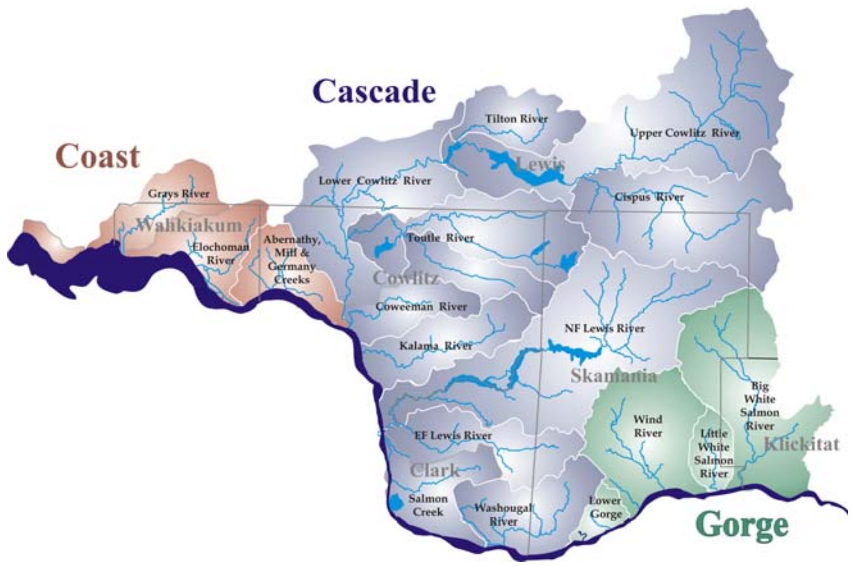

Lower Columbia Salmon Recovery And Fish & Wildlife Subbasin Plan

APPENDIX D - ECONOMICS

Lower Columbia Fish Recovery Board

December 15, 2004

Preface

This is one in a series of volumes that together comprise a Recovery and Subbasin Plan for Washington lower Columbia River salmon and steelhead:

--	Plan Overview	*Synopsis of the planning process and regional and subbasin elements of the plan.*
Vol. I	Regional Plan	*Regional framework for recovery identifying species, limiting factors and threats, the scientific foundation for recovery, biological objectives, strategies, measures, and implementation.*
Vol. II	Subbasin Plans	*Subbasin vision, assessments, and management plan for each of 12 Washington lower Columbia River subbasins consistent with the Regional Plan. These volumes describe implementation of the regional plan at the subbasin level.*
		II.A. Lower Columbia Mainstem and Estuary *II.B. Estuary Tributaries* *II.C. Grays Subbasin* *II.D. Elochoman Subbasin* *II.E. Cowlitz Subbasin* *II.F. Kalama Subbasin* *II.G. Lewis Subbasin* *II.H. Lower Columbia Tributaries* *II.I. Washougal Subbasin* *II.J. Wind Subbasin* *II.K. Little White Salmon Subbasin* *II.L. Columbia Gorge Tributaries*
Appdx. A	Focal Fish Species	*Species overviews and status assessments for lower Columbia River Chinook salmon, coho salmon, chum salmon, steelhead, and bull trout.*
Appdx. B	Other Species	*Descriptions, status, and limiting factors of other fish and wildlife species of interest to recovery and subbasin planning.*
Appdx. C	Program Directory	*Descriptions of federal, state, local, tribal, and non-governmental programs and projects that affect or are affected by recovery and subbasin planning.*
Appdx. D	Economic Framework	*Potential costs and economic considerations for recovery and subbasin planning.*
Appdx. E	Assessment Methods	*Methods and detailed discussions of assessments completed as part of this planning process.*

This plan was developed by of the Lower Columbia Fish Recovery Board and its consultants under the Guidance of the Lower Columbia Recovery Plan Steering Committee, a cooperative partnership between federal, state and local governments, tribes and concerned citizens.

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Economic Considerations

1.0 ECONOMIC CONSIDERATIONS

This section identifies a staged approach for the economic analysis of actions proposed in the Recovery Plan as part of the implementation process. While this recommendation was developed independently, the end results are similar in approach (but not in scale) to the economic analysis conducted in the Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement (USACOE 2002, Appendix I), which is occasionally referenced for purposes of comparison.

Extensive work has been performed to identify strategies, measures and ultimately specific actions that are necessary for the recovery of fish populations. The actions have been designed and selected for their impact on the biological objectives set forth in Volume 1, Section 6. In addition to their ecological impact, the prioritization and grouping of the proposed actions must also consider their economic and political feasibility. The primary goals of this economic analysis are two-fold: 1) quantify the costs and benefits of each action and 2) assist in developing and prioritizing groups of actions based on their ecological impact as well as their economic, political and social feasibility, given uncertainty and imperfect information. The recommended tasks for the economic work plan are:

1. Begin with a reconnaissance-level cost benefit analysis of the wide variety of actions proposed in the Recovery Plan. Identify, based on expected ecological results, actions or groups of actions that should be considered for more detailed economic analysis. (Phase I of the System Configuration Study that preceded the Lower Snake River Report)

2. Use the Fisheries Economic Assessment Model (FEAM, a modified version of IMPLAN) to perform a static input-output analysis of regional economic impacts after groups of proposed actions for detailed economic analysis have been developed.

3. Explore using or developing a simple to moderately complex decision analysis tool and/or ecological model. Determine whether the number of actions, possible permutations and complexity of interrelationships will overwhelm the capacity of a straight forward cost-benefit analysis. Evaluate whether a simplified model that incorporates synergies, interrelationships and potentially qualitative attributes can more effectively combine and reduce the number of individual proposed actions into a manageable list of alternatives for economic analysis. (A much simpler version of the ambitious Plan for Analyzing and Testing Hypotheses (PATH) model developed for the Snake River (Peters and Marmorek 2000)).

4. Using existing research to quantify costs and benefits related to construction and operation, commercial and recreational activities (or use values), and hydropower operations. If significant impacts are anticipated, also quantify costs related to water supply, flood control, agricultural and urban land use, recreation, transportation and tribal circumstances.

5. Explore if and how it to avoid the problems and controversies that have caused previous efforts to consider preservation values and ultimately choose not to include them in the quantitative portion of the economic analysis. (USACE 2002, CALFED 2004b)

6. Evaluate whether the increased insight or accuracy gained either by a more complex ecological model, decision analysis tool or an integrated ecologic and economic model is feasible and warrants the significantly larger time, budget and data requirements of such models.

The above recommendations are based on the hypotheses listed below, which should be critically evaluated early in the reconnaissance-level assessment. The hypotheses are:

1. Scope and budget constraints are likely to limit an economic analysis to a relatively independent cost-benefit and a static regional input-output analysis. Further work is required to determine whether the benefits of more complex and integrated methods are warranted and possible within budget constraints.
2. Through qualitative expert judgment, it will be possible to reduce the extensive number of proposed actions into a manageable number of groups of individual actions that reflect the range of possible costs and benefits OR experts will quickly determine that such a reduction is not possible and that a more complex analysis incorporating the interrelationships and qualitative impacts of individual actions will be necessary.
3. While there is an extensive degree of interaction between the ecological results of individual actions, the direct economic costs of individual actions are, for the most part, relatively discrete and additive. There is some overlap and economies of scale involved in implementation costs, but to the extent analytical methods are required to propose and evaluate groups of actions, it will be of primary importance to model ecological interactions and of secondary importance to model economic cost interactions.
4. It is not clear at this time that attempting to build a complex ecological model or an integrated biologic and economic model for the recovery plan is an appropriate or realistic goal. In particular the substantial amount of data required to calibrate and run such models is currently lacking, particularly for individual subbasins.

1.1 ANALYTICAL METHODS

This section briefly describes, in order of increasing complexity, the types of economic analyses that might be applied to a fish recovery plan. The approaches described below are differentiated by three basic criteria:

1.1.1 Integration

- **Independent:** The economic analysis is relatively independent, requiring inputs from and providing output to ecological and other analyses. Analyses are performed sequentially in an iterative process, requiring a high level of interpretation and judgment at each step. The number of actions and combination of individual actions that can be analyzed is relatively small.
- **Integrated:** ecological, economic and possibly other factors are formalized and built into the structure of an integrated ecologic and economic model. An integrated model is more complex and less transparent, but can adopt mathematical (Linear programming & optimization) or computational (Monte Carlo simulation) approaches to evaluating a large number of actions and combinations of actions.

1.1.2 Subjectivity

- **Subjective:** relationships that are more difficult to quantify are subjectively evaluated outside the economic model and reflected in adjustments to or weighting of the data entered into the model and the interpretation of outputs produced by the model, or
- **Quantitative**: all important relationships are quantified, parameterized and incorporated within the formulae and the structure of the model itself.

1.1.3 Simplicity

- **Simple:** Ecological and economic relationships are greatly simplified, resulting in analysis that is less complex and more transparent to a wide variety of technical and non-technical stakeholders. Simplification may also increase stability and permit the use of more rapid and robust computational and optimization techniques.
- **Complex:** the complex ecological and economic interactions in the real world being studied are formalized and included in the model. These might include non-linear and discontinuous relationships, cumulative and temporal effects, critical thresholds and feedback effects.

Some experts are more trusting of a complex models' attempt to more accurately reflect real world relationships, while others are suspicious of the illusion of accuracy that such models provide while hiding assumption upon assumption inside the model. To non-technical stakeholders complex models are black boxes that are either trusted or not depending on the results and the perceived biases of those performing the analysis.

1.1.4 Cost-Benefit Analysis - Independent, Subjective & Quantitative, Simple

The economic section of an EIS/EIR typically contains a standard cost-benefit analysis with two discrete steps. First, measures are developed and proposed according to their ability to meet specified ecological objectives, such as minimum water quality or adult productivity. Then an economic analysis estimates both the costs and benefits of each proposed measure and ranks the measures in terms of net economic benefits. Attempts may be made to quantify and include indirect, societal and ecological impacts, but more often, such impacts are incorporated with subjective rankings or weights (such as high, medium, low) or are described qualitatively when presenting the results. The results of the economic analysis generally lead to culling or modifying the proposed measures, which are then re-evaluated in an iterative process. Experts and decision makers digest the information presented from several relatively discrete analyses and describe their rational for selecting the best option or strategies.

Cost-benefit analysis provides an analytical basis for eliminating measures that are not cost effective and ranking measures based on net economic benefits. The ecological and societal benefits that cannot easily be measured monetarily are considered in parallel with, but not included in the net economic benefit calculations. The ability to incorporate and model synergies and more complex interactions among suites of actions is generally limited. Cost benefit analysis is widely understood and transparent to a wide variety of non-technical stakeholders. Finally cost-benefit analysis is also widely accepted as acceptable justification and documentation in legal and regulatory proceedings.

1.1.5 Regional Economic Model (Input-Output)

Cost-benefit analysis can be augmented with Input-Output models, which are commonly used as part of regional economic impact studies. Input-Output models use an extensive variety of regional economic data to develop a detailed model of trade flows between and among all major sectors of the economy within a region. Input-Output models use this information to calculate multipliers that predict how some initial change in industry output or final demand will cause changes to total regional output, income, and employment, as well as the distribution of these impacts among different sectors.

Whereas a cost-benefit analysis is usually focused on the direct economic impacts of proposed actions, Input-Output models take these direct impacts as inputs use multipliers to calculate the indirect and induced impacts in the regional economy. If increased harvests are permitted, the direct impact is the increased sale of fish and resulting increase in output of commercial fisheries. The indirect impacts would be the increased purchase of the inputs (fuel, equipment etc.) used in harvesting and processing of the fish. Increased output would also lead to increased income for owners and workers in the fishing industry, which leads to the induced effects resulting from increased spending at local businesses. Input-Output models also show the distribution of the direct, indirect and induced impacts among the different economic sectors (manufacturing, retail trade, government etc.) as well as the extent to which the local vs. external economy is affected.

IMPLAN/FEAM - *Independent, Quantitative, Simple*

IMPLAN is relatively inexpensive and commonly used static Input-Output model developed by the U.S. Forest Service and marketed commercially by the Minnesota IMPLAN Group (MIG). IMPLAN uses extensive data sets from a variety of national sources to model trade flows for over 500 industrial sectors. IMPLAN adjusts the national level data to fit the economic composition and estimated trade balance of a chosen region. The model itself costs $450 and data sets for each county cost $150.

Static Input-Output models such as IMPLAN employ several key simplifying assumptions.

1) **Constant returns to scale.** Production functions are linear. Any change in output affects all inputs proportionally.

2) **No supply constraints.** Production within an industry is not restricted by the availability of necessary inputs.

3) **Fixed commodity input structure.** Price changes do not cause a firm to buy less expensive substitute goods. The mix of inputs required in each industry does not change, regardless of output.

4) **Homogeneous industry output.** The proportion of all commodities produced by an industry remains the same regardless of output. An industry does not increase the output of one commodity without proportionately increasing the output of all its other products.

Each of these simplifying assumptions causes an input-output model to depart from the economic reality it is trying to mimic. Input-output models are imperfect representations of complex economic relationships and dynamics. Although the precision of a particular input-output model is difficult to assess, it is generally prudent to assume that IMPLAN input-output models have a margin of error of plus or minus 20%.

Dynamic and Computable General Equilibrium Input Output Models - Independent, Quantitative, Complex

Much more complex and extensive dynamic and computable general equilibrium models that overcome some of the limitations of static models have been developed. Such models allow for substitution of goods and services, feedback effects, and changes over time. While such models are better suited for long-term analyses, they are much more data intensive, complex and expensive than static models. Regional Economic Models, Inc. produced a commonly used dynamic Input-Output model

1.1.6 Ecological Models and Decision Analysis Tools - Independent or Integrated, Subjective and/or Quantitative, Complex

Several types of more complex ecological models and decision analysis tools (also known as multi criteria, multi attribute or stated preference models) have been developed specifically to help resource managers balance and optimize actions based on a number of attributes (Prato 2003, Peters and Marmorek 2000, Layton et al 1999, Guroack et al. 1998). Ecological models (such as PATH) are used to distill the range of actions and their complex interrelationships into a manageable number of options for a subsequent economic analysis. Decision Analysis tools (such as the Ecosystem Diagnosis and Treatment or EDT) use a wide variety of methods and approaches and cannot always be neatly categorized. In general, decision analysis tools help watershed managers select and optimize measures based on multiple factors such as fish populations, water quality, habitat quality, hydropower, flood control and agricultural production. The simplest decision analysis tools use subjective or relative weightings places on each criteria by experts while more complex tools attempt to quantify and parameterize impacts. Ecological models and decision analysis tools can also incorporate interrelationships and synergies between and among different actions, allowing for a quasi-optimization process for selecting optimal strategies.

While some platforms have been developed for building such models and tools, they must be developed and customized for particular region, a time intensive and expensive process. Decision analysis tools are therefore generally limited to large, long-term regional management efforts. Such tools can also be helpful in facilitating negotiations and consensus in large and complex stakeholder processes.

1.1.7 Bioeconomic Models - Integrated, Quantitative, Complex

Bioeconomic modeling integrates biological and economic influences with the goal of assisting decision makers in selecting optimal strategies for managing fisheries. Bioeconomic models are typically limited to simple depictions of ecological systems, which limits their accuracy but also allows for more stable and transparent optimization processes. There has, however, been increasing interested in incorporating more complex interactions, non-linearities, discontinuous change, critical thresholds and ecosystem stability as well as stochastic processes in bioeconomic models. A simple model would use carrying capacity and growth rates along with production functions for commercial fishing to calculate the profit maximizing level of stock and harvest. More complex models add utility functions for recreational fishing and even passive values and include functions or impose constraints to represent environmental quality. Still more complex models incorporate time, multiple populations and various management strategies.

One advantage of simplifying relationships is that it allows for optimization through linear or non-linear programming. It is also possible to incorporate probability or run Monte Carlo simulations to test actions under a variety of possible outcomes.

1.1.8 Additional Objectives

There are additional objectives that may be important to consider in developing an economic analysis and selecting the modeling approach. In complex, long-term analyses involving significant uncertainties, it is often desirable to employ probabilistic analysis or Monte Carlo simulation that presents possible impacts under a wide range of possible scenarios. While there are a wide variety of programming languages and models, they need not be excessive complex or inaccessible. Crystal Ball and @Risk provide add-ins providing optimization and Monte Carlo simulation capabilities for Excel, which can be an advantage given that Excel is a widely used and understood platform. One should also consider whether it will be ultimately necessary to use the economic analysis as the basis for allocating costs and benefits among various stakeholders or developing specific financing options. The CALFED effort to develop financing options has found the quantification and allocation of costs and benefits to specific parties quite difficult (CALFED 2004a, CALFED 2004b). In particular, there is a lack of general agreement regarding how to measure and allocate benefits to the public, which can be large and diffuse. A final consideration is whether the model will be used by a large number of stakeholders to facilitate discussion and consensus, or only by a limited number of experts for use in developing and presenting recommendations.

1.2 IMPACTS

This section presents the metrics used to describe and quantify the expected results of particular actions. This section describes the proposed metrics for use in the economic analysis, again in order of increasing complexity and data requirements. Experts from various fields working together will need to determine the appropriate balance between desire to accurately reflect complex real world relationships with time and budget constraints as well as the desire for simplicity and transparency.

Care should be taken to present costs for projects of varying magnitude and duration in a comparable fashion using net present values (NPV), annualized values, internal rate of return (IRR) and $/unit where appropriate. NPV provides a measure of absolute or total benefits (dollars) while IRR measures the relative benefits (percent). With an unconstrained budget, any project with a positive NPV or IRR should be undertaken. With real world limitations, both measures are helpful in selecting the combination of projects that maximizes total NPV while meeting budget constraints. Each measure also has its limitations; NPV is highly sensitive to discount rates, and IRR calculations do not always provide a unique solution under complex cash flows. Of course neither measure can incorporate important qualitative factors.

1.2.1 Primary Impacts

This report refers to primary impacts as those which are directly related to the implementation of an action and the ultimate objective of increasing the number and health of the fish population.

Implementation Costs

Direct Costs - An economic analysis starts with the direct cost of implementing a proposed action. In many cases these involve the capital and operational expenditures required to construct or implement the proposed action. In a preliminary or scoping level analysis, an average or range of representative per unit costs ($/acre, $/mile) may be used. Later analysis will require expert cost estimates specific to each project. Cost ranges have been identified for a variety of habitat improvement actions. The economic analysis will review these and other figures contained in the Recovery Plan and determine whether they are sufficient, appropriate and accurate enough to apply to the actions specifically proposed in the East Fork Lewis Subbasin plan as well as the full range of actions that are likely to be proposed and evaluated throughout the remaining subbasins. It appears likely that additional research will be required. At a minimum costs will need to be broken out into initial capital and ongoing operation and maintenance expenditures.

Financing - Interest rates and the cost of capital can dramatically affect the net present value costs for a particular project. For most projects an average interest rate or cost of capital may be appropriate. However, to the extent special circumstances may make financing costs for a specific project or type of project higher or lower, that should be taken into account. In particular if grants or low interest loans are likely to be available or if a project will be financed through municipal vs. private debt, the cost of capital should reflect such opportunities. Discount rates may also significantly affect comparisons, particularly between actions with high capital vs. operational costs. The Lower Snake River Report used three different discount rates to account for various viewpoints (USCAE 2002).

Fish Population (Benefit)

The recovery plan is concerned primarily with increasing fish populations and economists in particular might be tempted to reduce the ultimate impact of any proposed action or group of actions to a single metric, the number of fish produced. The economic benefits could be calculated based solely on the number of fish produced, using the commercial and recreational use values described below. Secondary impacts, such as improved aesthetics or drinking water quality would only be considered qualitatively. This approach would require a high degree of expert judgment in selecting groups of actions to be evaluated. Ecological experts may estimate or use an ecological model to compute the cumulative effect of the individual actions grouped together. Probabilities may be assigned to a range of numbers to calculate expected values for the economic analysis.

It is possible to describe the value of fish population in both economic and qualitative terms. Broadly speaking the value of an improved fish population can be divided into use values involving the active pursuit of catching fish and preservation or passive values involving the preservation of the resource. Applying an economic value to use values is more straightforward and commonly accepted than it is for preservation values, which present some methodological issues.

Use Value: Commercial Fishing - Increased fish populations can be valued for commercial fishing either in terms of increased output and revenues from the sale of more or more desirable fish or in terms of reduced costs due to the reduced effort required to catch a given number of fish. The economic value of both the existence of and improvements to fish populations in the Western US and the Pacific Northwest have been studied frequently using a variety of methods (Industry output, fleet value, effort per fish); the process of review and selecting appropriate measures for this analysis should be relatively straightforward.

Use Value: Recreation - The value of fish populations and improved habitat for recreational use is not quite as straightforward, but has also been frequently studied using a variety of methods (Recreational expenditures, travel cost method). Here again, researching as estimating appropriate values should be straightforward.

Preservation Value - Economics refer to three categories of preservation or passive values: existence values, option values and bequest values. Estimating the economic effect of improved fish populations on preservation values is only slightly less studied, but nevertheless much more problematic. A growing body of literature had developed around quantifying passive values through the use of contingent valuation (also referred to as willingness-to-pay). These studies involve various methods of surveying or otherwise eliciting how much respondents are willing to pay for the preservation of a resource (Buchli et al 2003, Knowler et al 2003, Huper et al 2000 Loomis et al 2000).

However, despite attempts to address concerns with contingent valuation surveys, several problems still persist (Giraud et al 2001, Balistreri et al 2001):

- results often appear inconsistent with the economic assumption of rational choice
- values seem implausibly large given the multitude of programs and the availability of substitutes
- realistic budget constraints are difficult to impose on respondents
- complex policy and program information cannot be adequately simplified and conveyed
- appropriate regional or market boundaries for the extent of study or impact are difficult to establish.

The counter argument to these concerns is that whatever the value is, we know it is not zero, so it is better to include some measure of economic value as opposed to none at all. Still the Lower Snake River Report elected not to include passive use values in the calculation of net economic benefits due to the large range of values presented and the uncertainty and controversy surrounding those values (USACE 2002). The CALFED Financing Options Report in attempting to quantify and allocate the costs and benefits of various water and fish related programs found that the passive use benefits were an order of magnitude larger than the total program costs (CALFED 2004b). That two large and recent efforts attempted to incorporate economic preservation values but ultimately chose not to include those values in the quantitative portion of their analysis raises a concern for this analysis. This report therefore suggests examining how the concerns that caused passive use values to be excluded from those efforts can be overcome in this analysis.

1.2.2 Secondary Impacts (Cost or Benefit)

In addition to the number of fish, this work plan recommends applying economic values to secondary impacts as well. This will require that additional metrics be included in the ecological evaluation of each action. In addition to fish population, action groups would also be measured based on the impacts listed below (which may be costs or benefits).

Hydropower Impacts - Instream flow requirements and other measures will limit the flexibility available to reservoir operators in managing power generation. Using historical flow records, the loss of water available for hydrogenation can be calculated. In the reconnaissance-level analysis an average $/kWh and kWh/AF of lost water will be sufficient. This method is often used by environmental organizations with limited budgets and expertise when intervening in FERC relicensing cases (Cutter and Purkey 2003). However such estimations should be used with some caution. Reservoir operations and power generation are extremely complicated and average values can easily overstate lost power revenues. Due to reservoir operating rules (flood control) and weather (spill events) not every cfs of instream flow necessarily leads to lost generation, and reservoirs can sometimes be managed to minimize the effects if instream flow requirements during peak hours, when power prices are higher. Such complex interactions is why extensive generation models are usually used to quantify the effects of modifying reservoir operations, as was done for the Lower Snake River Report (USACE 2002).

