate of Discount -

Impact Element	2 Dams Remain +Mitigation	Only Elwha Out	Only Glines Out	Both Dams Out
	--------in millions of dollars-------			
Impact Costs:				
Project Acquisition	--	14.5[1]	15.0[1]	29.5
Construction-Est.1	--	24.5	37.3	44.6
-Est.2				62.4
-Est.3				111.4
Regional Energy Cost	196.7	187.6	281.6	171.9
Total Costs-Est.1	196.7	226.6	333.9	246.0
-Est.2				263.8
-Est.3				312.8
Impact Benefits:				
Commercial Fishery	-3.7	5.2	9.5	30.1
Sport Fish Business	-1.0	0.4	2.1	4.5
Recreation & Tourism	--	--	--	132.6
Ediz Hook	--	--	--	0.9
Total Bus. Net Revenue	-4.7	5.6	11.6	163.6[2]
Non-Market Benefits	-2.8	1.2	5.9	30,651.9[3]
Total Project Benefits	-7.5	6.8	17.5	30,815.5

Notes: [1] Same as Table 26.

[2] Same as Table 26.

[3] This figure includes sport fishing non-market benefits estimated at $12.7 million.

Table 30

Summary of the Net Present Value of Elwha River Benefits and Costs - at 4% Rate of Discount -

Impact Element	2 Dams Remain +Mitigation	Only Elwha Out	Only Glines Out	Both Dams Out
	--------in millions of dollars------			
Impact Costs:				
Project Acquisition	--	14.5[1]	15.0[1]	29.5
Construction-Est.1	--	24.5	37.3	42.9
-Est.2				60.0
-Est.3				107.2
Regional Energy Cost	152.8	144.2	216.4	129.8
Total Costs-Est.1	152.8	183.2	268.7	202.2
Est.2				219.3
Est.3				266.5
Impact Benefits:				
Commercial Fishery	-4.5	1.7	4.7	18.9
Sport Fish Business	-1.1	-0.1	1.0	2.8
Recreation and Tourism	--	--	--	94.5
Ediz Hook	--	--	--	0.7
Total Bus. Net Revenue	-5.6	1.6	5.7	114.1[2]
Non-Market Benefits	-3.2	-0.5	2.8	29,133.7[3]
Total Project Benefits	-8.8	1.1	8.5	29,247.8

Notes: [1] Same as Table 26.

[2] Same as Table 26.

[3] This figure includes sport fishing non-market benefits estimated at $7.4 million.

Table 31

Summary of the Net Present Value of Elwha River Benefits and Costs - at 7% Rate of Discount -

Impact Element	2 Dams Remain +Mitigation	Only Elwha Out	Only Glines Out	Both Dams Out
	-------in millions of dollars-------			
Impact Costs:				
Project Acquisition	--	14.5[1]	15.0[1]	29.5
Construction-Est.1	--	24.5	37.3	38.3
-Est.2				53.6
-Est.3				95.7
Regional Energy Cost	89.5	82.1	123.2	70.4
Total Costs-Est.1	89.5	121.1	175.5	138.2
-Est.2				153.5
-Est.3				195.6
Impact Benefits:				
Commercial Fishery	-5.0	-1.6	-1.3	4.5
Sport Fish Business	-1.1	-0.9	-0.4	0.4
Recreation & Tourism	--	--	--	42.1
Ediz Hook	--	--	--	0.4
Total Bus. Net Revenue	-6.1	-2.5	-1.7	47.0[2]
Non-Market Benefits	-3.4	-2.3	-1.0	25,199.0[3]
Total Project Benefits	-9.5	-4.8	-2.7	25,246.0

Notes: [1] Same as Table 26.

[2] Same as Table 26.

[3] This figure includes sport fishing non-market benefits estimated at $1.1 million.

It can be observed from these tables that benefits of moving from the present (no action) situation on the Elwha river fall significantly short of costs for all of the "in part" restoration options. This is because increased returns to fisheries are modest and will rebuild very slowly - while associated costs are significant and occur in initial project years.

Conversely, benefits from removal of both Elwha and Glines Canyon dams substantially outweigh costs, regardless of the discount rate used - even if non-marketed benefits are discounted at 1 cent on the dollar.

This conclusion conforms with impacts on Native American material circumstance and culture. The two dams preempt fisheries secured by ancestors of the Lower Elwha S'Klallam Tribe in its Treaty with the United States (Point No Point) in 1855. At present, the Tribe lives in extreme poverty, with little in the way of future economic opportunity, save through a renewed fishery. Removal of the two dams would have a substantially beneficial cultural and material impact on the Tribe. The partial options considered would have little or no remedial effect - depending on the impact sector considered.

XI. References

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