Water Supply - Similarly, proposed actions may reduce water available for delivery to agricultural and urban users, but the impact is not necessarily a one to one relationship. Average regional values for alternative water supplies (i.e. pumping groundwater) may be used for incremental and temporary increases or reductions in water deliveries. Permanent reductions might lead to changes in cropping patterns, agricultural land being taken out of production or require investment in alternative supply sources.

Flood Control - Proposed actions may conceivably increase or decreased degree to which reservoir operators must release water to maintain the required flood reservation, the reservoir capacity kept empty in anticipation of possible runoff. Unless the proposed action includes a modification of reservoir operating rules, flood rules are usually considered inviolable and such impacts would be measured by their effect on water supply and hydrogenation.

The variability and unpredictability of weather, runoff and power demands illustrates the importance of incorporating probabilistic analyses in analyzing the impact of actions on reservoir operations if such impacts represent a significant portion of the action's costs or benefits. A probabilistic analysis or Monte Carlo simulation can actually allow changes in reservoir operating rules to be analyzed as potential actions for increasing instream flows or natural runoff patterns (Cutter and McCain 2002). An example might be examining how much does holding back 1,000 AF or water for flushing or attraction flows increase the risk of flooding (by increasing the releases that may be necessary to maintain a required flood reservation) or increase the risk of water shortages and what is the economic cost of that increased risk.

Agricultural and Forested Land Use - Actions that take agricultural land out of production, regulate agricultural or forestry practices, or decrease irrigation will generally lead to a decrease in agricultural production. Agricultural reports will provide average yields and prices with which the direct impact of reduce production can be measured. In many cases average yields might not, however, be appropriate, if a grower has the option of fallowing the least productive land or if the land selected for its habitat value is of unusually high productivity. Depending on the payments received by growers, the overall impacts to the local can be positive or negative. However, in most cases, the distribution of impacts among different sectors in the local economy will be uneven. In particular, growers or landowners may have a positive net impact, while laborers or agricultural support services (i.e. crop dusting) will generally see a negative impact (Mitchell and Cutter 2004). Regional economic impact analysis will be particularly important in such cases.

Water demand per acre is high agricultural land relative to other land uses. A positive impact of decreasing agricultural production will be the decreased water use.

Urban Land Use - Policies limiting or regulating the development of urban land may lead to decreased property values (and correspondingly tax revenues). On the other hand, improved habitat also has the effect of increasing proximate property values (Mooney et al. 2001). Due to the unique issues faces in individual locations, property value impacts are more difficult to generalize from available studies, though reconnaissance-level estimates are possible.

Recreation (non-fishery) - Actions that improve habitat or instream flow or improve riparian or terrestrial habitat could potentially lead to an increase in tourism and recreation in the area. The increased number of visits and resulting local expenditures can be estimated using a variety of techniques. Such estimations generally involve a high degree of subjective assumptions and can be controversial if significant.

Transportation - It is possible some actions will result in increased costs or decreased volume for water transportation. Increased costs or decreased output for the water transportation sector can be estimated, as well as the incremental cost of using less efficient or economical forms of shipping.

Tribal Circumstances - It may be desirable or necessary to calculate the above impacts that specifically impact tribal lands and populations. In addition, in other studies, tribes have emphasized that the revenue obtained from commercial sales of salmon represent an important source of revenue, but also that such revenue does not represent the greatest part of value that tribal peoples associate with salmon. Tribes consider dollar revenue a severely limited indicator of tribal value and lead to an inadequate estimate of the full impacts to the tribes.

1.2.3 Biological Impacts

Despite including and quantifying several factors, the above methods still omits several important biological goals such as persistence probability, productivity and diversity, from the economic analysis. Instead such factors are subsumed in the fish population impact, but not explicitly included in an economic analysis or quantitative model. Similarly the limiting factor analysis lists many interrelated factors in various categories life stages and locations (e.g. sediment transport, habitat diversity, contaminant exposure) that are not explicitly or quantitatively included. There are two fundamental approaches to incorporating these ecological factors more explicitly in an economic analysis, which are described in the next section.

1.3 ANALYTICAL APPROACH

This section describes the proposed analytical approach for the economic analysis of the impacts presented in the previous section.

1.3.1 Qualitative Analysis

The most straightforward method is a simple matrix or spreadsheet model that allows users to input qualitative rankings or weights for the ecological factors that are not easily quantified in economic terms. This approach is often necessary due to constraints in time, budget or expertise. A reconnaissance-level analysis may begin simply with a matrix of economic impacts and qualitative ratings for those impacts not easily measured with an economic value. A spreadsheet, which applies weights to each factor and calculates a combined score for purposed of ranking may also be applied. Such an approach is simple and transparent to non-technical stakeholders and facilitates discussion regarding prioritizing and evaluating multiple criteria. However, the process is still highly subjective and, particularly when dealing with complex systems, prone to common individual and group biases. Organization behavior studies have thoroughly documented problems with groupthink, overconfidence, misperceptions of risk and collective rationalization as well as many other biases that enter into group processes.

More complex decision analysis or multiple criteria analysis tools can also be used for this type of analysis. The East Fork Lewis Subbasin Plan's use of the EDT model for the habitat factor analysis represents one example of this type of analysis. Users input a mixture of quantitative and qualitative information describing their watershed and the EDT model produces reports regarding the types of actions and locations that are likely to have the largest impact. A wide range of decision analysis tools have been implemented for watershed management (Prato 2003, Guroack et al. 1998, Peters and Marmorek 2000, Layton et al 1999).

1.3.2 Quantitative Analysis

Another possible approach is a more quantitative ecological model that attempts to quantify and parameterize the most important interrelationships for the proposed actions being studied. A wide variety of ecological models and decision analysis tools for use in watershed management have been developed, including PATH for the Lower Snake River Report. The Improvement Increments objectives presents a simple example of how impacts of various actions are multiplicative and interrelated. It is quite possible that the sheer number of actions and complexity of their interrelationships will require a more formal and quantitative approach than a matrix or decision analysis tool can provide. For example a simplified fish population model could be used to help identify groups of actions that fit well together in producing desirable ecological outcomes. Such an approach was used in evaluating the multi-year impacts of measures designed to restore natural high-flow regimes in the San Joaquin River Basin (Cutter and McCain, 2002). An ecological model could also distill a number of ecological factors into metrics such as fish population that can be more easily incorporated in an economic analysis.

This report recommends beginning with an assessment regarding whether a simple matrix or spreadsheet approach will be sufficient given the complex interrelationships and number of alternatives. If such an analysis appears overly simplistic or inadequate, an evaluation of more robust methods for incorporating qualitative and quantitative measures, such as decision analysis tools and/or ecological models, is recommended.

1.3.3 Regional Impact Analysis

Finally, for the economic impacts that can be calculated, this report recommends using the FEAM/IMPLAN model to estimate regional and distributional impacts. Time and budget constraints may preclude implementing more advanced Input-Output models and the analysis of ecological interactions probably warrants more attention in any case. The FEAM/IMPLAN model will calculate how changes in industry output and final demand (purchases made by institutions and households as opposed to businesses) impact individual sectors and the regional economy as a whole. FEAM/IMPLAN is capable of producing reports regarding industry output, wage income, proprietor income, property income, taxes and employment. FEAM/IMPLAN uses trade relationships derived from national data and apply them to the regional economy, so some care must be taken to ensure relevant local trade flows are accurately represented. The simplifying assumptions identified above must also be considered when interpreting FEAM/IMPLAN results. In particular, IMPLAN increased purchases of all inputs proportionally in response to a change in output, so actions that impact only a specific part of the production function must be modeled differently than actions that impact the entire supply chain (as specific example is discussed in the next section).

1.4 EXAMPLE APPLICATION to East Fork Lewis Subbasin Plan

This section discusses how the economic work plan might be applied to individual actions in the East Fork Lewis Subbasin. Table 1 and Table 2 list representative actions from each limiting category: Habitat (Subbasin), Hydropower, Harvest, Hatchery, Ecological Interaction, Other Fish and Wildlife Species and Education, Outreach and Enforcement. The East Fork Lewis Subbasin Plan did not include specific actions for all limiting categories, leading to the inclusion of some representative recovery measures. This list is designed for purposes of illustration only and is not designed to be exhaustive or fully represent each type of action that may be applied in a particular subbasin. Rather the actions discussed here are designed to give an idea of how an economic analysis would approach each type of action and the particular challenges raised.

1.4.1 Cost-Benefit Analysis

Table 1 and Table 2 list actions down the left column and potential impacts across the top row. Table 1 lists both the primary and secondary *quantitative* impacts discussed in the previous section and suggests the potential magnitude of each impact. The last column indicates whether an action is likely to have distributional impacts in a Regional Economic Impact (Input-Output) analysis. Again the ratings of the impacts were made by economists, not biologists, and should be viewed only for purposes of illustration. Table 2 lists some more *qualitative* impacts that may be important in evaluating each action, but are not easily measured with an economic value.

While each action will have a range of ecological, political and economic outcomes, for purposes of economic analysis, each action can be generally categorized as one of several types:

1. **Construction or Restoration**: Involves capital and operational expenditures for infrastructure and habitat improvements
2. **Land Purchases**: Involves the outright purchase of land or easements. Usually capital intensive and resulting in potential distributional impacts due to land use changes.
3. **Financial or Technical Assistance**: Encourages desirable behavior though voluntary financial or technical assistance

The above categories generally have relatively high costs in capital or operational expenditures as well as potentially significant costs in secondary impact categories. At a reconnaissance-level, implementation costs can be estimated using average regional values as suggestion in the previous section; for example habitat restoration or land purchases would be based on a $/river mile or $/acre figure. Later analysis will require expert cost estimates specific to each project. For a more detailed analysis, estimates specific to each action would be required. The secondary impacts, which may be costs or benefits, would be calculated on a similar basis.

4. **Land Use Regulation**: impacts land use practices through regulation rather than direct purchase or management.

5. **Reservoir Operation Regulation**: modifies reservoir operations to provide instream flows, mimic natural flow regimes or improve migration. May have significant impacts on hydrogenation, water supply and flood control.
6. **Harvest Regulations**: Rules and policies designed to increase or decrease the harvest of a particular species of fish.
7. **Enforcement**: Increased or more effective enforcement of new or existing regulations.

Regulations and enforcement may require increased operational budgets, but will have lower implementation costs than outright purchase or construction. Secondary costs on other parties can, however, be significant, as can distributional impacts. Land use regulations will lead to a change in land use, affecting agricultural and forestry production. Changing property values will affect revenues to land owners and property tax receipts. Instream flow regulations may have little or no implementation costs, but can dramatically affect power generation revenues.

8. **Management**: Active management of fish populations through hatchery or other management practices.

Operational costs may or may not be high relative to other categories. Management actions will usually increase the budgets of resource management agencies, but may or may not have significant secondary impacts.

9. **Evaluation**: Research, monitoring and evaluation of ecological relationships or recovery plan actions.
10. **Education**: Outreach and education regarding fisheries.

The benefits of research and education are widely accepted, but difficult to quantify or categorize economically. Studies using Monte Carlo analysis to estimate the value of in-season population monitoring have been performed (Link and Peterman 1998).

The qualitative impacts listed in Table 2, can do not lend themselves well to economic evaluation, but are nevertheless important. As described earlier, it may be possible to evaluate qualitative impacts through a simple matrix or spreadsheet analysis that weights different factors and provides aggregate scores for ranking. On the other hand, experts may conclude that more complex methods are required and suggest the development of an ecological model, a decision analysis tool or both.

Tables 8.2 and 8.3 are not designed to present an exhaustive list of possible impacts; previous studies have suggested alternate presentations. In particular the Northwest Power Planning Council's Human Effects Analysis of the Multi-Species Framework presents the following list of impacts.

Table 1. Quantitative Impacts of Proposed Actions.

Action	Type	Primary		Secondary							REI
		Implementation	Population	Hydropower	Water Supply	Flood Control	Agriculture	Urban	Recreation	Tribal	Distributional
Habitat											
Restore off-channel chum spawning channels	Construction/ Restoration	✚	✚	**+**		**+**			+	**+**	**+**
Increase funding for purchase of easements or property	Land Purchases	✚	**+**		**+**		✚	✚	+	**+**	✚
Land use management to protect watershed processes	Land Use	**+**	✚	**+**			**+**	**+**	+	**+**	**+**
Upgrade on-site sewage systems	Assistance	**+**	+		+			+		**+**	+
Hydropower											
WRIA instream flow prescriptions	Regulation	**+**	✚	✚	✚	✚	**+**		+		**+**
Harvest											
Minimize incidental impacts to naturally spawning steelhead	Regulation	**+**	**+**						+	+	+
Hatchery											
Mark Skamania Hatchery steelhead	Management	+	+						+		
Research, monitor and evaluate performance of hatchery actions	Evaluation	+									
Ecological Interactions											
Manage northern pikeminnow	Management	+	**+**						+	+	+
Other Species											
Regulate to avoid significant impacts on green sturgeon	Regulation	+	**+**						+		
Education, Outreach & Enforcement											
Teacher training and assistance	Education	+									+
Cooperative enforcement partnerships	Enforcement	+									

Note: The level of economic impact resulting from proposed actions ranges from low (blank cell) to high (bold plus symbol)

Table 2. Qualitative Impacts of Proposed Actions

		Ecological		Social/Political			
Action	**Type**	**Diversity**	**Resiliency**	**Jurisdiction**	**Visibility**	**Equity**	**Aesthetics**
Habitat							
Restore off-channel chum spawning channels	Construction/ Restoration	✚	✚	**+**	**+**		+
Increase funding for purchase of easements or property	Land Purchases	**+**	**+**	**+**	**+**	**+**	✚
Land use management to protect watershed processes	Land Use	**+**	✚	✚	**+**	**+**	**+**
Upgrade on-site sewage systems	Assistance	+	+		+	+	+
Hydropower							
WRIA instream flow prescriptions	**REGULATION**	✚	✚	✚	✚	**+**	+
Harvest							
Minimize incidental impacts to naturally spawning steelhead	Regulation	✚	✚	+		**+**	
Hatchery							
Mark Skamania Hatchery steelhead	Management	**+**	**+**		+		
Research, monitor and evaluate performance of hatchery actions	Evaluation	+	+				
Ecological Interactions							
Manage northern pikeminnow	Management	+	**+**	+	+		
Other Species							
Regulate to avoid significant impacts on green sturgeon	Regulation	**+**	**+**	+	+		
Education, Outreach & Enforcement							
Teacher training and assistance	Education				+		
Cooperative enforcement partnerships	Enforcement			**+**			

Note: The level of economic impact resulting from proposed actions ranges from low (blank cell) to high (bold plus symbol)

Table 3. Categories of Human Effects and Suggested Indicators.

Implementation Cost
Economic Efficiency
Net value of fisheries production
Net value of hydropower production
Net value of recreation
Net value of transportation
Net value other (agriculture, forestry, mining)
Regional Economic Effects
Personal income
Output
Employment
Social Effects
Income distribution(poverty, etc.)
Health (mortality, etc.)
Passive use values
Other quality of life
Environmental quality
Tribal Effects
Salmon
Other valued assets (beaver, bear, bull trout)
Equity between tribal and non-tribal persons
Water quality measures
Wildlife habitat

Source: NPCC 2000 with modifications by Shannon Davis, The Research Group

1.4.2 Regional Impact Analysis

The primary and secondary cost figures from the cost-benefit analysis can be entered into the FEAM/IMPLAN model to estimate regional and distributional impacts. IMPLAN is set up to model changes in industry output as well as final demand (demand for goods and services on the part of institutions and households). Implementation costs can usually be modeled as an expenditure (or increase in output) in the appropriate category (Commercial construction, water and sewage systems etc.). Some adjustments may be necessary to convert other cost numbers into representative output or final demand numbers. The imposition of new regulations regarding pesticide use may increase the grower's costs and a decrease agricultural production. Increases in the cost of inputs cannot be modeled directly in IMPLAN; instead it requires adjustments to the agricultural production function used in IMPLAN (which in any case is recommended, as agricultural data is admittedly unreliable in IMPLAN). Similarly, one of the simplifying assumptions mentioned previously in this chapter was constant returns to scale and a fixed production function. Thus a change in agricultural output in the model will affect all inputs to agriculture proportionally, not just pesticides and related costs. Methods for dealing with such impacts are included in reports on the third party effects of water transfers (Mitchell and Cutter 2004, Howe and Goemans 2003).

An example table of IMPLAN output, representing the impacts of a $2.0 million construction project is shown in Table 4. Note that though the multiplier effects, the total impact of the expenditure on the local economy was $2.8 million. Wage Impacts of the same project are shown in Table 5.

Table 4. Example IMPLAN Output Report.

	Direct	Indirect	Induced	Total
TOTAL	**$1,996,523**	**$463,035**	**$370,149**	**$2,829,707**
Agriculture	-	1,397	4,148	5,545
Manufacturing	-	15,924	8,004	23,929
Water, sewage and other systems	-	7	26	33
Construction	1,996,523	598	4,997	2,002,118
Wholesale Trade	-	64,706	25,477	90,183
Transportation & Warehousing	-	40,940	10,635	51,575
Machine Rental & Repair	-	125,843	30,948	156,791
Retail trade	-	37,555	50,043	87,598
Commercial & Prof. Services	-	162,908	153,923	316,830
Government	-	13,157	81,948	95,105
Institutions	-	-	-	-

Table 5. Example IMPLAN Wage Report.

	Direct	Indirect	Induced	Total
TOTAL	**$590,088**	**$140,241**	**$98,596**	**$828,925**
Agriculture	-	173	952	1,125
Manufacturing	-	3,610	1,429	5,039
Water, sewage and other systems	-	2	6	7
Construction	590,088	200	1,641	591,929
Wholesale Trade	-	23,264	9,160	32,424
Transportation & Warehousing	-	11,740	3,644	15,385
Machine Rental & Repair	-	20,270	8,428	28,698
Retail trade	-	15,180	19,253	34,433
Commercial & Prof. Services	-	62,046	48,848	110,894
Government	-	3,756	5,235	8,992
Institutions	-	-	-	-

1.5 CONCLUSION

Presenting the results of a cost-benefit analysis in simple matrix or a spreadsheet model that attempts to appropriately weight and score all the impacts for a relative ranking may be sufficient for a reconnaissance-level analysis. Time and budget constraints may preclude more involved methods. The advantage of this approach is its simplicity and limited data requirements; input from experts and stakeholders can be easily incorporated. In some cases it can lead to close to optimal solutions without the cost and effort of more involved processes. In addition, this method is easily understood by a variety of stakeholders.

The limitations of this approach must be understood. The process of establishing the weights and criteria by which actions will be judged will facilitate discussion and impose some rigor on the analysis. However, the process is still highly subjective and, particularly when dealing with complex systems, prone to common individual and group biases. Organization behavior studies have thoroughly documented problems with groupthink, overconfidence, misperceptions of risk and collective rationalization as well as many other biases that enter into group processes.

The report, therefore, recommends that an exploration of the feasibility and benefits of more rigorous methods discussed above be explored, and if possible, implemented. A simple or moderately complex ecological model can provide a more robust quantification of interactions between individual actions and assist in developing rankings and groupings of the most effective combination of actions. A decision analysis tool can combine quantitative and qualitative factors in a more thorough and analytical way than a matrix or spreadsheet. In addition such models can more quickly analyze a large number of actions or permutations. Finally incorporating probability either through stochastic formulas or Monte Carlo simulation can substantially increase the level of understanding and decision making. While there are a wide variety of programming languages and models, they need not be excessive complex or inaccessible.

In addition, this report recommends using the FEAM version of IMPLAN to model regional economic impacts. While more capable Input-Output models are available, it is likely that budget constrains will preclude their use and that effort would be better spend on the ecological and cost-benefit analysis. IMPLAN is inexpensive, commonly used and provides a sufficient, first-order measure of regional and distributional impacts. Model outputs will be used as a guide to assist in making decisions regarding implementation of this plan. Decisions regarding specifics of plan implementation will take into account the results of modeling but ultimately the overriding goal of this plan is to recover listed stocks and actions implemented will need to achieve that goal.

Appendix D, Chapter 2
Economic and Demographic Profile

2.0 ECONOMIC AND DEMOGRAPHIC PROFILE

2.1 SUMMARY

2.1.1 Area Definition

This chapter presents an economic and demographic profile of the subbasin plan's region. The region encompasses five counties in southwest Washington: Wahkiakum, Lewis, Cowlitz, Clark, and Skamania (Map I.1).[1] The region has a mix of urban and rural land uses, with Clark County the most urban (549.7 persons per square mile) and Skamania the least urban (6.0 persons per square mile) (Table I.1).

2.1.2 Employment Trends

Natural resource (timber, agriculture, commercial fishing) based industries are declining in importance to the region's economy. Timber related employment (logging services and sawmills) has been in decline since the early 1980's. Agriculture production in the region is along the north to south corridor of central Lewis County, Cowlitz County, and Clark County and includes mostly hay and raspberries for crops and cattle, dairy cows, and broilers for livestock. Agriculture production has not changed much in recent years and mechanization has lowered labor requirements. Commercial fishing employment is mostly related to ocean fish resources with landings and seafood processing businesses located in Pacific County. There is also a lower Columbia River salmon gillnet fishery. Industry trends for harvest and seafood processing have been for declining labor requirements. Non-lumber and wood products related manufacturing employment in the region is dominated by pulp and paper mills, which while continuing to operate, have had static hiring. Food processing businesses, including seafood processing in Pacific County, have announced cutbacks as agriculture production has shifted to eastern Washington and Oregon. Two aluminum plants ceased operations in 2001 and another metals manufacturer has closed. High technology businesses located new plants in Clark County in the 1990's, but no new major plant expansions have occurred in the 2000's. Other economic sector growth has been in trade, health and tourism related services, and government.

Major private manufactures within the region are: Norpac Paper Mill (joint effort of Weyerhaeuser Company of the U.S. and Nippon Paper Industries of Japan), Longview Fibre Paper Mill, J.H. Kelly Construction (contractors), Foster Farms, Steelscape (metals), and RSG Forest Products in Longview; TransAlta Canada coal mine and power production, National Frozen Foods in Centralia; several high technology businesses (Hewlett-Packard, SEH, Wafertech, AVX/Kyocera, Sharp Microelectronics, Matsushita, and Linear Technology) in Vancouver; and the Georgia Pacific Paper Mill in Camas. The Reynolds Metal Company in Longview and the Vanalco aluminum smelter in Vancouver are being maintained for operation, but have been closed since 2001. Prudential Steel Company in Longview closed in 2002.

1. The contained watersheds in the planning region also include minor portions of Pacific (Grays River) and Klickitat (Big White Salmon River) counties. The portions in these adjacent counties are reflective of the plan's region, so only the five counties are used in the economic and demographic profile.

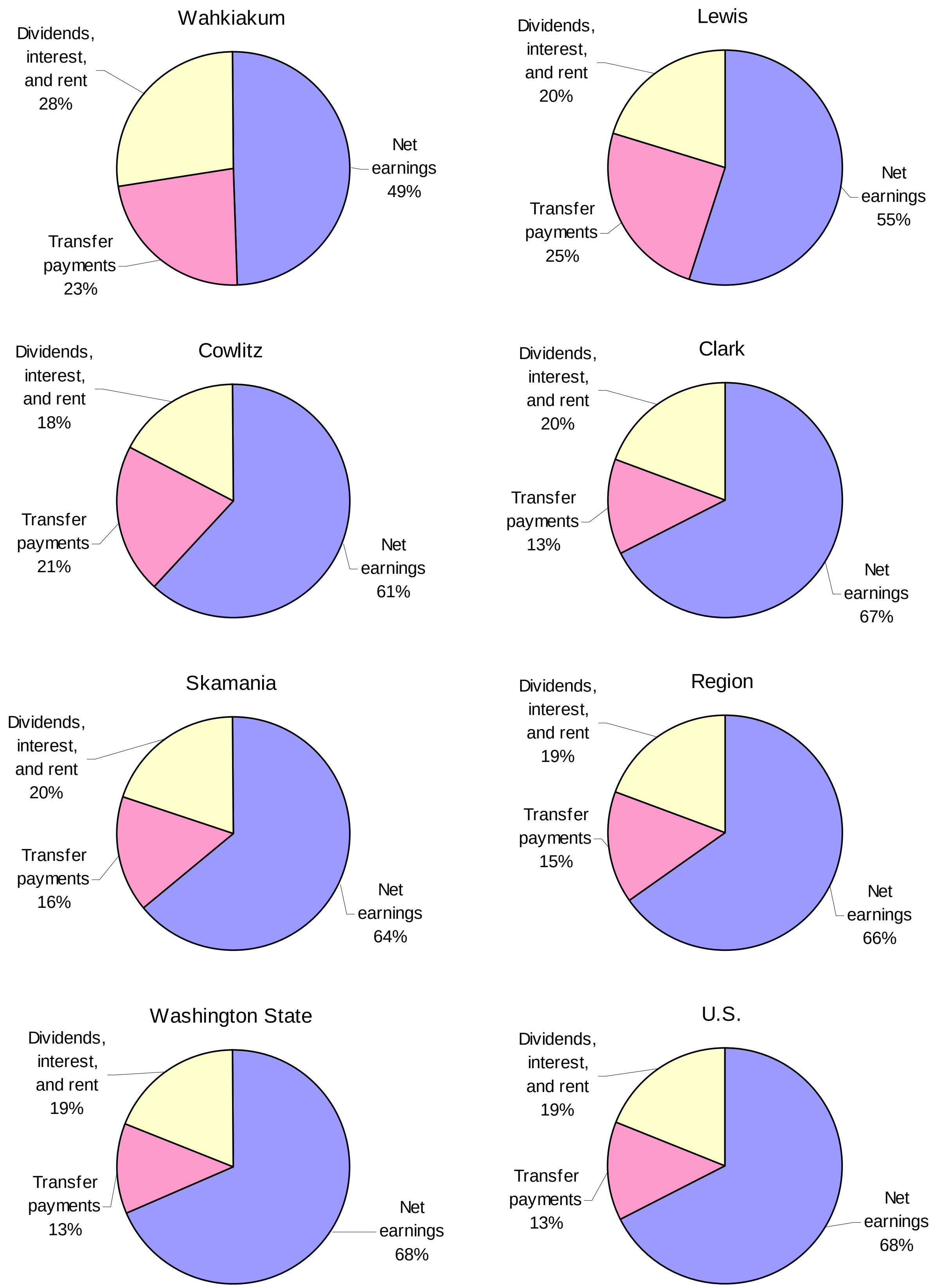
Map I.1
Salmon Recovery Plan Region

Table I.1
Economic and Demographic Characteristics of Planning Region

	Planning Region Counties												State of	
	Wahkiakum		Lewis		Cowlitz		Clark		Skamania		Total		Washington	U.S.
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	Amount
Population (Year 2000)														
Number	3,824	1%	68,600	13%	92,948	18%	345,238	66%	9,872	2%	520,482	100%	5,894,121	281,421,906
Incorporated	14.8%		40.5%		58.3%		51.8%		18.2%		50.6%		59.6%	--
Unincorporated	85.2%		59.5%		41.7%		48.2%		81.8%		49.4%		40.4%	--
Age														
Under 18	23.4%		26.5%		26.8%		28.7%		26.6%		28.0%		25.7%	25.7%
18 to 64	58.1%		58.0%		59.9%		61.8%		62.4%		60.9%		63.1%	61.9%
65 and over	18.5%		15.5%		13.3%		9.5%		11.0%		11.1%		11.2%	12.4%
Ethnicity														
White	93.5%		93.0%		91.8%		88.8%		92.1%		90.0%		81.8%	75.1%
Other	6.5%		7.0%		8.2%		11.2%		7.9%		10.0%		18.2%	24.9%
Education														
High school over age 25	84.2%		80.5%		83.2%		87.8%		85.9%		86.0%		87.1%	80.4%
Median household income in 1999 ($)	39,444		35,511		39,797		48,376		39,317		--		45,776	41,994
Economic (Year 2000)														
Wage and salary employment	915	0%	26,502	14%	41,364	21%	123,411	64%	2,134	1%	194,326	100%	2,940,967	139,002,000
Proprietary employment	734	1%	7,848	15%	7,190	14%	35,522	68%	770	1%	52,064	100%	612,059	27,756,800
Employment by industry	1,649	1%	34,350	14%	48,554	20%	158,933	65%	2,904	1%	246,390	100%	3,553,026	166,758,800
Farm and agricultural services	411	5%	2,960	34%	1,664	19%	3,615	41%	158	2%	8,808	100%	143,388	5,234,100
Farm	175	4%	1,755	39%	702	15%	1,818	40%	96	2%	4,546	100%	80,004	3,113,000
Agricultural services	236	6%	1,205	28%	962	23%	1,797	42%	62	1%	4,262	100%	63,384	2,121,100
Mining	0	0%	664	51%	164	13%	467	36%	0	0%	1,295	100%	5,411	784,200
Manufacturing (incl. forest product	303	1%	4,535	13%	10,295	29%	20,571	57%	366	1%	36,070	100%	371,171	19,114,800
Services	587	0%	19,267	13%	27,350	18%	100,458	67%	1,324	1%	148,986	100%	2,270,912	109,235,400
Construction	0	0%	1,677	9%	3,260	18%	13,409	73%	128	1%	18,474	100%	214,331	9,446,300
Government	262	1%	5,247	16%	5,821	18%	20,413	63%	871	3%	32,614	100%	547,813	22,944,000
Gross farm sales ($000's) (Year 1997	2,715	2%	82,778	57%	15,919	11%	43,083	30%	1,532	1%	146,027	100%	4,767,727	--
Crops	3%		28%		46%		40%		87%		34%		68%	--
Livestock	97%		72%		54%		60%		13%		66%		32%	--
Personal income ($000's)	86,440	1%	1,512,443	10%	2,309,418	16%	10,335,767	71%	224,570	2%	14,468,638	100%	191,644,569	8,677,490,000
Net earnings	42,623	0%	832,904	9%	1,425,077	15%	6,986,115	74%	143,468	2%	9,430,187	100%	130,901,069	5,869,194,000
Transfer payments	20,009	1%	374,768	17%	479,724	21%	1,328,400	59%	36,471	2%	2,239,372	100%	24,240,285	1,171,083,000
Dividends, interest, and rent	23,808	1%	304,771	11%	404,617	14%	2,021,252	72%	44,631	2%	2,799,079	100%	36,503,215	1,637,213,000
Poverty rate (Year 1999)	8.1%		14.0%		14.0%		9.1%		13.1%		10.7%		10.6%	12.4%
Geographic (Year 2000)														
Area (square miles)	264	4%	2,408	40%	1,139	19%	628	10%	1,656	27%	6,095	100%	66,544	3,537,438
Density (persons per square mile)	14.5		28.5		81.6		549.7		6.0		85.4		88.6	79.6
Commute patterns														
Average travel time to work	28.1		25.7		21.3		24.7		29.7		24.4		25.5	25.5

Sources: U.S. Census Bureau, U.S. Bureau of Economic Analysis, and USDA National Agricultural Statistics Service.

Figure I.1
Personal Income by County, Region, State, and U.S. in 2001



Source: U.S. Bureau of Economic Analysis.

The aggregate unemployment rate in the region has trended consistent with Washington's rate. Clark County is consistently lower than the region's rate and the other four counties consistently higher than the statewide rate (Figure I.3).

2.1.3 Population Trends

Overall population has grown (53 percent between 1980 and 2000) in response to economic opportunities and the area's attractiveness to retirees. Clark County's population growth (80 percent between 1980 and 2000) is tied to the Portland-Vancouver Metropolitan Area's trends, given the short commuter distance to businesses on the Oregon side of the Columbia River and a more favorable tax exposure for residents located in Washington (Figure I.2).[1] The four other counties' population growth (19 percent between 1980 and 2000) has been much less as job opportunities at timber related businesses have been declining. There are no Indian reservations located in the region, and there is a lower regional (1.0 percent in 2000) than statewide (1.6 percent in 2000) Indian race composition. The race white (81.8 percent statewide and 90.0 percent in the region in 2000) is the overwhelming ethnicity. The older age cohort (65 and over) has been growing faster in the region when Clark County is omitted (2.2 percent between 1980 and 2000) than in Washington (0.8 percent) and the nation (1.1 percent). Clark County's change in the older age cohort (0.5 percent between 1980 and 2000) has been less than the State and nation, which is reflective of a younger age group migration to take advantage of the metropolitan area employment opportunities.

2.1.4 Income Sources

The earnings share of income sources in Clark County (67 percent) is consistent with Washington (68 percent) and the national average (68 percent) in 2001 (Figure I.5).[2] The share of income from retirement related sources is much higher in the other four counties (12.3 percent) than Washington (7.0 percent) and the nation (7.9 percent).

The following sections describe county level economic and demographic profiles.[3] The data referenced in the descriptions are contained in the appendix to this report.

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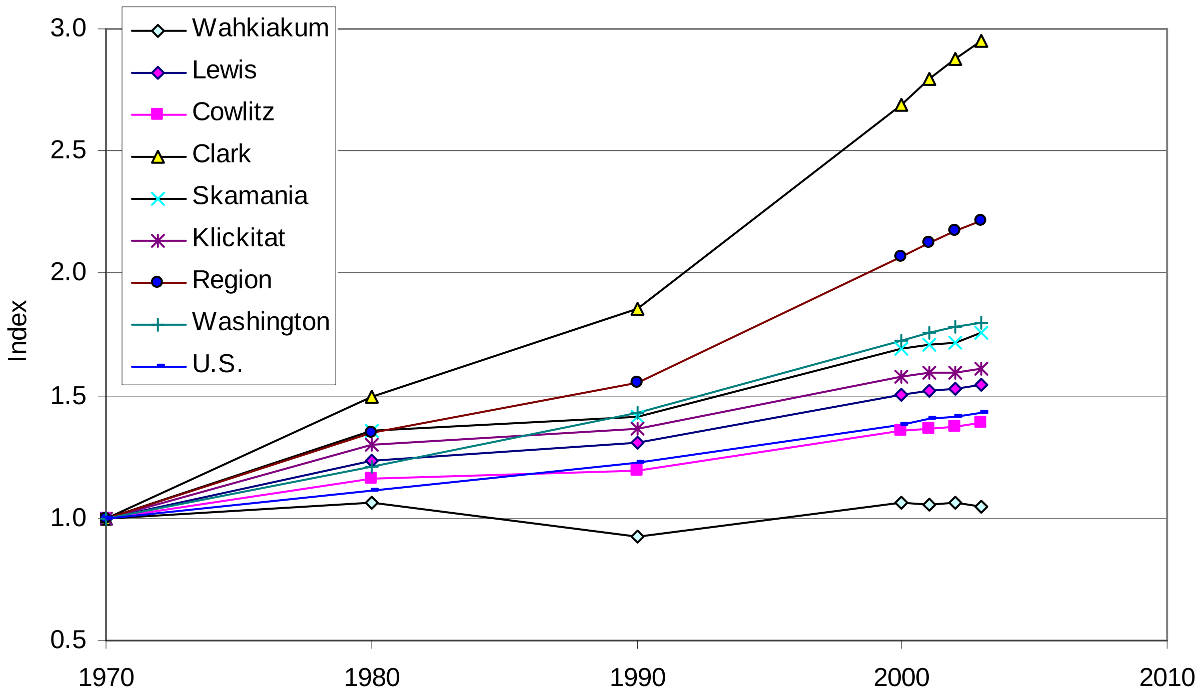
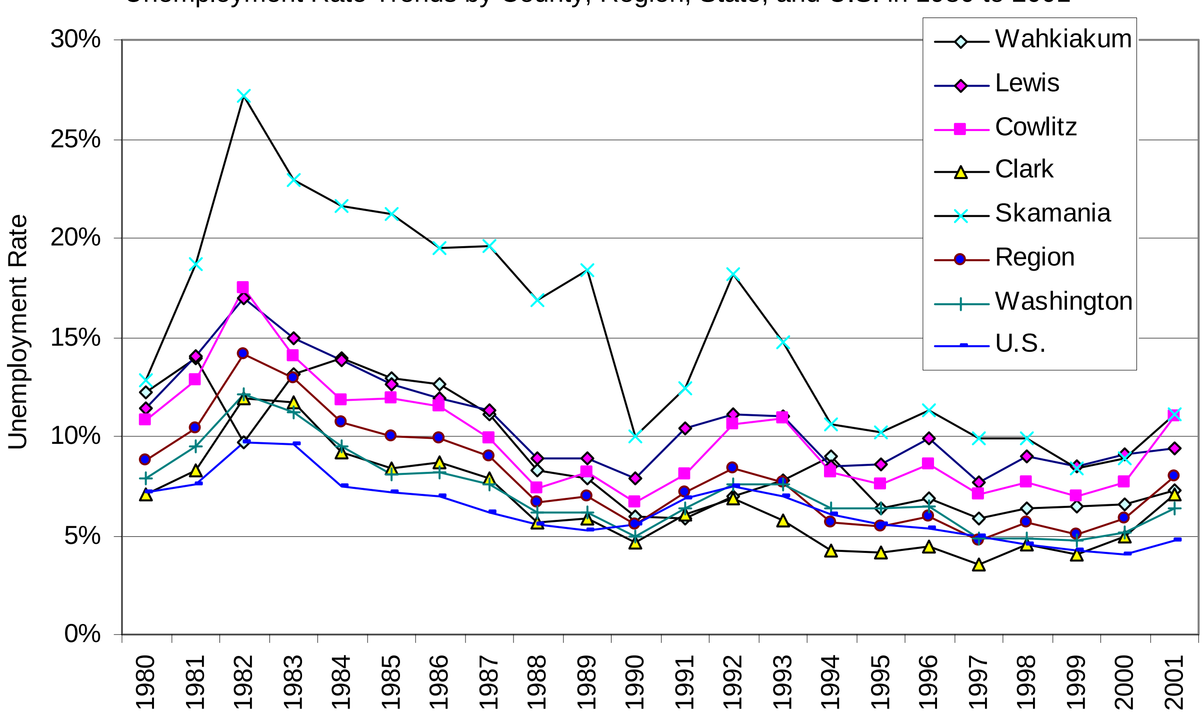
1. The property tax rate is lower in Clark County than in Oregon's counties and residents can shop in Oregon to avoid Washington's sales tax.
2. The non-earned income sectors include investments (dividends, interest and rent for example) and transfers (retirement income for example). Investments and transfers are sometimes referenced by economists as prior generational earned income rather than non-earned income.
3. The information is selectively taken from Washington State Employment Security Department's County Economic Profiles.

Figure I.2
Population Index Trends by County, Region, State, and U.S. in 1970 to 2003



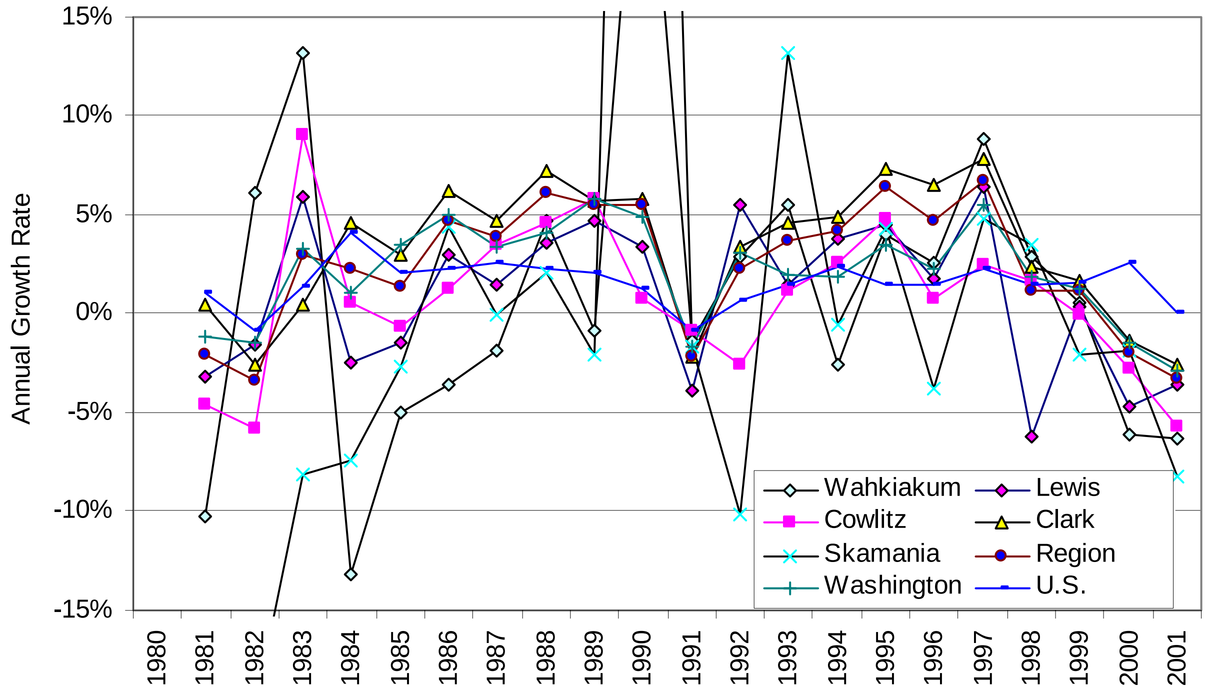
Source: U.S. Census Bureau.

Figure I.3
Unemployment Rate Trends by County, Region, State, and U.S. in 1980 to 2001



Source: Washington State Employment Security Department and U.S. Bureau of Labor Statistics.

Figure I.4
Total Employment Annual Growth Rate by County, Region, State, and U.S. in 1980 to 2001



Notes: 1. Skamania County annual growth rate in early 1990's nearly doubled the County's employment base, due to the opening of the new Skamania Lodge in Stevenson, Washington.

2. Wahkiakum County's high annual growth rate in the early 1990's was in response to the opening and expansion of the Norpac and Weyerhaeuser paper mills.

Source: U.S. Bureau of Economic Analysis for region, Washington Employment Security Department for statewide, and U.S. Bureau of Labor Statistics for U.S.

2.2 PROFILES

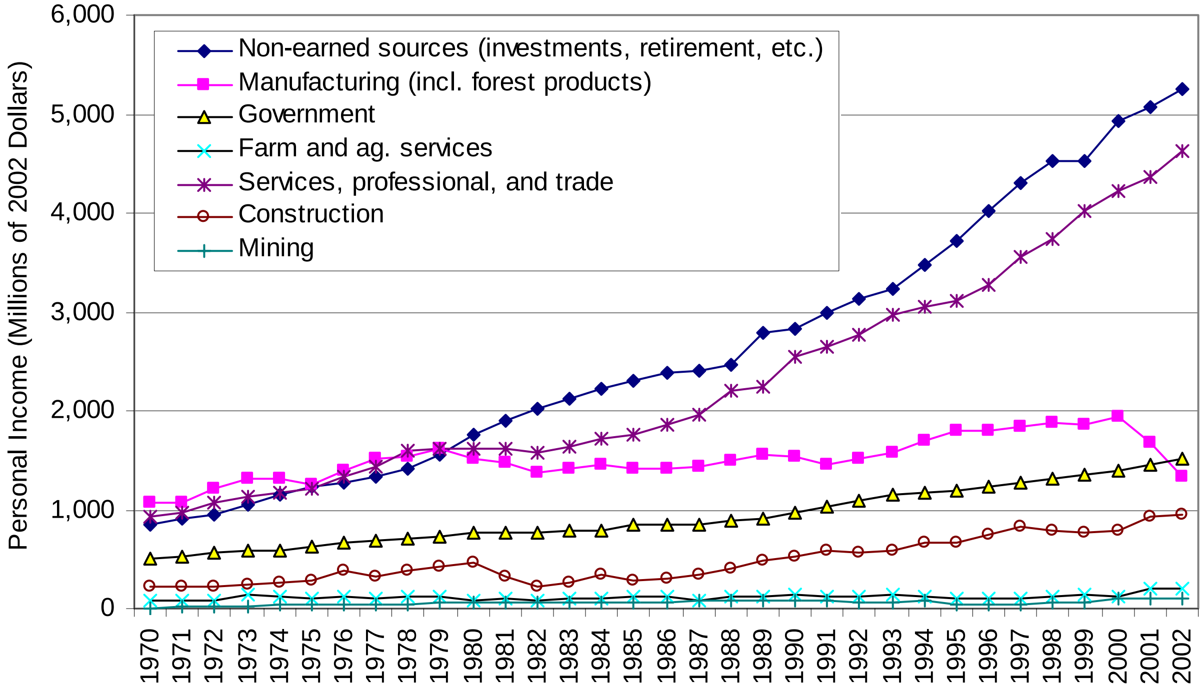
2.2.1 Wahkiakum and Cowlitz

Geography

The geographically contiguous counties of Wahkiakum and Cowlitz are situated in southwest Washington. To the north are Lewis and Pacific counties and to the east, Skamania County. Southeast of Cowlitz County, the Lewis River forms a boundary with Clark County. On the south and southwest border of Wahkiakum and Cowlitz counties, respectively, is the Columbia River with Oregon on the other side.

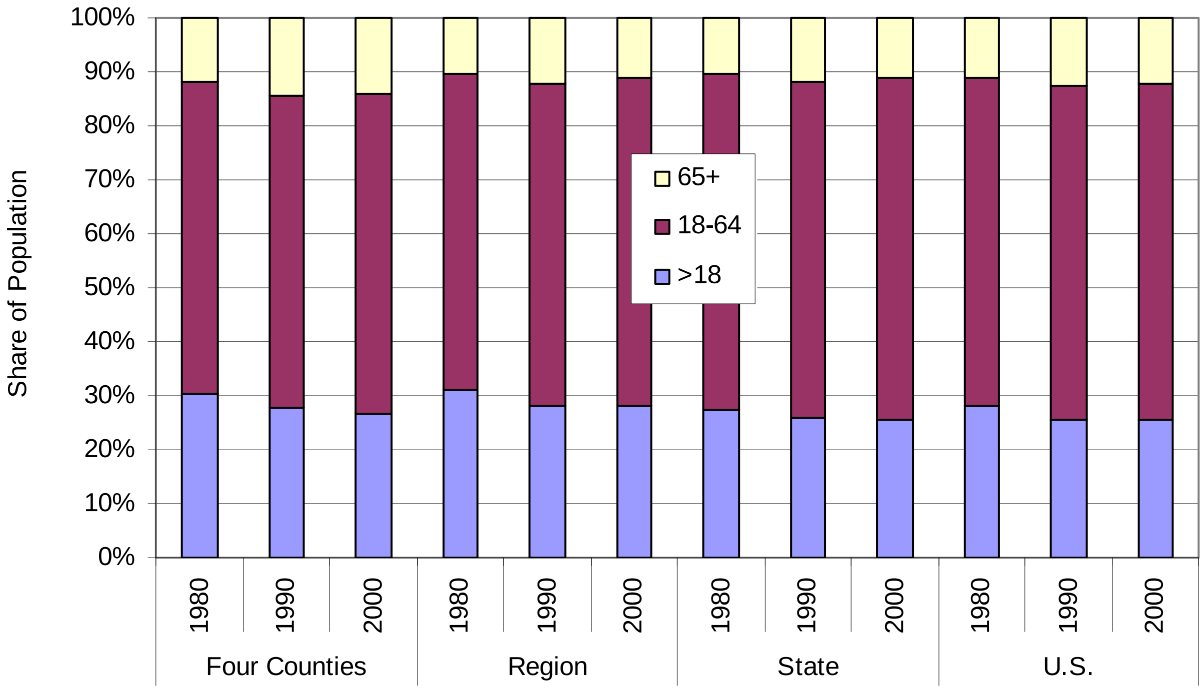
Wahkiakum and Cowlitz counties constitute geographic areas of 1,139 square miles and 264 square miles, respectively. As such, they rank 28th and 37th in size among Washington counties. Its geographical ranking makes Wahkiakum the third smallest county in the State. Taken together, the counties represent just over two percent of the State's total land mass. The topography of the two counties is very similar. Both are part of the Puget Sound-Willamette Depression. The depression is a geologic formation extending south from Puget Sound to the

Figure I.5
Sources of Income by Sector for Region in 1970 to 2000



Note: Personal income is adjusted to 2002 dollars using the GDP implicit price deflator developed by the U.S. Bureau of Economic Analysis.
Source: U.S. Bureau of Economic Analysis.

Figure I.6
Age Cohort Trends by Region, State, and U.S.



Source: U.S. Census Bureau.

Willamette Valley in Oregon. It was created eons ago by the same forces (i.e., shifting plates) which created the Cascade Range.

Despite nestling up against the Cascade Range, the region is not exceptionally elevated. Those parts of Cowlitz County that abut the Cascades rise to around 4,000 feet above sea level; the highest is Elk Mountain (4,538 feet). Mount St. Helens (8,365 feet) is just to the east of the Cowlitz-Skamania County border. Most of Wahkiakum and Cowlitz counties, though, is rather hilly, reaching elevations of around 1,000 feet above sea level.

As might be expected, a number of tributaries flow through the counties from sources originating in the Cascades. In Cowlitz County, the major rivers include the Cowlitz, Toutle, Coweeman, Kalama, and Lewis. Chief among these is the Lewis River; it has been dammed at two points within Cowlitz County (at Yale Dam and Ariel Dam), resulting in Yale Lake and Merwin Lake. In Wahkiakum County, the major tributaries are the Grays and Elochoman rivers, both of which flow directly into the Columbia.

Population Trends

Population changes are viewed as important economic indicators because people tend to follow jobs. The recessions of the early 1980's and long-run job losses in the timber industry caused the population to stagnate for about eight years in Cowlitz County and brought about a drastic 14 percent drop in Wahkiakum County (between 1980 and 1991). In fact Wahkiakum didn't register positive growth until 1989. Population growth for both counties has for the most part been positive since then, though less than the statewide pace.

Overall for the period 1970-2001, the population in Cowlitz County grew 37 percent (from 68,616 to 93,900). Wahkiakum County's increase was only six percent (3,592 to 3,800). During the same time, the State's population swelled by over 75 percent. Annualized growth rates were 1.0 percent in Cowlitz, 0.2 percent in Wahkiakum, and 1.8 percent statewide.

Employment Trends

While total nonfarm employment continued to increase slightly through 1980 due to construction projects, lumber and wood products jobs began disappearing, falling to 4,100 in 1982 and further to 3,200 in 1985. In a space of two years (1980-1982) there was a loss of 11 percent of all jobs. As the national and state economy expanded during the rest of the decade, almost 8,000 jobs were added, which amounted to a 28 percent increase. This recovery was spearheaded by expansion of non-timber manufacturing, the opening of a new paper mill, and the opening of the Three Rivers Mall. The effects of the national recession in 1990-91 were muted, to a degree, by a surge in construction employment related to capital projects at the Port of Longview and the Norpac paper mill. Nevertheless, the recession did cause a downward blip in total employment. Another construction surge began in 1993 following Weyerhaeuser's decision to rebuild its pulp mill. Since the recession of the early 1990's, growth has been moderate and consistent.

For the most part employment changes in Wahkiakum, Cowlitz, and Washington have been affected by the same forces and have moved in similar patterns. However, Wahkiakum County with its extremely small employment base (820 nonagricultural workers in 2000) has been more susceptible to wide fluctuations. The mid-1980's was particularly hard on the County;

every year between 1979 and 1987 there were net losses. Conversely the mid-1990's were a time of very high job growth in Wahkiakum.

An issue in most economies today is the ongoing transition from goods-to services-producing industries (goods-producing industries include manufacturing, construction, and mining). Wahkiakum and Cowlitz counties are no exception to this. As recently as 1976, employment in goods-producing industries exceeded that of services-producing industries in the two counties combined. However, since then service-based industries have grown more rapidly, and by 2000 there were more than twice as many service employees.

2.2.2 Lewis

Summary

After several years of economic distress in the first half of the 80's, primarily associated with cutbacks in the timber industry, Lewis County began to show fairly consistent positive growth. From 1986 to 1997, nonagricultural jobs and the civilian labor force averaged annual increases of 3.1 and 3.4 percent, respectively. Since 1995, the two largest industry divisions, trades and services, grew by 13 and eight percent, respectively, while the combined construction and mining divisions increased 4.5 percent. On the other hand, manufacturing lost 460 jobs in 1998, and declined by 8.2 percent between 1995 and 1999. Further, the County average wage of 1999 has increased by 11 percent since it bottomed out in 1990.

The unemployment rate decreased from 11 percent in 1993 to 8.2 percent in 1999. Unemployment, while low by the County's standards, nevertheless idled about 2,500 workers in 1999 and the 8.2 percent rate is significantly higher than the State's 4.7 percent. Population and migration growth were strong from 1995 to 1997, but have since slowed down. The annual population growth rate decreased from 2.4 percent in 1997 to zero growth in 2000.

When looking at industry divisions the Lewis County economy appears adequately diverse. On a closer look, one observes that several of the divisions are unusually dominated by one industry. For example, about 30 percent of construction and mining employment is in coal mining; 42 percent of agriculture employment is in forestry; 60 percent of manufacturing employment is in lumber and wood products; and 50 percent of transportation and public utility employment is in trucking and warehousing. The latter three are heavily influence by the timber industry.

Though the economy is improving, there remain serious problems. The average wage of $25,362 lags the statewide average by about $10,000. Per capita and household incomes are also considerably less than the statewide figures. It should be noted, though, that the State's figures are heavily influenced by the high tech and aerospace industries of King and Snohomish counties. If King County is taken out of the average wage calculation for the State it goes down to $24,711 in 1999.

Lewis County does have some comparative advantages. The West Coast's primary north-south conduit, Interstate 5, cuts directly through the County, and Highway 12 gives good access to eastern Washington. The principal cities, Centralia and Chehalis, are about equidistant from the major markets and deep-water ports of Seattle-Tacoma and Portland-Vancouver. A major deepwater port is only minutes away in Olympia. Land and wage costs are lower than those of major employment centers in Washington, the cost of living is relatively low, and there is a readily available labor force. Port areas in Centralia and Chehalis have also recently been certified as Foreign Trade Zone (FTZ) sites which should give a boost to trade and manufacturing in the area.

The establishment of the large factory outlet mall in Centralia has also been a boon to the employment situation in the area and the coal mine and coal-fired steam plant continue to contribute heavily to the County's economy providing a large number of relatively high paying jobs. TransAlta Canada purchased both the plant and the mine in June 2000. TransAlta is spending $200 million in new scrubber technology for the plant, as well as investing another $100 million into the mine for boosting production. TransAlta also plans to invest $210 million to build a new 248 megawatt (MW) gas-fired, combined cycle power plant at Centralia Power Plant site.

Geography

Lewis County, located in the southwest part of Washington State, touches eight other Washington counties. To the north are Grays Harbor, Thurston, and Pierce; east is Yakima; south is Skamania, Cowlitz, and Wahkiakum; and west is Pacific County. Its boundaries are purely political creations except for that portion of the northern boundary which briefly parallels the Nisqually River, and the entire eastern boundary which tracks along the crest of the Cascade Mountains. Lewis is the largest county in western Washington; it covers 2,452 square miles, is rectangular in shape, and measures about 90 miles (east to west) by 25 miles (north to south). The elevation in Lewis County varies widely. The broad, relatively flat and low-lying western section of the County gives way to the rugged Cascade Mountains in the east. In the Centralia-Chehalis area, for example, the elevation is about 185 feet above sea level; to the east, around White Pass, a popular skiing area, it goes above 5,000 feet. Old Snowy Mountain, near the Cascade Crest, reaches 7,950 feet—the highest point in Lewis County.

About three-fourths of the County is rugged, mountainous, and forested. The remainder is given over to, or suitable for, agriculture and is characterized by low rolling hills interspersed with rivers and tributaries. Significant rivers include the Cowlitz, Chehalis, and Newaukum. The Cowlitz is particularly important because of its fish runs and hydroelectric production. Mayfield and Riffe lakes, both man-made reservoirs, are the largest bodies of water in Lewis County and are situated in the central part of the County.

The major population centers of Chehalis and Centralia, in the western central region of the County, are located on the flood plains of the Chehalis River and its tributaries, including the Skookumchuck and Newaukum rivers. This area's topography ranges from gently rolling uplands to hilly uplands and terraces with elevations from 100 to 1,000 feet.

Beneath the surface of the land in Lewis County are varied quantities of mineral deposits and significant amounts of coal in some areas. The County contains portions of the Snoqualmie and Gifford Pinchot National Forests and Mt. Rainier National Park (Mt. Rainier is about 10 miles from Lewis' northeastern boundary). Approximately one-third of Lewis County is designated as national forest.

The mountainous eastern portion of the County tends to protect the western areas from icy temperatures; the Pacific Ocean to the west also serves as a moderating influence on the weather. Consequently, the climate of the more heavily populated areas is generally moderate with warm dry summers, long rainy winters, and few extremes to disturb the norm.

Population Trends

The population of Lewis County increased tenfold from 45,467 in 1970 to 69,000 in 2000. The annual average growth rate during these thirty years was 1.4 percent, compared to 1.8 percent average growth for the State. Throughout the 1970's, Lewis County grew an average of 2.1 percent per year, with an all time high of 4.7 percent growth in 1980. In comparison the statewide average population growth rate was only 1.9 percent. Population growth then virtually stagnated at a 0.3 percent average from 1981 to 1987. The recessionary years of the early-1980's drove down the County's growth rate (the County lost population in 1983 and 1985). Statewide growth was also lower (1.3 percent) but not nearly to the same degree.

From 1988 through 1997 the average annual growth rate was 1.8 percent. Statewide average growth for the same period was 2.2 percent. Most recently the growth rate in Lewis County has been at a stagnate 0.3 percent annual average from 1998 to 2000.

Components of population change such as births, deaths, and migration can provide insight into larger population trends. From 1990 to 2000 the population of Lewis County increased by 9,642. Eighty-one percent of this growth was due to migration. This is very high compared to the statewide share of growth due to migration, which was 59 percent. Lewis County ranked 13th in terms of the percentage of population growth due to migration. Annual migration was fairly high from 1991 to 1997, with a peak of over 1,700 persons in 1995. Migration has most recently tapered off to between 350 and 400 persons in 1998 and 1999. It may be that Lewis County is becoming a "magnet" of sorts for retirees, in particular former state employees, who are looking for a nice piece of land and, to a lesser extent, folks trying to "flee" urbanization in Thurston County.

Employment Trends

Since the "double-dip" recessions of the early 1980's, which brought down the County's employment to 17,300 in 1982, nonfarm employment in Lewis County has increased every year except for 1991 and 1998. Since 1983, job growth has averaged 2.2 percent annually hitting an all-time high of 25,120 in 1997 and then declining to 24,970 in 1999. The average growth rate for this time period at the state level was 3.1 percent. Although Lewis County tends to follow the State trend, the peaks and valleys tend to be higher and lower for Lewis County compared to the State. The annual job growth rate climbed from -1.0 percent in 1985 to an all time high of 7.3 percent in 1989. The growth rate then declined to -1.2 percent in 1991 before gradually increasing to a new peak of 4.7 percent in 1994. The job growth rate then steadily declined to -1.6 percent in 1998. The 1999 growth rate improved to 1.1 percent. The negative growth rates in both 1991 and 1998 were due predominately to jobs lost in the construction and mining, and manufacturing sectors. On the other hand, the high growth rate in 1994 was due to more jobs in trade (450), manufacturing (340), government (170) and services (130).

The labor force figures discussed earlier showed Lewis County employment in 1999 to be 31,020. The nonfarm figures above showed there were 24,970 jobs in the County. Aside from agricultural workers (about 1,000) and the self-employed who are included in the total, the difference can largely be attributed to commuting. (The labor force numbers are based on residence, i.e., those who live in Lewis County, regardless of where they work. The nonfarm numbers are based on workplace location.)

A good number of workers residing in Lewis County commute to workplaces outside the County. According to the 1990 Census, about 3,500 residents of Lewis County worked elsewhere. The largest number, some 1,750, worked in Thurston County. About 600 worked in Cowlitz County, and Pierce and King counties also had fair numbers of commuters. These are substantial numbers: if the ratio from 1990 still holds, some 15 percent of the County's employed persons—over 4,000 workers—commute to work outside the County and bring their paychecks back into the County.

With the sale of the Centralia steam plant and mine in 2000 a strong resurgence is underway in operation of that facility. Over $200 million in new pollution control equipment expenditures means the mining/power plant employment base seems secure for the long term. In addition to the coal burning plant, there has been a recent announcement (March 2001) that Chehalis Power Ltd. signed an agreement with the State to build a 520-megawatt plant in Chehalis.

2.2.3 Clark

Summary

Clark County was the fastest growing county in Washington for most of the 1990's. In the 10-year period ending in 1999, Clark County averaged 4.1 percent growth per year in both population and nonagricultural employment. The cumulative increase in each category was almost 50 percent. Employment growth reached 6.5 percent in 1993, and peaked at 7.3 percent in 1994. Unemployment hovered around four percent through the latter half of the decade.

Two forces drove this long expansion. First was new investment, especially in high-technology manufacturing. Corporations such as Hewlett-Packard, SEH, Wafertech, AVX/Kyocera, Sharp Microelectronics, Matsushita, and Linear Technology helped prolong the boom. Even accounting for setbacks, there was substantial net gain in employment in electronics and computer peripherals. The second driver of Clark County's expansion was population in-migration. The County is part of the greater Portland metropolitan area, and took part in the region's strong economic growth during the 1990's. One-third of the County's labor force commutes across the Columbia River to Portland every day. The County attracted more than its share of new residents to the region due to its available land, lower property taxes, lower housing costs, and good schools. During the first half of the decade, much of the influx came from California, which was then suffering from high unemployment. One feature of the population boom was the annexation of a number of unincorporated areas into the City of Vancouver in order to improve the provision of urban services. As a result, the city's population tripled and Vancouver became the fourth-largest city in the State. Rapid population growth was accompanied by the expansion of consumer-related industries such as retail trade, banking, insurance, real estate, health care, and social services. However, many corporate-related services, such as law offices, management consulting, engineering, and architects, remained concentrated in the core Portland area.

Beginning in 1997, the Clark County economy began to cool off. The California exodus had evaporated as that state's economy recovered. The sharp decline in many Asian economies, and the cooling off of demand for computer-related products, had a disproportionate impact on the Pacific Northwest, and especially affected Japanese owned local companies like Sharp Microelectronics. A number of other unlinked retrenchments also occurred during this period.

Along with Hewlett-Packard's transfer of manufacturing jobs was the closure of Jantzen's clothing operation, and the shift of the regional Farmers Insurance processing center back to Portland. GST, a locally based fiber optic carrier, declared bankruptcy and was sold in 1999, losing half its employment in the transition. The closure of the Vanalco aluminum smelter at the beginning of 2001 added to the toll. What lies ahead for the County is partly dependent upon its unique location. Clark County is part of the Portland metro area, but is only linked through two interstate bridges, which are quickly approaching capacity. Because of its role as a suburban county, it has a higher proportion of its property developed for residential uses, as opposed to commercial or industrial. Further, the State sales tax and the lack of the sales tax in Oregon mean that the County only has two-thirds of the State per capita taxable sales, as many residents shop just over the border to avoid the tax. These factored together mean that the County has a relatively lower tax base to draw from for infrastructure and basic services, such as roads, schools, and parks. Another structural issue is the County's low Medicare reimbursement rate (ironically due to previous efficiency in health care costs), which has made it difficult to recruit new physicians. Clark County should continue to be the home for more high-tech expansion in the future—possibly onsite at Wafertech, at the Columbia Tech Center, and at the Ridgefield junction.

Geography

Topography. Clark County, in southwestern Washington, is one of the smaller counties in the State with a total land mass of 628 square miles (405,760 acres). It is 35th in size among the 39 Washington counties. The County is part of the geologic depression stretching from the Willamette Valley to Puget Sound. It is bounded to the south and west by the Columbia River, which separates it from the State of Oregon. To its north is the Lewis River, which separates it from Cowlitz County. And to its east is the Cascade Range and Skamania County. The County rises from low elevations along the Columbia through the terraces and bench lands formed by previous forks of the river to foothills 3,000 feet above sea level in the northeastern reaches of the County. The East Fork of the Lewis River flows east to west through the middle of the County, while the Washougal River and Lacamas Creek flow through the southeast portion before emptying into the Columbia.

Climate. Local climate is influenced by several factors—its proximity to the Pacific Ocean, its location between the coast and the Cascades, and its rising elevation from the southwest to the northeast. The result is generally mild weather with fairly wet winters. Rainfall runs from 41 inches a year in Vancouver to 125 inches a year in Cougar.

Land Use. Land use patterns include heavy urban development in the southern third of the County, rural and agricultural land in the western and central parts of the County, and forest lands in the northern and eastern parts of the County. Much of the better farmland, located along the flood plain of the Columbia, has or is being converted to urban uses.

Watershed. At least 90 percent of the County's water comes from groundwater (as opposed to surface reservoirs) with wells operating throughout the County. The most plentiful source of water is the aquifer running beneath the Columbia River; wells along the river have virtually no recharge problem. Inland wells have a more limited supply and in some cases are drawing water faster than can be replaced. The entire County water supply may one day be integrated, drawing mainly from the Columbia aquifer.

Population Trends

During the 1990's, Clark County has been the fastest growing county in the State. According to the Census Bureau, Clark County is among the nation's 50 fastest-growing counties in terms of net population increase. The County averaged 3.9 percent annual growth between 1990 and 2000, exceeding the statewide average of 1.2 percent. Clark County has grown 45 percent from 1990 to 2000, outpacing all counties and the statewide 21 percent growth. Over the same period, population growth in the County peaked at 5.2 percent in 1990 and declined to 2.3 percent in 2000. Population growth has slowed for a number of reasons during the past two years. Economic growth in the entire Portland metro area slowed due to the Asian economic crisis and slower growth in high technology markets. Also, the recovery of the California economy from a slump earlier in the decade lessened the number of in-migrants from that state. Even with the slowdown, the County's annual average rate of growth going from 1970 to 2000 has been 3.4 percent, much higher than the State average of 1.8 percent over the same period.

Two things cause population change. One is natural change: births and deaths. Only major socioeconomic occurrences alter the pattern of natural change (both the Great Depression and the aftermath of World War II resulted in significant changes in the nation's birth rate). The second cause of population change is migration, which can give insight into an area's current economic trend. The migration trend is quite revealing in Clark County. From 1990 to 2000, Clark County gained 106,947 residents. Of that number, 25,622 were the result of natural population increase (45,509) births and 19,887 deaths) and 81,325 were the result of net in-migration.

The changes in Clark County's population are due primarily to in-migration, which is the difference between the number of people moving into and the number of people moving out of the County. This migratory element has generally followed cyclical patterns. In the 1980's in-migration tapered off during the 1980-82 recession and growth rates were actually lower than the national average during the mid-1980's. In the 1990's, in-migration expanded rapidly, adding 84,291 residents to the County between 1990 and 1999. This is 247 percent more than all of the 1980's added together. Clark County attracted more than its share of new residents to the region due to its available land, lower housing costs, and good schools.

Employment Trends

Clark County's nonagricultural employment rose at an average of 4.5 percent over the 1970-2000 period, growing from 32,610 to 117,200. The growth has considerably outpaced the State, where nonfarm jobs grew by a rapid, but much lower, average rate of 3.2 percent. For most of that period, job creation in the County exceeded the statewide rate, except for the years affected by the national recessions of the early 1970's, 1980's, and 1990's.

Two forces drove this long expansion: new high-technology investment and population in-migration. The big industry sectors behind the boost in employment were construction, retail trade, and services, all of which have grown at an annual average rate of 4.4 percent since 1970. Clark County's employment base has changed from manufacturing and government (almost 60 percent of all jobs in 1970) to one dominated by retail trade and services (almost 50 percent of all jobs in 1999). From 1999 to 2000 the country averaged four percent growth per year, outpacing the State's 2.6 percent annualized growth.

In recent years, however, a slowdown in Clark County's nonagricultural employment growth occurred. The County's annual average growth rates of 2.7 percent in 1998 and 1.2 percent in 1999 fell behind the State's 3.2 percent and 1.8 percent, respectively. The decline was a result of slower population growth along with several company closures and/or physical transfer of operation centers either out of state or out of the country.

2.2.4 Skamania

Summary

For decades, Skamania County's economy rested on timber—directly, through logging and milling; and indirectly, through U.S. Forest Service employment. Ninety percent of the County is forestland, and 80 percent of the County is part of the Gifford Pinchot National Forest. Geography and politics have greatly influenced the Skamania County economy.

Timber-related employment began to decline in the 1980's, dropping from 820 in 1979 to 620 in 1988. Harvest restrictions were placed on federal lands. Local timber supply was limited. Log prices rose. In early 1992, scarce timber and competition from chipboard substitutes led to the closure of Stevenson Co-Ply, the largest mill remaining in the County. Because the mill was a co-op, the job loss was accompanied by loss of savings. By 1993, only 180 timber jobs remained in Skamania. In 1996, timber harvest from federal lands dropped from an average of 250 million board feet to less than five million. That same year, federal employment fell from a peak of 420 to only 240 workers.

While most of Skamania is in forested, mountainous terrain, the bottom strip of the County borders the Columbia Gorge. The Columbia Gorge has influenced the County economy in two major ways: (1) In the 1978-82 period, construction of a second powerhouse at the Bonneville Dam boosted County construction employment, chiefly through construction workers commuting into the County. This, however, had the unfortunate side effect of skewing County labor force estimates in the 1980-89 period. Through the use of a faulty commuting ratio, the labor force size was underestimated and the unemployment rate overestimated. After the 1990 Census, the adjustment factor was corrected. (2) In 1986, the creation of the Columbia Gorge National Scenic Area (NSA) helped augment the County's growing tourism industry. Around 15 percent of the County was made part of the NSA, with some restrictions placed on the development in the Gorge area.

Federal subsidies helped build the Skamania Lodge, a conference center and destination resort that opened in 1993 and is now the largest private sector employer in the County. An interpretive museum is now in operation and other retail and service spin-offs have come on line. In addition, a number of manufacturing jobs related to windsurfing have been created.

Skamania County's transition from timber to tourism has had a number of effects. In 1990, population and labor force growth began picking up. Almost half of the Skamania labor force commutes to work outside the County because of fewer job opportunities. With the Stevenson Co-Ply mill closure in 1992, unemployment rose sharply, reaching 18 percent before declining to nine percent in 2000. One-third of the jobs in the County used to be in manufacturing. By 1996, the manufacturing employment numbers had fallen below 15 percent. With the advent of the Skamania Lodge in 1993, trade and service employment rose from a 19 percent to a 35 percent share of the County employment in 2000. Government or public sector, which is the County's largest employer, accounted for a 40 percent share of the County employment in 2000.

The annual average wage for jobs in Skamania County has fallen steadily over the past two decades—with the exception of the powerhouse construction years and the latter years of the 1990's. In 2000, the County's annual average wage was $25,512. In comparison, inflation adjusted wages in the early 1970's were in the $30,000 range. Per capita personal income (PCPI) in Skamania County has not declined mainly because of increases in investment income and government transfer payments. The County's PCPI at $21,702 in 2000 was 24 percent below the State average.

Skamania Lodge, the resort destination and conference center that opened in Stevenson in 1993, is in the midst of a major $15 million expansion. An addition of 35,000 square feet of meeting space and an increase in the number of rooms from 195 to 254 is boosting not only future employment but also other tourism related industries in the area. Other resorts and lodging establishments are expected to expand in the area. Through indirect job creation, the coming years in Skamania County is expected to bring an expansion to tourism and tourist-related businesses in the area. A modest growth in the County population and employment is expected to occur. Skamania County foresees a continuance of a significant share of its labor force (currently at 55 percent) commuting to jobs outside the County—to its neighboring counties of Clark and Klickitat as well as to its neighboring state of Oregon.

Geography

Because Skamania County is bisected north and south by the Cascade Mountain Range, it is alternatively viewed as being part of eastern or western Washington. Skamania is also the southernmost county in the State. It is bounded by Lewis County to the north, Cowlitz and Clark counties to the west, Yakima and Klickitat counties to the east, and Oregon and the Columbia River to the south. Skamania County constitutes a geographic area of 1,657 square miles and ranks 24th in size among Washington 39 counties in 2000.

Skamania County is dominated by mountainous, rugged and heavily forested terrain. Approximately 80 percent of the County's land area is comprised of the Gifford Pinchot National Forest and the Mount St. Helens National Volcanic Monument. The County's central feature is the 8,365-foot Mount St. Helens, the most active volcano in the continental United States. Located in the County's northwest sector, the volcano's 1980 eruption devastated the surrounding area and spewed ash throughout the northwest and beyond. Off the Pacific Crest Trail, which runs north and south through the County, are some of the region's highest elevations. These include Sunrise Peak (5,880 feet), Council Bluff (5,163 feet), Steamboat Mountain (5,425 feet) and Lookout Mountain (5,692 feet).

Rivers. Skamania County has several major tributaries. The Washougal and Wind rivers, located in the lower half of the County, carry runoff south to the Columbia River. The Lewis River, in mid-County, flows through the Swift Creek dam and reservoir before continuing west to the Columbia River. The Columbia River is considered one of the country's most scenic rivers as it passes along the County's southern border.

Climate. Skamania County enjoys a mild but variable climate. Rainfall and temperature figures grow drier and warmer as one travels from west to east.

Population Trends

For the period 1970-2001, the population in Skamania County grew 69.4 percent, going from 5,845 to 9,900. By comparison, the State's population increased by 75.1 percent during the same period. Of this growth, most occurred during the years 1976-80 and from 1988 onward. Most of the 1980's was a period of no growth to slow growth. The differences in the rates were generally linked to national economic activity. Severe recessions in the early and mid-1970's and early 1980's put stoppers on population growth in Skamania County. Since 1988, the population growth has not been spectacular, but it has been strong and steady due to a positive net migration. The most recent 1990-91 national recession did not seem to have any adverse effect on the County's population. Overall for the 1970-2001 period, the County's growth was slightly behind the State: 1.7 percent versus 1.8 percent annualized growth. From 1996 to 2001, the County and the State's annualized growth rate both went lower: 1.2 percent and 1.4 percent, respectively, due to lower rates of in-migration.

Employment Trends

Skamania County's nonfarm employment grew from 1,610 in 1970 to 2,070 in 2000. Nonagricultural employment grew substantially through the 1970's, culminating in a large 1980 construction peak. There were 3,360 jobs in that year. After that boom, employment fell off to its previous level. With minor fluctuations, employment remained at that level through the decade. The downturn in 1992 was centered in manufacturing, with the closure of the Stevenson Co-Ply Plywood Mill. The opening of the Skamania Lodge in 1993 drove the recovery following that.

Nonfarm employment growth in the County to the State from 1970 to 2000 indicates the County's 29 percent increase was quite low compared to the 152 percent growth experienced on a statewide basis. This increase translated into a County annualized average growth of 0.8 percent. During the same period, the State was at a greater 3.1 percent. From 1996 to 2000, Skamania County's nonagricultural employment growth averaged 1.8 percent; the State's, 3.0 percent. More recently the number of County jobs increased from 2,030 in 1999 to 2,070 in 2000, a 2.0 percent increase compared to the statewide 2.8 percent. The data differ from the labor force data presented earlier. The number of nonfarm jobs is only a portion of the total labor force numbers. Nonagricultural employment numbers are derived from surveys of establishments located in Skamania County. The labor force data are based on individual residence in the County, regardless of where the employing establishment is located. A large number of Skamania County residents work outside the County. In 2000, more than half (nearly 55 percent) of employed County residents worked outside the County, mainly in the neighboring counties of Clark and Klickitat as well as in the neighboring state of Oregon.

The major changes have been the growing share of transfer and investment income and the increase in the "other industries' section in these counties, both causing a reduction in the relative importance of the natural resource based industries.

2.3 OUTLOOK FOR REGION ECONOMIES

Communities in the Pacific Northwest and elsewhere are undergoing significant social and economic transition as traditional industries decline, new industries emerge, and population ages and expands with the flow of migrants from inland areas. Long term decreases in the overall supply of timber have led to rapid downturns in the wood products industries. Likewise, the importance of commercial fishing has been reduced due to decreases in available fishery stocks' abundances and declining real prices. Industries benefiting from tourism and retirement have been expanding, leading to diversification in communities having visitor attractions. Many communities have chosen to take advantage of these trends by focusing on developing their tourism and other service industries as traditional natural resource based industries decline.

The following is a discussion of some global, national, and regional trends that may affect southwest Washington communities' economic growth.[1] The discussion is included to provide a larger view of social and economic forces that affect southwest Washington communities.

2.3.1 National and International Trends in Natural Resources Use

The world experienced some substantial economic growth during the last 20 years due to a relatively peaceful period and integration of technologies in most economies. This has brought about integration of the economies of developed and developing countries. The result of this integration is better markets for some products and increased competition for others, especially natural resource commodities. Increased supply and aquaculture substitutes for natural resource commodities (products from agriculture, timber, and marine based industries) have created downward price pressure on products that are the mainstay of developing countries.

As the world economy slowed, additional demand pressures are affecting these commodities. Following the unusual high growth up to 2000 at around 4.7 percent, world economic output started contracting significantly after late 2000 (Food and Agriculture Organization of the United Nations, 2002). The global economic slowdown negatively affected international trade and commodity markets. International commodity prices, which were already weak, suffered further downward pressures caused by the economic downturn. Non-fuel primary commodities suffered an overall decline of an estimated five to six percent starting in 2001.

Some of these trends may be reversing. The demand for wood products related to the Iraq war and the strong growth of the Chinese economy has resulted in what may be short-term upward pressures on commodity prices. In addition, the devaluation of the U.S. dollar in terms of the Euro and the yen has decreased the downward price pressures for commodities. Most commodity prices are expected to increase in the short term. The long-term effect will depend on the status of the Chinese economy and to some extent the stability of the dollar to other major currencies.

It's always tempting to take short-term occurrences and predict long term trends. However, both the long-term increase in supply due to increase in technology and productivity, and the slow increase in effective demand points to no expectation of long-term real price

1. The discussion references several important studies and quotes from the studies are liberally repeated. Care was taken to make sure interpretations of the quotes are within the context of authors' conclusions.

increases for natural resource commodities. The following is a brief discussion of expectations for prices for the major natural resources produced in southwest Washington economies.

Timber

Timber supply and demand is determined by interactions of global, national, regional, and local consumers, producers, and landowners. International trade in forest products increased during the periods of global trade expansion. For example, global production of solid wood products (which includes sawn wood and wood based panel) increased up to 2000, rising by 1.7 percent to a level of 610 million cubic meters. The increase in production was attributable to the developed countries, where production increased by 2.6 percent. Overall, global output of pulp and paper products continued to show strong growth, with an increase of 3.2 percent in 2000.

The most important change in timber production is in the composition of product consumption. In the U.S., for example, per capita consumption of solid wood products has fallen, while per capita fiber consumption has increased 45 percent throughout the past four decades. Recent research suggests that per capita wood product consumption will decline over the next 50 years. There will be less reliance on solid wood products manufactured from logs and greater reliance on engineered and reconstituted products for structural applications (Haynes and Horne 1997). Greater use of recycled fiber will also decrease the demand for timber.

Recent increases in retail prices for lumber, especially plywood, due to the Iraq war and construction taking advantage of low interest rates, may mask this long-term trend. However, the long-term trend for lower returns on timber are being anticipated by the larger timberland owning companies in the Northwest. According to Gary Lettman, economist for Oregon Department of Forestry (2004), many of the larger companies are selling their timberlands based on expectations of low returns to their investments in timber lands in the Pacific Northwest.

As the plantation production of the 1950's and 1960's in areas such as South America and New Zealand begins to emerge into the global market, the most optimistic assumption is that in the long term prices will stabilize. The more pessimistic forecasts call for a decrease in forest product prices in the medium term. An exception may be specialty products produced in the Pacific Northwest from cedar or alder: cedar for decorative products and alder for cabinetry.

Agriculture

In 1918, the German chemist Fritz Haber won a Nobel Prize for the process of turning air into nitrogen fertilizer (National Public Radio, 2002). Without this innovation, the Earth would not have been able to support its increasing population. Today, fertilizer factories pour out 100 million tons of nitrogen each year, and an estimated two billion people depend on the process to help grow the food they eat. This process, coupled with other technologies and marketing strategies helped some regions experience strong increases in output.

Viewed in the longer-term context, annual agricultural production growth over the last five years averaged 1.7 percent, compared with 2.1 percent over the preceding five-year period and 2.5 percent in the 1980's. The declining trend in agricultural output growth in Asia is largely attributable to China, where the growth rates are tapering off. In Eastern Europe, a strong increase of 11 percent in grain production helped depress prices of wheat and other commodities.

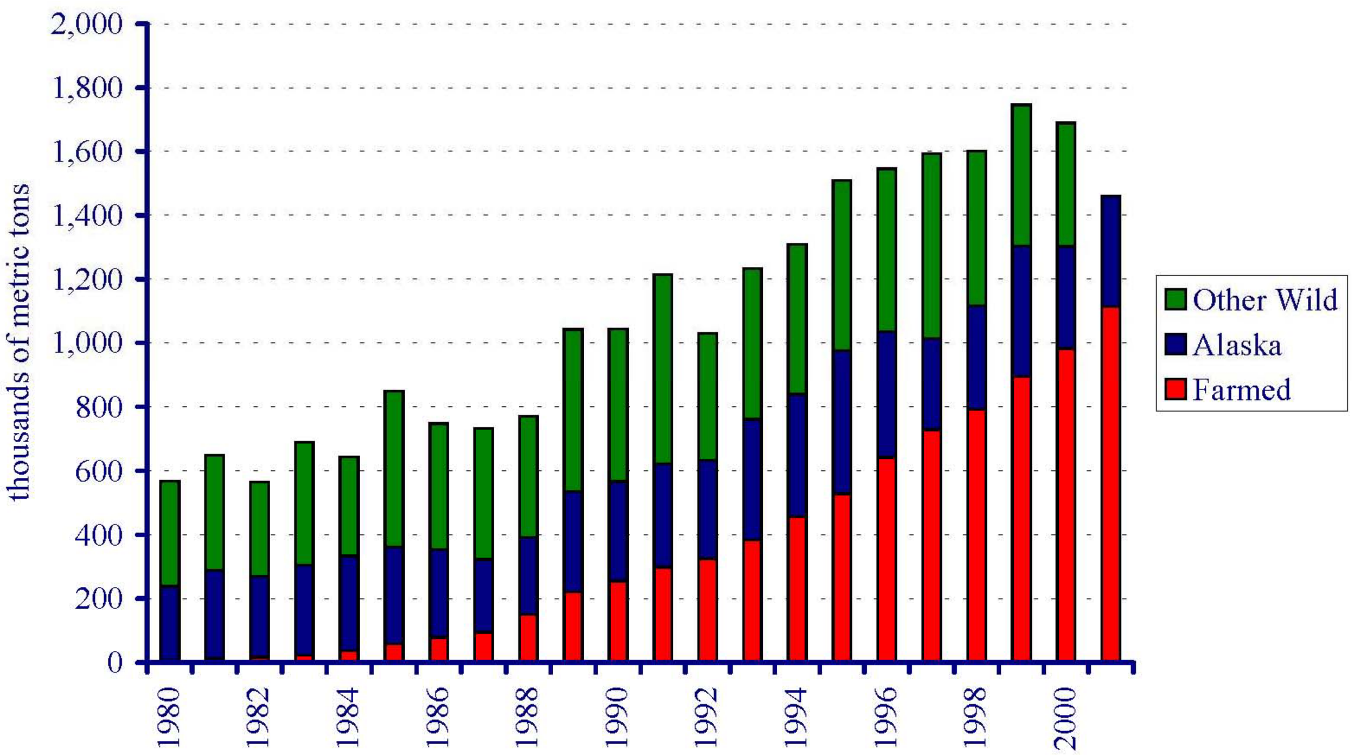
The developed countries are faced with large subsidies for agricultural producers, while the developing countries face low subsidized world agricultural prices as they are searching to join world markets with their agricultural production. The prospect for agriculture is at best constant, inflation adjusted prices. Desmound O'Rourke (2004) painted an especially pessimistic picture of eastern Washington agriculture production and prices. Much of this production is heavily dependent on water availability, has relatively high labor costs, and is very much interconnected to worldwide demand for its products and is especially vulnerable to emerging Chinese competitors.

Commercial Fisheries

For the two decades following 1950, world marine and inland capture fisheries production increased on average by as much as six percent per year, trebling from 18 million metric tons in 1950 to 56 million metric tons in 1969 (Food and Agriculture Organization of the United Nations, 2000). During the 1970's and 1980's, the average rate of increase declined to two percent per year, falling to almost zero in the 1990's.

This leveling off of the total catch follows the general trend of most of the world's fishing areas, which have apparently reached their maximum potential for capture fisheries production, with the majority of stocks being fully exploited. It is therefore very unlikely that substantial increases in total catch will be obtained. In contrast, growth in aquaculture production has shown the opposite tendency. Starting from an insignificant total production, inland and marine aquaculture production grew by about five percent per year between 1950 and 1969 and by about eight percent per year during the 1970's and 1980's, and it has increased further to 10 percent per year since 1990 (Figure I.7).

Figure I.7
World Capture Fisheries and Aquaculture Production



Source: ISER, University of Alaska.

The global patterns of fish production owe much to the activities of China, which reports production in weight that accounts for 32 percent of the world total. Other major producer countries are Japan, India, the United States, the Russian Federation, and Indonesia (Food and Agriculture Organization of the United Nations, 2000).

Total aquaculture production reveals the enormous potential of this source of food towards food security and poverty alleviation, if the environmental impacts and other issues of sustainability relating to aquaculture facilities and to aquaculture production receive sufficient attention.

For captured fish, the number of under exploited and moderately exploited fisheries resources continues to decline slightly and, as fishing pressure increases, the number of fully exploited stocks remains relatively stable, while the number of overexploited, depleted, and recovering stocks is increasing slightly. Indices that were developed to monitor changes on marine ecosystems suggest that ecosystems may be shifting away from the under exploited state, giving cause for concern that continued heavy fishing may lead to more widespread changes.

Rivers, lakes, and wetlands account for less than one percent of the global surface area, but yield at least eight percent of global fisheries production. However, these productive ecosystems are under pressure from the needs of a growing human population. The World Resources Institute reported that half of the world's wetlands were lost in the last century and that dams, diversions, and canals fragmented almost 60 percent of the world's largest rivers. Per capita water consumption increased by 50 percent between 1950 and 1990, and human use of available water resources is expected to increase from its current level of about 54 percent to more than 70 percent by 2025.

Even though there is a concern about the long-term sustainability of capture fisheries and water demands of aquaculture, the short to medium term expectations are that increased production will sustain downward pressures on seafood production. From a production point of view, there are dozens of promising species being farmed or under development. Tilapia, catfish, cod, halibut, red drum, cobia, black cod, and various species of bass, bream, and snapper all have attributes that make them candidates (Forster 2002). For example, a recent report from the University of Washington (Huppert and Best 2004) notes, "... a significant expansion in sablefish supply through aquaculture developments could flood the market, force prices down..."

Tourism

Demand for natural resource based recreation is based on available time and disposable income. The trend in developed countries is slower population growth and a shift toward older and wealthier populations. In the U.S., for example, population is expected to continue to grow, albeit at a declining rate, over the next 50 years. The population will become older, more affluent, more educated, and more racially and culturally diverse. The gross national product is expected to grow at an average rate of 2.7 percent over the next half century, and growth in per capita disposable income is expected to increase in line with general aging (Table I.2).

Population growth and the proportion of that population having a degree of affluence are the most significant factors to increase in recreation activity. The significant population increases expected for the Pacific Northwest and the rest of the U.S. over the next 50 years are a harbinger that major increases in recreation outdoor activity will occur.

Table I.2
United States Population, Gross National Product, and
Income Between 1929 and 1994 and Projections to 2040

	Population		Gross National Product		Disposable Personal Income		Per Capita Disposable Personal Income	
Year	Millions	Annual rate of change	Billion 1982 dollars	Annual rate of change	Billion 1982 dollars	Annual rate of change	1982 dollars	Annual rate of change
1929	121.8	--	709.6	--	498.6	--	4,091	--
1933	125.7	0.8	498.5	-8.4	370.8	-7.3	2,950	-7.8
1940	132.1	0.8	772.9	7.9	530.7	6.2	4,017	5.4
1945	139.9	1.1	1,354.8	-1.9	739.5	-1.3	5,285	-2.4
1950	151.7	1.7	1,203.7	8.5	791.8	7.1	5,220	6.2
1955	165.3	1.8	1,494.9	5.6	944.5	5.6	5,714	3.8
1960	180.8	2.1	1,665.3	2.2	1,091.1	2.2	6,036	0.1
1965	194.3	1.3	2,087.6	5.8	1,365.7	5.8	7,027	4.5
1970	205.1	1.2	2,416.2	-0.3	1,668.1	4.3	8,134	3.1
1975	216.0	1.0	2,865.0	-1.3	1,931.7	1.9	8,944	0.9
1976	218.0	0.9	2,826.7	5.3	2,001.0	3.6	9,175	2.6
1977	220.3	1.0	2,958.6	4.7	2,066.6	3.3	9,381	2.2
1978	222.6	1.1	3,115.2	5.3	2,167.1	4.9	9,735	3.8
1979	225.1	1.1	3,192.4	2.5	2,202.6	2.1	9,829	1.0
1980	227.7	1.2	3,187.1	-0.2	2,214.3	0.1	9,723	1.1
1981	230.1	1.0	3,248.8	1.9	2,248.6	1.5	9,773	0.5
1982	232.4	1.0	3,166.0	-2.5	2,261.5	0.6	9,732	-0.4
1983	234.8	1.0	3,279.1	3.6	2,331.9	3.1	9,930	2.0
1984	237.1	0.9	3,501.4	6.8	2,469.8	5.9	10,419	4.9
1985	239.3	1.0	3,607.5	3.0	2,542.2	2.9	10,622	1.9
1986	241.6	1.0	3,713.3	2.9	2,645.1	4.0	10,947	3.1
1987	243.9	1.0	3,804.4	2.5	2,704.0	2.2	11,134	1.7
1988	246.3	1.0	3,954.2	3.9	2,798.3	3.5	11,418	2.6
1989	248.8	1.0	4,054.2	2.5	2,848.1	1.8	11,512	0.8
1990	251.5	1.1	4,103.9	1.2	2,897.1	1.7	11,591	0.7
1991	252.7	0.5	4,079.0	0.1	2,908.6	0.4	11,510	0.1
1992	255.5	1.1	4,172.6	2.3	2,998.7	3.1	11,737	2.0
1993	258.1	1.0	4,302.7	3.1	3,044.8	1.5	11,788	0.4
1994	260.6	1.0	4,476.8	4.0	3,152.7	3.5	12,080	2.5
				Projections				
2000	272.0	0.8	5,383	2.6	3,580.7	2.1	13,164	1.4
2010	291.0	0.7	7,031	2.7	4,503.0	2.3	15,474	1.6
2020	307.0	0.5	9,166	2.7	5,697.7	2.4	18,559	1.8
2030	318.0	0.4	11,957	2.7	7,259.5	2.5	22,829	2.1
2040	327.0	0.3	15,627	2.7	9,313.3	2.5	28,481	2.2

Source: Haynes and Horne (1997).

Age structure influences recreation activity in that older people tend to travel farther for recreation, stay in developed campgrounds, and stay longer than young people. Older age groups will tend to be more educated than people in those age groups today, suggesting their participation rates in active outdoor recreation will be higher. As more people travel to the Pacific Northwest for vacations, recreation will become an increasingly important export of economies.

Especially important is the expected increased demand for natural resource based recreation facilities and services throughout the northwestern U.S. A large part of the attractiveness of the region for both residents and visitors is the quantity and variety of recreation facilities and opportunities.

2.3.2 Effects of Natural Resource Use Trends on Southwest Washington Communities

Increased technological input in natural resource production is increasing output of traditional natural resource commodities. Chemical fertilizers have changed the capacity of limited land and water resources to produce agricultural commodities. Engineering advances are increasing the capability to harvest timber in areas that were formerly inaccessible. At the same time, the growth of plantation forests is producing fiber that is utilized in engineered wood products, and increased recycling and electronic communication is decreasing the demand for low quality pulpwood. In fisheries, as new harvesting technologies are used to fully utilize most fisheries, a growing number of fish stocks are placed in the over fished status. The high prices of some species in the late 1980's encouraged aquaculture in species such as salmon and shrimp. Aquaculture produced output is now the determining factor in prices of fishery products.

In the short to medium term the technological advances have increased world production and reduced real prices for most natural resource commodities. In the longer term, the byproducts of this increased production will have some predictable consequences. Increased nitrogen run-off will result in higher ecosystem costs, such as algae clogged waters. Increased plantation timber production will affect diversity of timber areas. Water resources are the most likely to be most affected by increased aquaculture production. Additional pollution and the threat of chemical and disease contamination will have to be addressed. The southwest Washington areas are an attractant for future residents and visitors, because of the relative abundance of natural resources. These are a comparative advantage at present to draw visitors and will become a greater attractant as other areas in the world and in the U.S. become more developed. The challenge will be for the southwest Washington areas to protect this comparative advantage while at the same time keeping pace in economic development.

2.3.3 Lessons Learned From the West's Growth and Dependence on Natural Resources

The economic growth of the West was highly dependent on the availability of cheap or free natural resources. For most of the 19th century the emphasis on public land management was simply to move land from federal to private ownership. During this time American politicians viewed the federal lands as a vast resource to be settled and exploited. Driving economic interests during the disposal period were fur trading, transportation, homesteading, agriculture, mining, fishing, and forest use (Lynch and Larrabee 1992).

For example, the post-WWII housing boom, predictions of long term demand for timber and shortage of private timber resulted in federal policies that allowed twice as much federal timber to be cut between 1950 and 1966 as had been cut in the 45 years before the war. Since the 1960's, demands for sustainable use of natural resources, particularly federal forest lands, led to acts such as the Multiple Use Sustained-Yield Act of 1960.

Wilderness enthusiasts and others sought to put recreation on equal footing with extractive uses, while traditional users -- timber operators, ranchers, and miners -- all argued for greater allocation to their particular needs. As extractive uses are curtailed, communities argue for resumption of traditional use for the economic benefits. There are however some studies that question the "good old days" belief.

A study by Power and Barrett (2001) describes the changes in the West as once-important natural resource industries declined dramatically in terms of jobs and incomes. Since these industries - mining and metal processing, logging and lumber products, and agriculture - historically supported European settlement and are widely believed still to be the economic lifeblood of the region's rural areas and small cities, their decline has provoked deep economic anxiety: the fear that large parts of the region will become depressed and its residents will be forced to move elsewhere.

Power and Barrett summarize that despite these fears, changing industrial structure has not triggered a decline in the region or an overall loss of jobs, income, or residents. On the contrary, as industrial transformation has proceeded, in-migration, employment, and aggregate real income (the total dollar income received by all residents, adjusted for inflation) have boomed. During the last half of the twentieth century, the Mountain West was the fastest growing multi-state region of the United States. During this period, only one region, the coastal states of the Pacific West, seriously challenged this lead, and during the 1990's the Mountain West grew twice as fast as this previously close competitor. Power and Barrett conclude that environmental protection, rather than threatening economic well-being, enhances welfare and protects the very source of the economic vitality the Mountain West enjoys.

In this transition, as total personal income grew, per capita income may not increase at the same rate. This may be a result of national demographic and lifestyle trends more than an indicator of economic well-being. Although falling pay per job signals an erosion of earning opportunities, it nevertheless overstates how badly workers and their families are doing. This is true for a variety of reasons. One is that as more of the population joins the work force, the decline in pay per job may be the result of a growing preference among workers for part-time employment. Another is that holding more than one job, workers can increase their earnings as individuals, even if each job pays less. Additionally, income per capita rose steadily because non-employment income rose. The increase in the number of part-time workers during the 1980's and 1990's should not be seen as a sign of deteriorating job market. About nine of every 10 workers working part-time say they do so by choice.

Power and Barrett conclude by advocating several public policy alternatives for economic development of the rural West. These are:

- Public policy makers must recognize that local government cannot manipulate local pay and income by subsidizing job creation.

- Local economic policy should focus on enhancing the ability of existing residents to earn a decent living rather than trolling for additional employers with tax breaks or other subsidies.
- Public policy should stay focused on the present and the future rather than on some folktale version of the past.
- Local economic policy should treat the community's site specific characteristics, both public services and the quality of the natural and social environments, as important determinants of both citizen well-being and local economic vitality. This makes those public goods an important part of the local economic base.

A study by ECO Northwest (1999) concludes "the sky did not fall." A judicial injunction in 1991 and related events reduced timber harvests in Oregon and Washington from a peak level of 15.7 billion board feet (bbf) in 1988 to 8.3 bbf in 1996. The reduction in logging triggered widespread fear of economic catastrophe. These dire predictions, however, did not materialize. Instead of collapsing, the region's economy expanded. While timber harvests fell 86 percent on federal lands and 47 percent overall from their peak 1988 to 1996, employment in the lumber and wood products industry fell 22 percent. In contrast, total employment in the region rose 27 percent.

ECO Northwest cites several reasons for the diminishing importance of logging in the region's economy. Some of these are:

- Lumber and wood products employment had been steadily decreasing in the Pacific Northwest.
- The lumber and wood products industry represents a small component, about 1.9 percent of total employment in 1996, of the Pacific Northwest economy.
- Analysts have known for several decades that the timber industry has been liquidating the stock of timber at rates so high that the logging levels had to go down.
- Before 1991 the timber industry exported more than three bbf of logs annually, or about one-fourth of all logs cut in the region. As the Asian economies cooled, log exports dropped by half, as the industry diverted logs to domestic mills.
- Although most trees grow in rural areas, the bulk of the lumber and wood products industry is located in or near the metropolitan areas, where the timber industry plays a relatively small role.

ECO Northwest then concludes that unlogged forests have become more important to the economy. The vitality of the region's economy depends in no small part on the health and vitality of its forests. Many firms locate in the Pacific Northwest because it has a good workforce and many workers, in turn, are here because they cherish the quality of life. Residents of the region derive numerous services from healthy forests. The services constitute, in effect, a "second paycheck" that complements the "first paycheck" they derive from their place of employment and pension programs.

Several policy implications for economic development are advanced by this study. They are:

- States with the best economic performance typically have the highest environmental quality.
- States with the most stringent actions to protect threatened and endangered species typically have the best economic performance.
- Counties with scenic and natural resource amenities typically exhibit stronger economic performance, in terms of jobs and incomes, than counties with concentrations of extractive industries.
- Counties adjacent to wilderness typically exhibit stronger economic performance, measured in jobs and incomes, than others.

Taken together, the ECO study concludes that logging reductions on federal lands in the Pacific Northwest are an integral part of, and not an impediment to, the region's economic evolution.

2.3.4 Expected Social and Economic Changes

Social Changes

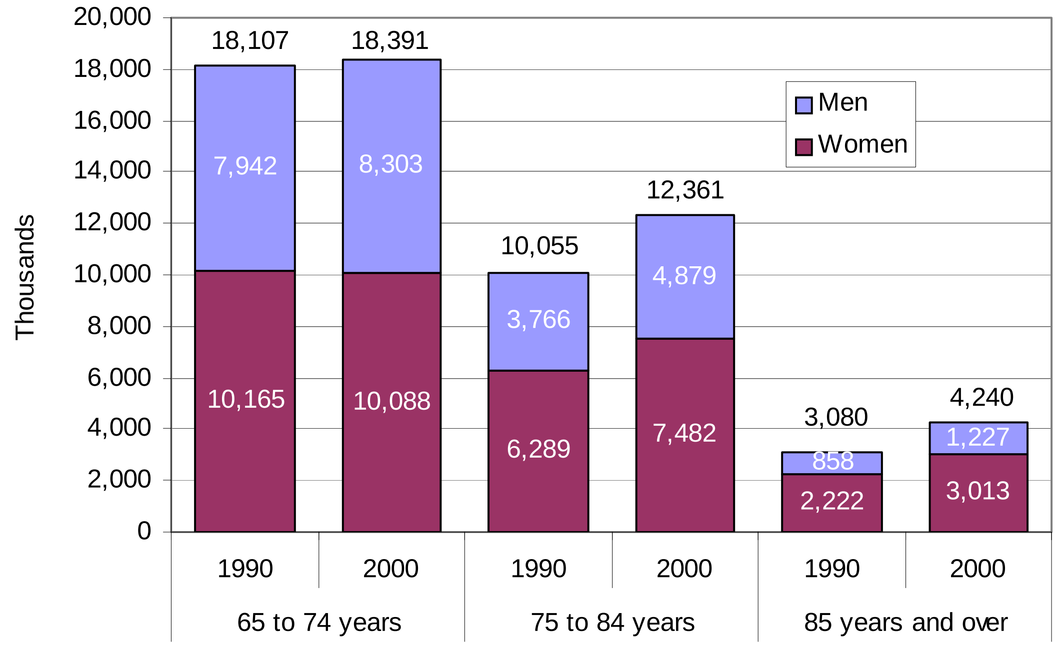
Parts of the global population are growing at or close to three percent per annum. In other parts, population growth is either flat or increasing at a low rate. Most of the larger growth rates are taking place in underdeveloped or developing countries. The countries that have low growth rates tend to be the economically developed areas. This creates a dilemma for world trade. The effective demand for natural resource commodities will not increase with population increase. Also, the shift toward lower growth rates and older population in the developed countries will also reduce the demand of commodity goods and increase the demands for free time goods and other services.

In 2000, 35 million people 65 years of age and over were counted in the United States. This represents a 12 percent increase since 1990, when 31.2 million older people were counted (Figure I.8) (U.S. Census Bureau 2001). The change in Oregon and Washington mirrored the national trend. Oregon went from 391,324 (13.8 percent total) to 438,177 (12.8 percent total) or 12.0 percent increase. Washington went from 575,288 (11.8 percent total) to 662,148 (11.2 percent total) or 15.1 percent increase.

The changing population base (global, U.S., and statewide) will influence every aspect of the southwest Washington communities. It will affect such areas as the composition and quality of the work force, social and health care needs, education, and housing.

The Pacific Northwest rural population has fluctuated in response to business cycles. There was significant increase in population in the 1970's and again in the 1990's. However, during the natural resource recession of the 1980's, there was a loss of population. The sudden downturn in the economy of 2001 and 2002 has not translated into negative population growth rates (Oregon Department of Administrative Services 2002).

Figure I.8
U.S. Population 65 Years and Over by Age and Sex in 1990 and 2000



Source: U.S. Census Bureau (2001).

For the next 10 years, the elderly population will continue to increase steadily, but not dramatically. The older members of the baby boom will be nearing 60, and the youngest members will just have passed age 40. Then, from the years 2010 through 2030, growth will virtually halt for any age group other than the elderly. By the Year 2020, the U.S. will have nearly as many people over 60 as under 20 years of age. Furthermore, the size of the elderly population will be at least two and a half times the size of the elderly population in 1980 (Hanus 1988).

The principal cause of the aging of the American population is the decline in fertility. Many demographers believe that fertility levels will remain low and could drop further. The entrance of large numbers of women into the work force, together with modern contraceptives, has afforded women the choice to be more financially independent and to control their fertility.

The labor force will be shaped primarily by three factors: the aging of the baby boomers, the shortage of entry level workers due to the low birth rates, and the influx of women into the work force. Due to the scarcity of educated entry level workers, employers will face increased costs of upgrading prospective hires through training and development, and producing compensation and career development packages to attract the best talent. Basic educational competency and literacy will become ever more important. For children, this may mean much greater emphasis on early childhood education. Among early entrants into the job market and for the existing work force, it will mean lifelong training and retraining.

A greater proportion of women in the work force will mean that programs geared toward assisting their needs will be required. Childcare, flexible work rules, pensions that accommodate absences for pregnancy leave, job sharing, and special training will be considered. Adult day care will become necessary since fewer women will be home to take care of aging parents.

The Oregon Employment Department's Research Section periodically projects occupational trends for the State. These projections are a result of a three-year employer survey of occupational staffing patterns and economic analysis of industrial employment levels as well as employment patterns. The projected growth in payroll employment from 2000 to 2010 is 18.2 percent. Some of the 730 occupations listed are expected to grow much more quickly, some much more slowly, and yet others to decline. A summary of the projections shows that most of the natural resource based occupations that are on the Oregon Coast are forecast to decline, while service producing sectors account for most of the increase (Figure I.9) (Slater 2002).

For Washington, the new job creation is projected to be strongest in the professional, technical, and service fields (Washington State Office of Financial Management 2000). Overall, the projected growth rates for the State's occupational sectors are consistent with those on the industry side, confirming that the State's economy will continue to shift toward service-producing activities.

Figure I.9
Oregon Occupational Projections

Summary of the Oregon projections:

- 200,000 new jobs in the next 10 years.
- Every industry will add jobs.
- Overall growth rate much slower than the most recent 10 years.
- Service-producing sector accounts for 94% of the new jobs.
- But ... manufacturing and construction both growing.
- Out of more than 50 "major" industries, only nine are projected to lose jobs: lumber, primary metals, federal government, food processing, apparel, paper products, textiles, leather, and rubber/plastics.
- Every occupational group will add jobs.
- Professional/technical adding the most (high-wage).
- Out of more than 700 occupations, almost 150 are projected to decline in employment.

Source: Slater (2002).

Economic Changes

Natural resource extractions have provided fairly steady employment in periods of strong U.S. economic growth. However, declines in natural resources available for harvests and declines in prices have reduced the total employment of these sectors. Global supply/demand changes have decreased the real prices offered for these commodities. Shifting demographic factors are increasing the demand for service jobs that support the tourist and retiree industries.

The following contains a summary description of the expected changes in the study area's natural resource industries due to the global and national influences.

Timber

The economies of many Pacific Northwest communities were constructed on harvesting historical inventory of timber (mostly Douglas fir). Inventory harvesting gave way to plantation management. Falling prices for timber and plantation management costs are affecting decisions for harvests.

Timber companies are placing large tracts of forestland on the market because of stockholders pressure to increase company returns. At investment requirements of about seven percent, timber will provide prudent returns if harvesting takes place under 40 years of age. Or, as was anticipated for many years, the real price of timber increases by one to three percent per year. The outlook for lumber and fiber products at the global level does not support these price projections. In addition, the plantation style forests in southwest Washington communities are facing diseases, such as Swiss needle cast, and a possibly devastating "Sudden Oak Death" disease (Cole 2002).

Timber that is harvested tends to be processed in several central manufacturing centers distant from the harvesting sites that have been upgraded and retooled for plantation logs. Milling used to occur close to cutting, but transportation costs as compared to milling capital costs have declined. Many factories cannot afford to have stranded investments and will haul logs long distances for processing. Consequently, lumber and wood products employment has declined much more dramatically due to productivity increases and the geographical concentration of milling centers.

Agriculture

The southwest Washington communities produce a diversity of crops and livestock. This includes vegetables, hay, raspberries, livestock, dairy cattle, broilers, and nursery and horticultural crops. Some communities have been very successful in marketing premium products.

Commercial Fisheries

The decline of available fish and fish prices has been well documented. The Magnuson-Stevens Act of 1976 provided for expansion of the American fishing fleet and the "fishing down to maximum sustainable yield" has been accomplished. The viability of Oregon and Washington's commercial fishing industry will be dependent on the ability to make more with less. Competing directly with fish produced in other countries or by aquaculture does not provide an opportunity for a stable southwest Washington fishing fleet. Any seafood development projects will have to include "niche" marketing that sells the cultural and environmental values provided by the Pacific Ocean waters. This is especially true of the harvest of salmon produced in the Columbia Basin. Viewed as a commodity, the future for prices of salmon is bleak. But viewed as a resource that may be sold based on cultural or health attributes, the prices received could be increased. However, this will depend on a strong marketing campaign.

Appendix D, Chapter 3
Economic Analysis Methods

3.0 ECONOMIC ANALYSIS METHODS

An economic analysis of the integrated regional strategy's recovery actions is needed for several reasons:

- If economic returns is paramount in selecting actions to implement, then a decision maker needs to know if benefits will exceed costs. A national perspective is usually used to calculate the net economic value.
- The economic effects resulting from the recovery actions should have some equitable spread across stakeholders. Sometimes economic impacts (measured by personal income or jobs saved/created) to stakeholder groups, like an industry sector within a certain geographic area, are used for this measurement. Stakeholders can also be defined to be the general public (Lewis 1995).
- Limited funding usually means actions have to be ranked and packaged for the order of implementation so as not to exceed available stipends. Net economic value and/or regional economic impact can be used as the basis for the ranking.
- Economic analysis can provide a common measure to help decision makers determine whether a tradeoff between one use (hydropower for example) might produce different economic effects for another use (recreation activity for example). The common measure can be impacts to the resource being used, like increased or decreased juvenile salmon mortality. Such an analysis can singularly look at only costs and biological outcomes without regard to dollar benefits. This type of examination is referred to as cost-effectiveness analysis.

Determining the benefits and costs from changes to natural resources is problematic, but for the above reasons is useful. For the example of rectifying declining salmon and steelhead populations, strategies for rebuilding the populations will be intrusive on the many human activities that are causing the problems. Urban development that has altered habitat, interruption of stream flows for dams, methods used in timber harvesting, and even fish hatchery practices that were supposed to mitigate for problems will all require attention. Understanding the economics for the changes from such widespread and divergent solutions will have to consider all of the human activity to be altered for the fixes.

The economic benefits from salmonid related recovery actions can be significant, but there will be costs too. ECO Northwest (1999) outlines the general characteristics of these costs:

- Many changes will entail doing things differently, but will have few costs. Affected firms, households, and agencies will be able to plan for the changes, phased in over time, and adopt salmon-friendly technologies, products, and services, with little or no costs.
- Many costs can be attenuated. For example, some foresters believe the potential reductions in timber-sale revenues from salmon-related restrictions on logging can be largely offset by changing forest-management practices (Lippke et al. 1999).
- Many costs can be spread out. For example, federal conservation programs can compensate farmers for reductions in sales when they take streamside land out of production (Ringer 1998).

- Few workers will be adversely affected. Job losses probably will be smaller than those to which the PNW successfully adjusted during the 1990's.
- Most workers will adapt fairly easily. If recent trends hold, about 50 percent of displaced workers would find replacement jobs in two months or less, and 55 percent of those reemployed would have equal or higher wages than before (Hipple 1999). Unemployment insurance, job retraining, and similar programs are available for those needing temporary help.
- The alternative may be even more costly. The costs of keeping salmon perched on the edge of extinction can be enormous (Friends of the Earth 1998). In the long run, especially, it almost certainly will be cheaper to rebuild healthy salmon populations and craft an economy that is salmon-friendly.

Polls have shown Pacific Northwest residents are willing to pay $30 to $97 per household per year to finance such costs (Washington Department of Fish and Wildlife 1996). However, such polls can be suspect and analytical approaches should be used to evaluate the recovery actions on a project-by-project basis.

The analytical approach will be different, depending on how the information will be used and the recovery actions' purposes. It will be necessary to measure the net economic value (NEV) at the national level if there is a federal perspective on action benefits and costs. NEV implies there is an efficient outcome that will occur when the sum of the benefits outweigh the sum of the costs. An analytical problem occurs when there are no value measurements for the benefits.[1] Dollar values can usually be garnered for the active use of the natural resource, such

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1. Most economic analysis will be incomplete because not all changes in long range values, nonfinancial values, and external costs are addressed. Long range value changes are those that can be expected to occur after a plan's actions are absorbed. (When these future changes are included, the revenue or costs streams are reduced to annual net present values in order for them to be used in the analysis. The choice of the discount rate to use in calculating net present value is controversial [Hanley and Spash 1993].) Because of the uncertainty in knowing these adjustments, analysts generally assume the change in the short term will approximate what happens over the course of the long term. Short term value changes are the immediate gains or losses to be expected to occur if the status quo is changed.

   Impacts on national, state, and local economies are analyzed only in terms of dollar flows. Economic values can also be nonfinancial (no market information exists), as well as financial (prices exist from markets where traded goods are for well-defined property rights that are exclusive, transferable, and enforceable [Panayotou 1992]). For example, people (termed non-users) who do not actually fish for salmonids will still place a value on the existence of the resource. Deriving this value must rely on expressed preference (either real or hypothetical) information. Because of lack of budget resources to do a more comprehensive analysis, the values of the non-users are generally not included. Those values can play a significant role in determining future programs related to the management of a natural resource and should be a criteria in any policymaking.

   Nonmarket values include livability considerations, and livability is becoming more important as Pacific Northwest economies mature. Economies are becoming dependent upon high-technology industries, industries that require a highly educated, highly skilled workforce. There is no doubt that one of the competitive advantages for an action is livability relative to other areas. It will not be necessary to pay premium compensation for a degraded environment or for overcrowding. Scenic and productive river basins can play an important role in drawing the major components of economic growth: capital and a highly skilled work force.

as for consumptive activities like timber harvesting, and on-site and off-site fishing. Getting dollar values for non-consumptive activities like hiking is harder because the users have to be asked or indirect methodologies used to determine their willingness-to-pay for the resource. It even becomes more difficult to determine the passive use of a resource. Both active and passive use values should be included in the NEV equation.[1] Where economic effects measured by jobs or household income in local economies is important to show that different stakeholders are benefiting from project actions, then a regional economic impact (REI) approach to the economic analysis needs to be completed. When it is of importance to know the cheapest action or set of actions to accomplish biological objectives (like a one percent increase in juvenile salmonid survival during downstream passage), then a cost-effectiveness analysis (CEA) is the economic analysis approach.

The following sections provide a non-expert description of these approaches. The description uses the example of benefits from increasing adult salmonid returns, because that is the underlying goal of the integrated regional strategy. However, many of the actions have other types of benefits, such as for water quality, flood control, and non-fishing recreation opportunities. These other aspects of environmental quality could sometimes serve equally as well for examples.

3.1 NET ECONOMIC VALUE

NEV attempts to measure the benefits received less costs for using a resource. In general, benefits are measured by willingness to pay and costs by opportunity costs. Opportunity costs reflect the foregone benefits from the use of a resource. There can be active use of a resource where consumption as well as non-consumption takes place and there can be passive use of the resource. Passive use can be thought of as non-use. The economic values to "non-users" are from existence values (knowledge of continual existence of the resource), bequest values (preserving the resource for future generations), or option values (users having the option to use the resource in the future). The non-users can be people who live near the resource as well as people who don't actually visit the Pacific Northwest.

The following sections discuss how NEV may be calculated when related to effects from on-site (within the subbasin plan's region) or off-site (other areas where the anadromous fish that are produced or are passing through the subbasin plan's region) recreational and commercial

All external costs are also not usually evaluated. Prices of products or services sold in the open market often do not reflect all the costs of making the product or providing the service. External costs are passed on to others in society, often in the form of dirty air, polluted water, or less biodiversity. External costs are difficult to identify and hard to quantify, but they can significantly decrease the value to society of commodity production. Although it would not be easy to allocate these costs to resource management plan strategies, they could make up a significant part of the costs of producing commodity outputs and should be evaluated along with market and nonmarket values.

1. A dollar value is only one of many ways to describe the "worth" of some resource or service. Wild origin salmon provides an excellent example of this concept. A biologist may say that the worth of the native fish are their genetic contribution to the survival of the species. An angler may say that the worth of the native fish is in their challenge and fight, and the sense of accomplishment at having landed one. A nutritionist may find no difference in the worth of native and hatchery fish, both providing the same calories, protein, etc. All of these people would be describing some aspect of the value of native fish, but none would be describing the dollar value.

fishing. A third section below discusses the non-user passive use values. The economic value classification scheme for use and non-use of a resource is shown in Figure II.1.

3.1.1 Recreational Fishing

The recreational fishing economic values are related to the act of fishing. A fishing act is generally defined as an activity carried out on a per trip or per day basis. The estimated values per day for anadromous fish fishing are listed in Table II.1. The values are from various other studies brought together to establish comparable levels for what people would be willing to pay for the fishing experience. Researchers refer to the method of relating values in one fishery and setting to another as a benefit transfer approach. Each recreational fishing experience may create its own value based on the species, geographic area fished, and other variables. The value may or may not be similar to another experience. A review of studies in the Pacific Northwest supported the estimate of $52 per day as a general guideline for the NEV from the recreational fishing experience for salmonids.[1]

3.1.2 Commercial Fishing

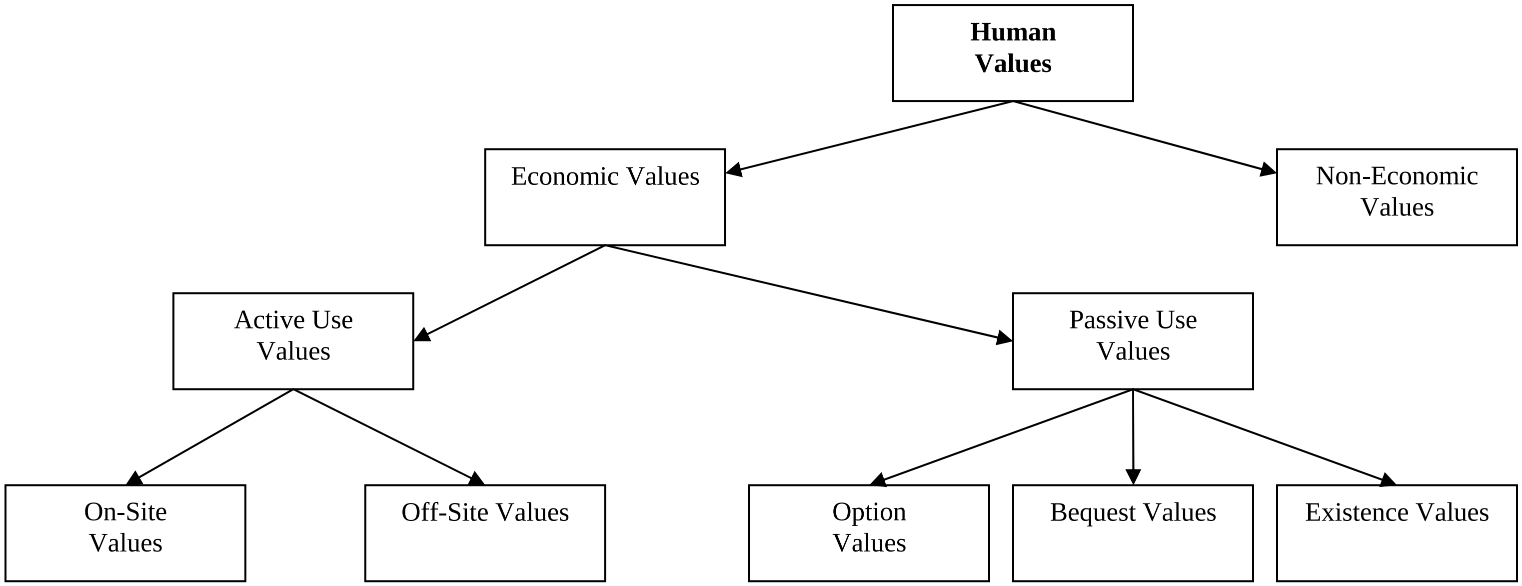
To compute the NEV from commercial fishing, the costs of harvest (fuel, repairs, labor, etc.) should be subtracted from the gross revenues. Because the fishing season is of short duration, most fishing boats are not limited to salmon fishing. The investment in boat and gear is also used for other fisheries. Also, at low levels of total salmon harvest and with small incremental changes in salmon production, it is often argued that any increased harvest could be taken with almost the same amount of labor, fuel, ice, etc. as before. Since the current fisheries (both the harvesting sector and processing sector) are greatly overcapitalized, in use of fixed and operating capital as well as labor, this is a plausible assumption. This assumption implies that almost no additional costs are involved and gross benefits are close to net benefits.

Generally, any valuation of salmon species involves a geographic area and a salmon species for which there are many substitutes. In such cases, the demand curve is relatively flat. That is, if consumers are faced with a rise in the price of one type of salmon in one area, they will simply shift their consumption to an alternative salmon product. In such cases, there are no extra benefits that could be counted resulting from consumers' willingness to pay different prices for a specific salmon product. Therefore, most economic valuations involving salmon will center on the benefits that a producer receives from the harvesting and processing of salmon.

The assumption of full employment is implicit in most benefit and cost analysis. But unemployment and excess fishing capacity, both transitory and chronic, seem to prevail in many Pacific communities dependent on commercial fishing. Changes in markets or fishing opportunities may make it necessary for people and capital to change occupations and/or locations. Various factors make it difficult for this to happen quickly enough to prevent a period of unemployment and idle capacity.

1. See Radtke et. al. (1999) for the review of these studies.

Figure II.1
Economic Value Classification Schematic



Source: Adapted from Bergstrom and Loomis (1994).

Table II.1
Anadromous Fish Net Economic Value and Regional Economic Impacts Modeling Factors

	Commercial Per Fish		Recreational Per Day		Days	Recreational Per Fish	
	REI	NEV	REI	NEV	Per Fish	REI	NEV
Species: Coho							
Ocean							
Alaska	21.29	10.20	60.00	51.43	1.00	60.00	51.43
British Columbia	18.15	8.70	60.00	51.43	1.00	60.00	51.43
Washington ocean	12.49	5.99	60.00	51.43	1.00	60.00	51.43
Washington Puget Sound	16.90	8.67	60.00	51.43	1.00	60.00	51.43
Oregon	17.43	9.17	60.00	51.43	1.00	60.00	51.43
California	20.65	9.35	60.00	51.43	1.00	60.00	51.43
Columbia Basin inland							
Freshwater sport							
Mainstem	--	--	60.00	51.43	1.00	60.00	51.43
Tributary	--	--	60.00	51.43	1.00	60.00	51.43
Gillnet	15.15	8.99	--	--		--	--
Tribal	15.15	8.99	--	--		--	--
Other	--	--	--	--		--	--
Hatchery surplus market	11.94	7.28	--	--		--	--
Hatchery carcass	2.00	1.23	--	--		--	--
Species: Spring/Summer Chinook							
Ocean							
Alaska	69.15	33.83	60.00	51.43	1.00	60.00	51.43
British Columbia	69.99	34.30	60.00	51.43	1.00	60.00	51.43
Washington ocean	48.31	23.68	60.00	51.43	1.00	60.00	51.43
Washington Puget Sound	41.22	21.19	60.00	51.43	1.00	60.00	51.43
Oregon	42.05	21.65	60.00	51.43	1.00	60.00	51.43
California	--	--	60.00	51.43	1.00	60.00	51.43
Columbia Basin inland							
Freshwater sport							
Mainstem	--	--	60.00	51.43	2.00	120.00	102.86
Tributary	--	--	60.00	63.23	2.00	120.00	126.46
Gillnet	98.59	49.95	--	--		--	--
Tribal	98.59	49.95	--	--		--	--
Other	--	--	--	--		--	--
Hatchery surplus market	49.12	26.87	--	--		--	--
Hatchery carcass	2.00	1.23	--	--		--	--
Species: Fall Chinook							
Ocean							
Alaska	69.15	33.83	60.00	51.43	1.00	60.00	51.43
British Columbia	69.99	34.30	60.00	51.43	1.00	60.00	51.43
Washington ocean	48.31	23.68	60.00	51.43	1.00	60.00	51.43
Washington Puget Sound	41.22	21.19	60.00	51.43	1.00	60.00	51.43
Oregon	42.05	21.65	60.00	51.43	1.00	60.00	51.43
California	53.80	22.53	60.00	51.43	1.00	60.00	51.43
Columbia Basin inland							
Freshwater sport							
Mainstem	--	--	60.00	51.43	1.50	90.00	77.15
Tributary	--	--	60.00	63.23	2.00	120.00	126.46
Gillnet	41.22	23.53	--	--		--	--
Tribal	41.22	23.53	--	--		--	--
Other	--	--	--	--		--	--
Hatchery surplus market	29.75	18.25	--	--		--	--
Hatchery carcass	2.00	1.23	--	--		--	--
Species: Summer/Winter Steelhead							
Ocean							
Alaska	--	--	60.00	52.85	1.00	60.00	52.85
British Columbia	22.28	11.44	--	--		--	--
Washington ocean	--	--	--	--		--	--
Washington Puget Sound	--	--	--	--		--	--
Oregon	--	--	60.00	52.85	1.00	60.00	52.85
California	--	--	--	--		--	--
Columbia Basin inland							
Freshwater sport							
Mainstem	--	--	60.00	52.85	2.00	120.00	105.70
Tributary	--	--	60.00	63.23	2.00	120.00	126.46
Gillnet	--	--	--	--		--	--
Tribal	16.89	9.99	--	--		--	--
Other	--	--	--	--		--	--
Hatchery surplus market	14.21	8.73	--	--		--	--
Hatchery carcass	2.00	1.23	--	--		--	--

Notes:
1. Average 1998 dollars per fish. See text for an explanation on how REI and NEV are derived.
2. Hatchery sales include carcass and egg sales.
3. Two days per fish harvested include released wild and retained hatchery fish. For steelhead retained fish only, the CPUE is 0.17 fish per day (or 5.88 days per fish).

Source: Radtke et al. (1999).

The Water Resources Council (1979) suggests that when "idle boats" are available, the only incremental costs of increased harvest will be the operating costs.[1]

Rettig and McCarl (1984) make recommendations on the calculations of commercial fisheries NEV's. Their recommendations range from 50 to 90 percent of ex-vessel prices.[2] Because primary processing is an integral part of producing salmon, a portion of the primary processor margins are also used to calculate the NEV of commercial fishing. Huppert and Fluharty (October 1996) utilized only the harvesting ex-vessel price and concluded that "All of these estimates are at or below the 50 percent net earnings rates suggested by Rettig or McCarl." (Rettig and McCarl 1984). (Processor margin is the difference between their purchase price, ex-vessel price, and their sales price.)

In periods of reductions, the 90 percent rule would be appropriate. However, if the total salmon harvest increases, it might not be appropriate to use the 90 percent level. A more appropriate level might be the 50 percent level (the lower level recommended by Rettig and McCarl (1984)). In a situation where new resources (capital and labor) were needed to harvest and process a greater amount of salmon, the actual additional costs of harvesting and processing would have to be deducted from the ex-vessel price and the processors' margin in order to arrive at the NEV of additional salmon harvest.[3]

Because it is difficult to collect data on the commercial salmon fishing industry for specific areas and specific gears and almost impossible to compare such estimates on a wide geographic and industry basis, a general guidance may be to present information on ex-vessel basis (properly defined so as to be comparable) and on a first level primary processing basis. (This being the minimal amount of processing required to move the fish out of the region - dressing, icing, packing, etc.) The first level processor basis should be used because in many areas tendering costs and other costs and incentives of specific fisheries may not reflect the actual ex-vessel prices. It may also be argued that the first level processing in any area is inseparable from the harvesting component.

A portion of the ex-vessel and ex-processor prices are therefore used as measures to facilitate guidelines in any of net value of commercial salmon fishing. Specific fisheries with acceptable data can be investigated to determine the net value of the fishery. For this analysis, in order not to complicate the presentation, a 70 percent margin is used to represent an "average" NEV for most commercial salmon harvested. The 70 percent margin is applied over a range of annual prices. The remaining 30 percent represents additional expenses of harvesting and primary processing required to produce a consumer product from Columbia River Basin anadromous fish runs.

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1. The estimates of "net value" of tribal harvest may be conservative. This conservative approach may be balanced by assumption of ex-vessel prices that may be received by in-river tribal harvests (Water Resources Council 1979).
2. In many small coastal communities, there are no substitutes for the processor involved in the primary processing of salmon. Much of the salmon is partially processed on board the boat. For these reasons, the harvesting and primary processing is included. Wholesale and retail margins are not included. The basic reason is that demand curve is expected to be flat, thereby no appreciable "surplus." For retailers selling seafood, there are also a host of substitutes available.
3. Chronic underemployment of human and capital resources in rural areas on tribal lands may result in very low incremental costs resulting from increased harvest opportunity. Other studies have suggested that the average cost increase with increased harvest opportunities may be two to nine percent (Barclay and Morley 1977). A two percent cost was utilized by Meyer in the Elwha Study (Meyer et al. 1995).

3.1.3 Passive Use Values

Economic value is very precisely defined as the relative value of a good or service, or what someone would be willing to give up (pay) in exchange for that good or service. This definition describes an anthropocentric view of value, that is, value to people (Goulder and Kennedy 1997). Therefore, for a fishery resource to have economic value, people must be willing to give up other valuable resources (which can be represented by money) in order to have the fishery resource. Clearly this makes economic value a function of peoples' preferences and their ability to pay.

When measuring economic value, it is not necessary to know why people value a resource (e.g. for nutritional reasons, for biological reasons, for recreation reasons), but rather how much they value it relative to other things (Tietenberg 1996). This makes it clear that economics is the appropriate tool when the objective is to allocate scarce resources. (A scarce resource is defined as a resource that people desire and need and of which there is a limited amount. A resource such as air may not fit this definition unless clean air becomes polluted.) For example, if something of value must be given up to save native fish populations, society needs to know whether the native fish are worth more than what must be given up. Information about the biological, nutritional, or recreational value of fish will certainly affect people's willingness to pay for the resource, but the economist does not need to know the motives behind people's willingness to pay in order to make socially efficient resource allocations. The calculation for social efficiency requires information on the total value of resources, that value being the result of many different motives. While recognizing that total value is the goal, there are methodological issues related to the measurement of economic value that have led to a distinction between different types of economic value.

People may value a particular resource such as the fishery because they either use the resource currently, or they intend to use it at some time in the future. Current and future use value can be either direct or indirect. An example of direct use value would be the willingness of anglers to pay for access to the salmon in ocean fisheries. This may be actual price paid, which may be market price or any price that may not signal a "market clearing" price; an angler may be willing to pay more than he is being charged on the market.[1] An example of indirect use value would be the willingness of a reader to pay for a magazine account of a fishing trip to the Pacific Northwest. In both cases, someone had to actually use the site or resource in order for something of value to be produced.

Since the anadromous fish of the Columbia/Snake River Basins contribute to the overall ocean stocks, some of the use value of these fish is actually realized in the ocean fishery. In a sense, there is a derived demand for the habitat of Pacific Northwest rivers since they are an input into the ocean fishery "product."

There are some people who are willing to pay for a resource, even though they never intend to use it. This type of non-use value is called existence value, because people are willing to pay to ensure that a resource exists, knowing that they will never actually use the resource. The motive for existence value may be that people want to ensure that a resource exists for future generations to enjoy. Some economists have separated this type of existence value into a

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1. Panayotou (1992) showed that for ecosystem goods and services, commercial markets fail to adequately capture the true value. Their common property nature prevents formation of efficient markets. The markets that do exist are fraught with imperfections that lead to undervaluation and/or over estimation.

separate category called bequest value, but it is clearly a subset of existence value. Another type of non-use value would be the willingness to pay for future use of the resource or its option price. This price represents the expected value of the future trip (expected consumer surplus), plus (or minus) any "option value." The option value represents any additional (or less) willingness to pay (above expected consumer surplus) for the option of future use, when future use is uncertain. Some have described option value as a kind of insurance premium, to guarantee that the resource will be available when, and if, future use is desired. Economists can argue for even other categories of non-use values, all of which should be considered in decision making.

It is likely that the fishery resources including salmonids provide all of the above types of values to society. The decision about which ones to focus on for measurement is a function of the resource allocation question being asked. For example, if a particular fishery resource is not threatened with extinction, there is no need to measure the existence value of that resource. Since society would not be deciding whether to allocate scarce resources to save the fishery, the existence value is not relevant. If the policy decision under consideration is whether to invest resources to increase the fish populations, then the values which are measured must correspond to only the increase in fish numbers. In other words, total use value would not be the appropriate value to compare with the value of the resources necessary to increase the population by some incremental amount. Given the different types of policy decisions which might be relevant, as well as the fact that the existence of some Pacific Northwest fish populations may be in question, measurement of total and marginal values are likely to be useful to decision makers.

Indicators of the magnitude of passive use values for salmonids can be extracted from literature. Table II.2 shows a compilation of study results.

3.2 REGIONAL ECONOMIC IMPACTS

The NEV of the fishery resource has been defined above as people's willingness to give up resources of value (money) to have the fishery resource. A common mistake that is often made is to include the costs associated with using the fishery resource (e.g. travel costs, lodging costs, equipment) as part of the NEV from the resource. These associated costs, or expenditures, are instead the source of local or REI's associated with use of the fishery.

The NEV must represent the value of the fishery resource itself, and not the value of the related travel and equipment items. For example, suppose the fishery was threatened by a hydropower development and policy makers wanted to know whether the anglers could "buy out" the hydropower interests. All of the money spent on travel and equipment is no longer available to be used to buy out the competing hydropower interests. However, the money that is left over, after all the costs of angling have been paid, is the net willingness to pay (consumer surplus) for the fishery resource (or fishing at the particular site). If extracted, this surplus could, in principle, be used to buy out the hydropower interests.

Table II.2
Passive Use Values Per Unit

A. Forest Use Values

- Rosenberger and Loomis (2001) gathered estimates of recreation values for North America from studies conducted between 1969 and 1998. For the Pacific Coastal region, 82 separate estimates across 22 recreation activities resulted in an average value of about $39 per recreation activity day in 2003 dollars.

- Power and Ruder (2003) cite a study conducted by Oregon State University and the Oregon Department of Forestry (ODF 1996) that estimated recreation use values for Oregon's forests to be about $128.11 per trip in 1992 dollars; adjusting for inflation this amounts to $159 per trip in 2003 dollars.

B. *Sportfishing Values*

1. Direct Use Values

Johnson et al. (1994) reviewed the literature current at the time of their study that reported direct use values for salmon and steelhead. Steelhead estimates ranged from $26 per day to $79 per day, while salmon estimates ranged from $24 per day to $79 per day for river fishing for salmon and $37 per day to $100 per day for ocean sportfishing for salmon.

2. Passive Use Values

Based on the literature, passive use values for a variety of increases in salmon populations ranged from $36 per household to $257 per household (adjusted for inflation to 2003 dollars) (Rosenberger and Loomis 2003). The median value per fish, when taking into consideration the total number of households and total increase in salmon population, was about $2,594 in passive use value per additional fish supplied.

Loomis and White (1996) provide other evidence regarding the magnitude of value estimates for rare and endangered species based on a review of the literature. The following are some of the average value estimates for a variety of species (all estimates are adjusted for inflation to 2003 dollars):

- Northern spotted owls, $89 per household per year;
- Pacific salmon/steelhead, $80 per household per year;
- Gray whales, $33 per household per year; and
- Bald eagles, $31 per household per year.

Some rare and endangered species values were estimated in the form of a one-time payment:

- Bald eagles, $275 per household;
- Humpback whales, $220 per household;
- Gray wolf, $85 per household; and
- Arctic grayling/cutthroat trout, $19 per household.

Notes: 1. The above estimates are dominated by their passive use value component; however, part of these estimates is for an active use value component. In a statistical analysis of the value estimates, Loomis and White found estimated values were higher when visitors to sites for the purpose of viewing the species were sampled as compared with a sample of regional or national households that may or may not have ever viewed the species or may have no intention of ever viewing the species (bequest and existence value expressions).
2. All estimates have been adjusted for inflation to 2003 dollars.

Source: Rosenburger (2004).

Another way to view the difference between NEV and REI is to consider NEV as the net loss to society if the resource were no longer available. Suppose that a specific river fishery were no longer available to anglers, and they had to either fish somewhere else or engage in some other activity. The money spent on travel and equipment would not be lost to the financial economy - in fact it could be spent on travel and equipment or some other commodities in some other location. But the value anglers received from fishing that specific river would be lost. It must be assumed that one river's fishing was preferred over (had greater value than) those of the other rivers or activities, or the anglers wouldn't have chosen the original site in the first place. Their net willingness to pay for the chosen fishery versus other fisheries or activities would be a loss to society. Their expenditures or associated impacts on income or jobs would be a loss to the economy in the vicinity of the preferred river, but would be a gain to some other local economy. REI, therefore, describe the local or regional effects on jobs and income associated with any specific area chosen as the point of interest.

The calculations for REI in this report are in personal income impacts. Corresponding measures for full time equivalent jobs may be developed by assuming the personal income is a person's average wage and salary or proprietors net income. It can be assumed in the Pacific Northwest that $30,000 is a reasonable estimate for a per job factor.

The above example should make it clear why local economies are often more concerned about REI than NEV, especially when the economic values are in the form of consumer surplus. If anglers are willing to pay some amount of money over and above their costs, but don't actually have to pay, the consumers get to take that surplus or value home with them in the form of "unextracted" income. It is not immediately obvious to local businesses that the consumer surplus generated from any specific fishery has any impact on the local economy. On the other hand, money spent on lodging, food, supplies, guides, etc., has a direct impact on local businesses and on personal income in the local area.

It is clear that NEV and REI are two distinct measures, and each is useful for different purposes. NEV's are important if the goal is to allocate society's resources efficiently. REI's are important in assessing the distributional impacts of the different allocation possibilities on the financial economies of areas. It may often be the case that society will want to invest in a less valuable resource because the local area or economy that holds the resource is in need of economic development. Nevertheless, having the information on economic value will tell society how much they are giving up in order to achieve the redistribution of economic activity or development.

Some of the REI may be new to an area, some of these may be considered a transfer from one region or industry to another. This issue is not considered in this study. For example, the expenditures on the NPMP for the sportfishing program may be a transfer from electricity paying consumers in Portland or California to anglers and businesses in eastern Oregon. These are allocation and equity issues and are not addressed.

3.2.1 Input/Output Models

Economic input/output (I/O) models are used to estimate the REI from resource changes or to calculate the contributions of an industry to a regional economy. The basic premise of the I/O framework is that each industry sells its output to other industries and final consumers and in turn purchases goods and services from other industries and primary factors of production. Therefore, the economic performance of each industry can be determined by changes in both final demand and the specific inter-industry relationships.

The models developed for this project utilize one of the best known secondary I/O models available. The U.S. Forest Service has developed a computer system called IMPLAN which can be used to construct county or multi-county I/O models for any region in the U.S.[1] The regional I/O models used by the Forest Service are derived from technical coefficients of a national I/O model and localized estimates of total gross outputs by sectors.[2] IMPLAN adjusts the national level data to fit the economic composition and estimated trade balance of a chosen region. Areas that are any combination of single counties can be constructed using IMPLAN.

The Fishery Economic Assessment Model (FEAM) uses the IMPLAN coefficients to generate the REI from ocean salmon harvests.[3] The FEAM model process is outlined in Figure II.2. Estimates of REI from composite stocks harvested from California to Alaska are determined by the information made available on contributions of Columbia River stocks to the ocean fisheries.

Figure II.2
The Fisheries Economic Assessment Model Process

- Based on IMPLAN
- Build I/O coefficients for fishing related expenditures
- Harvest data
- Primary processing data
- Economic impacts measured by personal income
- Translate to full time job equivalents
- Geographic areas

Source: Study.

In order to analyze the actions, regional input/output models were prepared for the State of Washington, metropolitan Portland/Vancouver area, and individual counties along the lower Columbia River.

1. The IMPLAN model is now being offered for general use by the Minnesota IMPLAN Group (Olson et al. 1993).
2. The available IMPLAN models are generally three to four years behind calendar years. This is due to data availability and the time it takes to prepare the models. Unless very dramatic changes take place in a regional economy, the sector coefficients will not change dramatically from year to year.
3. The FEAM was developed for the West Coast Fisheries Development Foundation by Hans Radtke and William Jensen in 1986.

3.2.2 Regional Economic Impacts Model Application

On the commercial side, representative budgets from the fish harvesting sector and the fish processing sector, as well as a price and cost structure for processing are used to estimate the impacts of changes. On the recreational side, charter operator budgets and recreational fishermen destination expenditures provide the basic data. The individual expenditure categories are used as input into the IMPLAN I/O model to estimate the total community income impacts.

Recreational Fishing Regional Economic Impacts

ODFW sponsored a comprehensive survey to compile information about angler characteristics, expenditures, and preferences of recreational anglers (The Research Group 1991). This study also estimated REI for seven management zones, eight species categories, and four water types. The REI estimates were completed with the same process of disaggregating the IMPLAN model and estimating impacts relating to specific expenditure categories, as is explained for commercial fisheries. This study has been used as the basis for showing the annual economic impacts of West Coast salmon fisheries (PFMC 2004). Assumptions from PFMC model are extended to calculating the impacts from salmon harvested in Alaska and British Columbia.

The REI estimates associated with recreationally-fished ocean salmon are shown in Table II.1. Factors affecting these estimates include the means of fishing, expenditures patterns, and success ratios. (It is assumed there will be legal access to the fish during the time they become available in any specific area.) The REI per salmon/steelhead harvested recreationally varies considerably by geographic area whether a fishing trip was guided or used a boat. Both of these fishing modes have higher expenditures per day than bank fishing, and therefore have higher REI.

Since estimating procedures usually start with catch numbers and REI's are based on expenditures per angler day, per day catch success rate is an important assumption. For ocean fishing, one fish per day success rates are used. This may range widely, depending upon area and species. Within the Columbia Basin, the success rates vary from species to species and by geographic area. Carter (1999) utilizes a one fish per day success rate for ocean fishing and up to two days per fish success rates for inland fishing. For tributaries above the Columbia/Snake confluence, two days per non-retained fish success rates are utilized (Bowler, July 1999). For steelhead retained, the fish per day success rate is 5.88 days.

Commercial Fishing Regional Economic Impacts

Representative budgets from the fish harvesting sector and the fish processing sector, as well as price and cost for processing are used to estimate the REI from commercial salmon fishing. The commercial salmon fisheries budget data are from the FEAM.

REI by species and geographic region used in this report are listed in Table II.1. For example, gillnet-caught fall bright Chinook command $1.50 per pound. The yield on this dressed fish, when it is marketed fresh, is 80 percent. The sales price for the primary product for the fisherman is $2.94 per pound. The community income received from this one pound is $2.86; people in the State outside the local area, that supply goods or services to local area, will receive another $0.50, for a total of $3.36. The total state income generated by one pound of salmon harvested and processed in the Pacific Northwest is $3.36. The average weight of these Chinook is 18.4 pounds. Thus, the total state level impact per landed Chinook is $61.74. For a troll caught fish landed at $2.30 per pound (round weight), the REI per fish may be $52.44. Part of the carcass and hatchery surplus sales also creates economic activity.

3.3 COST-EFFECTIVENESS ANALYSIS

CEA compares the costs and results of alternative actions, or groups of actions, that could be taken to accomplish a specific quantifiable objective. The essential requirements are a measurable objective (or reasonable proxy) and the economic costs of various actions that could be taken to achieve that objective.

A CEA is, fundamentally, a comparison of forecasts of what would happen under at least two alternative courses of action. An action scenario is an action or a group of actions that might be packaged together to accomplish the same objectives. CEA compares their costs and amount of accomplishment (effectiveness) to the status quo scenario.

CEA can be used to search for and identify scenarios that meet the cost-effectiveness criteria. For purposes of this type of analysis, the most cost-effective scenario is the one that reduces net costs (for example, power revenue losses plus costs of improved passage actions) and increases the objective (for example juvenile survival) relative to the status quo scenario. The cost-effectiveness is compared to other suggested programs that seek to satisfy the same objective.

CEA has a number of inherent limitations. A particular limitation is where there are multiple objectives that cannot be measured in common units, and so cannot be compared on the same basis. In such cases, there is no definitive basis for choosing among scenarios based on cost-effectiveness unless one scenario happens to be the best for all the objectives. One of the most important limitations of CEA is that it does not consider whether the given objective has a value that is greater than its cost. CEA seeks to meet an objective, but it does not address the value of meeting the objective. The objective is taken as a given. CEA cannot identify the scenario with the most economic benefit because the economic benefit of the objective is not considered.

CEA can be used, however, to identify efficiency improvements. If we are able to produce more fish at less cost, that is clearly an efficiency improvement, even if the most efficient result is to produce more fish at higher cost or fewer fish at lower cost. In many cases, it is not practical or even desirable to place dollar estimates on the objective, and CEA is the best tool for this situation. For example, most economists would agree that it is difficult to place a dollar value on wild salmon and steelhead. But for CEA, all that is needed is a measure of effectiveness.

The critical assumptions for undertaking a CEA for the recovery actions is knowing the project costs and the biological outcomes for an action. For example, an action could be to provide streamside fencing, but until some characterization is made on a project to fulfill this action, the cost side cannot be determined. There are a number of sources for per unit cost estimates, but there is no substitute for applying engineering standards to determine a project's budget. Evergreen (2004) has produced a handbook for assisting in determining cost estimates. Table II.3 shows the recommended middle ranges for a list of habitat improvement projects.

Suggested outcomes from projects is much less predictable to list than making assumptions about land acquisition, design, construction, and monitoring costs. Baseline studies and biological modeling is needed to establish species direct and indirect benefits. When outcomes can be quantified, a CEA can be used when there is a common objective to be measured such as the above mentioned one percent survival to outmigrating juvenile salmonids. It is not always possible to reduce outcomes to common units. For example, actions to alter harvest management policies will produce outcomes for returning adult salmonids. This objective is certainly a benefit, but is not the same measurement unit as the other mentioned objective for improving downstream migration survival. In such cases, using NEV or REI might be a better approach for comparing projects.

Table II.3
Potential Habitat Improvement Project Costs

Habitat Improvement Project	Cost Range
Land Purchase or Acquiring Conservation Easements	$700 per acre for undeveloped forest land to $1.2 million per acre for sites having existing urban land uses
Fencing	$3 to $12 per lineal foot depending on the design and terrain
Riparian Planting	$5 to $135 thousand per acre depending on site access and conditions and the types of materials
Culvert Improvements	$15 thousand each for a forest road to $800 thousand each for a 4-lane highway
Large Woody Debris/Engineered Log Jams	$1 thousand per stream mile when equipment is not needed and up to $80 thousand per structure for large streams where engineered log jams might be used
Streambank Improvements	$30 to $1,000 per lineal foot for excavation and erosion control measures to produce a bank for plantings
Nearshore Restoration	$100 to $1,250 per lineal foot depending on access and replacement/reconstruction needs
Floodplain Restoration	$10 thousand per acre for minor earthwork and hand excavation and up to $300 thousand per acre for major side channel reconnection projects.
Estuary Restoration	$20 thousand per acre and up to $2 million per acre depending on site conditions and extent of earthmoving

Source: Evergreen (2003).

Appendix D, Chapter 4
Economic Analysis Application to Selected Recovery Actions

4.0 ECONOMIC ANALYSIS APPLICATION TO SELECTED RECOVERY ACTIONS

4.1 PURPOSE

The Subbasin Plan's recovery actions are listed, but do not have the characterization and outcome descriptions necessary in every case to determine benefits and costs (Table III.1). This chapter will select a "handful" of recovery plan action types to demonstrate the economic effects that will result from the plan.

Five action types were chosen to demonstrate the economic effects. These are:

- Restore wetlands
- Preserve and restore streamside buffers
- Establish or modify in-stream flows
- Improve water quality
- Reduce outmigration predation

Action specific analysis can be completed once preferred alternatives are adopted and more information about their characterization and expected outcomes is known.

The effects from implementing the actions are to cause changes in the use of natural resources. In some cases, the economic tradeoffs sum to be negative in the short run and positive in the long run. In other cases, the opposite may occur or even be neutral. The economic analysis is to provide information to decision makers about the economic consequences rather than to judge which natural resource use is best. The economic analysis reviews a variety of consequences, but the emphasis is on what happens to anadromous fish habitat and water quality.

The discussion of the selected action types emphasizes the effects to anadromous fish, because assisting in the recovery of this resource has been identified as a basic tenet of the recovery plan. Preserving anadromous fish habitat for the production of wild stocks is important. While approximately 75 percent of all salmon and steelhead produced in the Columbia River system is from hatchery production, harvest management is based on conservation of wild stocks. In terms of economic impacts, wild stocks serve as a means to access hatchery produced salmon. Therefore, wild stocks can have a very high income producing potential.

Some recovery plan actions include making improvements to water quality. This can be an indirect benefit from creating salmon and steelhead habitat or can be through a directed project, such as from accelerating and fully implementing recent standards for pulp and paper manufacturing's water discharges. Higher standards for reducing bioaccumulative chemicals may not have any direct measurable economic impacts. The closing of pulp and paper mills has the potential to reduce local income and jobs. However, the threat of any closure would have to be analyzed in terms of comparable actions that are mandated for other similar manufacturers and substitute projects. The construction of increased pollution abatement equipment may actually increase local personal income by providing construction jobs in the short term.

Table III.1
Subbasin Plan Recovery Actions List

Habitat – Subbasin Streams and Watersheds	
Protection	
S.M1.	Preservation areas
S.M2.	Land use planning
S.M3.	Critical areas
S.M4.	Forest land management
S.M5.	In-stream flow protections
Restoration	
S.M6.	Habitat connectivity
S.M7.	Regulated stream flows
S.M8.	Water withdrawals
S.M9.	Channel restoration
S.M10.	Riparian and floodplain restoration
S.M11.	Watershed process restoration – crop and pasture lands
S.M12.	Watershed process restoration – forest lands
S.M13.	Watershed process restoration – developed lands
S.M14.	Watershed process restoration – mining sites
S.M15.	Wetlands restoration
S.M16.	Recreation management
Habitat - Estuary & Lower Columbia Mainstem	
E.M1.	Tidal swamp and marsh habitat
E.M2.	Connectedness between river and floodplain
E.M3.	Riparian condition and function
E.M4.	Toxic contaminants
E.M5.	Interrelationships among fish, wildlife, and limiting habitat conditions
E.M6.	Tagging and marking studies
E.M7.	Channel dredge activities
E.M8.	Sediment delivery processes and conditions
Hydropower Operation and Configuration	
D.M1.	Anadromous fish reintroduction above dams
D.M2.	Passage facilities at Bonneville Dam
D.M3.	Water flow
D.M4.	Allocation of water
Harvest	
General	
F.M1.	ESA Fishery Management Plans
F.M2.	Annual fishery management processes
F.M3.	Harvest objectives and current ESA management objectives
F.M4.	Incidental mortality
Fall Chinook	
F.M5	NOAA Fisheries' recovery exploitation rate
F.M6.	Sliding scale harvest
F.M7.	Habitat productivity and capacity
F.M8.	PFMC, NOF, and Compact
F.M9.	Monitor and evaluate fishery catch
F.M10.	Ocean, Columbia River, and tributary fisheries
F.M11.	Monitoring of stock specific harvest
F.M12.	Basin wide fish marking plan
F.M13.	Mass marking plan
F.M14.	Technical issues - mass marking

Table III.1 (cont.)

Chum	
F.M15.	Time and area management strategy
F.M16.	Pre-season and in-season management
F.M17.	Handle rate in sport fisheries.
Steelhead	
F.M18.	Commercial and sport impacts
F.M19.	Incidental impact
FM20.	Encounter triggers
F.M21.	Harvest plans for Wind River
F.M22.	Handle rate
Coho	
F.M23.	Sliding scale harvest
F.M24.	Selective sport fisheries
F.M25.	Columbia River commercial fisheries
F.M26.	Harvest Management strategy for Clackamas
Spring Chinook	
F.M27.	Selective fisheries
F.M28.	Handling mortality impacts
F.M29.	Gear, handling techniques, and regulatory options
F.M30.	Harvest rate plan
Hatchery	
General	
H.M1.	Supplementation and recovery
H.M2.	Risk containment measures
H.M3.	Region wide recovery and ecological context
H.M4.	Northwest Power and Planning Council's Artificial Production Review and Evaluation (APRE), and the WDFW's Benefit-Risk procedure
H.M5.	Mark hatchery fish
H.M6.	Adaptive management
H.M7.	P\Public education
H.M8.	Hatchery Genetic Management Planning (HGMP)
H.M9.	Funding
Fall Chinook	
H.M10.	Hatchery releases
H.M11.	Hatchery and natural spawners
H.M12.	Local watershed broodstock
H.M13.	Juvenile release strategies
H.M14.	Hatchery operation strategies
H.M15.	Mark hatchery fish
Spring Chinook	
H.M16.	Facilities
H.M17.	Reintroduction
H.M18.	Reestablished natural fish
H.M19.	Hatchery broodstock watershed transfer policies
H.M20.	Juvenile release strategies
H.M21.	Mark hatchery production
Chum	
H.M22.	Supplementation programs
H.M23.	Chum enhancement
H.M24.	Enhancement and risk management.
H.M25.	DNA data.
H.M26.	Hatchery broodstock watershed transfer policies

Table III.1 (cont.)

Steelhead	
H.M27.	Reintroduction
H.M28.	Broodstock development
H.M29.	Hatchery broodstock watershed transfer policies
H.M30.	Juvenile release strategy
H.M31.	Conservation/harvest programs
H.M32.	Mark harvest production
H.M33.	Harvest and removal of non local fish
Coho	
H.M34.	Hatchery supplementation programs
H.M35.	Reintroduction
H.M36.	Local broodstocks
H.M37.	Transfer policies
H.M38.	Juvenile release strategies
H.M39.	Mark hatchery harvest production.
H.M40.	Sanctuary areas
<u>Ecological Interactions</u>	
Non - native	
I.M1.	Regulatory, control, and education measures
I.M2.	Intentional introductions of aquatic species
I.M3.	Impacts of introduced, invasive, or exotic species
I.M4.	Established populations of introduced gamefish
I.M5.	American shad
Food Web	
I.M6.	Nutrient enrichment benefits
I.M7.	Ecological functions
Predators	
I.M8.	Northern pikeminnow fishery
I.M9.	Avian predators
I.M10.	Marine mammals

4.2 ECONOMIC EFFECTS FROM SUBBASIN PLAN RECOVERY ACTIONS

Five example projects are chosen to demonstrate an economic analysis. REI is the calculation method used in the analysis. NEV methods require more information about a particular recovery action's costs and has to be deferred until actions are better characterized. A following section discusses the application of CEA.

4.2.1 Restore Wetlands
Project: Restore 3,000 Acres of Tidal Wetlands

Wildlife Impacts

Assumptions

- It would be expected that populations of these species would be benefited and should increase proportional to increase in wetland/mudflat area.
- It is assumed that these areas could represent a potential refuge area that would attract significant wildlife for viewing.
- In areas for which we have data (e.g. Tillamook estuary), an area of about 18 square miles (11,520) attracted about 23 annual wildlife viewing days per acre per year.
- It is assumed that the 3,000 acres of restored wetlands will create about 69,000 additional wildlife viewing days.
- It is assumed that the cost will be of removing the 3,000 acres from fairly low productive agriculture.

Effects

- At $49.78 per day, impact of wildlife viewing, the restored acre impact may be $1,145 per year.
- The total annual impact of wildlife viewing of the restored wetlands in this area may be $3,434,820.
- In terms of full time equivalent jobs, this is equal to supporting 137 annual jobs (at $25,000 per year).

Fish Impacts

Assumptions

- Increases of salmon (smolts) could exceed 400,000 individuals if 3,000 acres of new wetland were created.
- Up to 40,000 additional fish would use this reconstructed wetland and thus benefit from this management activity.
- It is assumed that these smolts are coho, spring Chinook, fall Chinook, or steelhead. The calculations will center on coho, for two reasons:
  - Coho, in their life cycle, are in the stream for one year
  - The status of wild fish is such that they are the "limiting factor" for most management options
- An additional 40,000 fish that would otherwise not migrate to the ocean,

- These fish could be wild fish or hatchery fish that utilize this area as a "transportation" corridor.

<u>Effects</u>

- 40,000 additional fish at 7.5 percent ocean survival; 2,000 additional fish may survive. Depending on the state of recovery, up to 2,000 additional fish will be available for harvest and spawning areas throughout the Pacific Northwest.
- At a local economic impact of $22.49 to $31.76 per fish (harvested throughout its range), the additional 2,000 adults may generate $44,980 to $63,520 of personal income to the Pacific Northwest. The range depends on the species of smolts and the economic contribution per harvested adult.
  - Coho = $22.49
  - Steelhead = $25.14
  - Spring Chinook = $23.53
  - Fall Chinook = $31.76
- A smaller amount of income may be generated if any of the 2,000 are harvested in any different proportions than historical catch rates of hatchery fish released from lower Columbia hatcheries.
- In terms of full time equivalent jobs, this may equal one to two and a half additional annual jobs.
- If these restored wetlands are utilized by wild coho smolts, the additional surviving adults may be used to provide access to nine additional hatchery coho fish. This may amount to an additional $404,820 of income to the region or 16 additional jobs (access to Chinook may create additional income).

Agriculture Impacts

- It is assumed that the cost of removing 3,000 acres of agriculture is in terms of unimproved pastureland. One AUM may generate $12.21 of total personal income for the local area. Two acres per animal unit month of production an animal unit of production may generate $6.11 of income per acre per year from cattle grazing (at two acres per AUM). The amount of income lost by removing 3,000 acres from agriculture may be $18,315 per year.

Table III.2
Possible Economic Impacts of Restoring 3,000 Acres of Tidal Wetlands

	Possible Economic Impacts	
Resource Affected	Total Personal Income	Annual Jobs (FTE)
Wildlife (birds) viewing	$3,434,820	137
Fish (coho) enhancement	$44,980 to $404,820	2 to 16
Agriculture (grazing)	<$18,315>	<0.7>
Net gains <losses>	$3,461,485 to $3,821,325	138 to 152

4.2.2 Preserve and Restore Streamside Buffer Areas
Project: Restore One Mile of Buffer Area on One Side of Stream

Wildlife Impacts

Assumptions

- To obtain wetland-dependent wildlife in important wildlife areas, buffers need to retain plant structure for a minimum of 200 to 300 feet beyond the wetland.
- It is assumed these buffers would otherwise be in low-grade agriculture or forestry.
- A 200 foot wide buffer 200 feet long would equal about one acre of buffer. One mile of buffer (one side of water) would create 24.2 acres of buffer.
- One mile of buffer protection, on a wetland or estuary, is analyzed.

Effects

- On a watershed basis, an acre of improved habitat may yield 0.72 annual wildlife days. (This uses equivalency of Tillamook watershed acres to wildlife viewing days.) The result of one mile of improved buffer may be $868.89 of income impacts per year from increased wildlife viewing. Based on $49.78 income impacts per wildlife viewing day.
- In terms of annual jobs, about 29 miles of created buffer would generate one additional job from wildlife viewing.

Fish Impacts

Assumptions

- Buffer widths of 30 m or greater were necessary to protect salmon egg and juvenile development in streams. (To be consistent with previous analysis, a 200 foot buffer is analyzed. If wider buffer zones were created, the effects should be viewed as proportional.)
- Given a likely survival to adulthood of 10 to 20 percent for the smolt, these estimates yield a salmon density under pristine conditions less than 10 adults per 100 m^2 (about four per acre).
- Annual yield of coho smolts ranged from 5.5 to 16.9 smolts per 100 m^2 of rearing area.
- Smolts entering the ocean may survive to adults at 2.5 to 7.5 percent rate.
- The fish could be wild fish or hatchery fish that utilize this as a "transportation" corridor.

Effects

- Coho smolts survive at a 5.5 to 16.9 per 100 m^2 of rearing area and smolts survive up to a 7.5 percent rate; then up to 0.5 additional adults per acre may survive as a result of the buffer (e.g. 0.169 x 0.075 = 1.27 per 100 m^2 or about 0.5 adults per acre).
- One additional acre of buffer may create (at $22.49 per fish) $11.25 additional income per acre per year.
- One additional mile of buffer may create $349 of additional income per mile of buffer per year (24.24 acres x 11.25 = $272.70).
- In terms of annual jobs, about 92 miles of created buffer would generate one additional job from coho harvested in the Pacific Northwest.

- If these created buffers are utilized by wild coho smolts, the additional surviving adults may be used to provide access to nine additional hatchery coho fish. This may amount to additional $2,453 of annual income to the Pacific Northwest (24.24 acres x 0.5 fish x $22.49 x 9 = $2,453).

Agriculture or Forestry Impacts

<u>Assumptions</u>

- It is assumed that the cost of creating buffer of up to 200 feet would be a potential loss of unimproved pasture or timber growth.

<u>Effects</u>

- For a loss of agriculture, two acres of unimproved pastureland may yield one animal unit month of production. An animal unit month used for grazing cattle may generate $12.21 of income for the region or $6.11 per acre. Therefore, one mile of buffer not used for grazing has the potential not to generate $148 of income for the region (24.2 x 6.11 = $147.86).
- For forestry, the state plan already calls for a 75 foot buffer. Therefore, the increased buffer would affect about 15.1 additional acres. In western Oregon and Washington, riparian areas produce low grade wood (alder, hemlock, etc.) that may grow at about 250 usable board feet per acre per year. Low grade timber may create $398 of income impacts per MBF or $99.50 per acre per year. Therefore, a mile of additional 125 foot buffer may result in a loss of $1,502 per year in timber production.

Table III.3
Possible Economic Impacts From Preserving and Restoring Streamside Buffers (Per Mile Restored)

	Possible Economic Impacts	
Resource Affected	Total Personal Income	Annual Jobs (FTE)
Wildlife (birds) viewing	$869	0.03
Fish (coho) enhancement	$273 to $2,454	0.01 to 0.10
Agriculture	<$148>	<0.01>
Forestry	<$1,502>	<0.06>
Net gains <loss>	$1,673 to <$508>	0.06 to <0.03>

4.2.3 Establish or Modify In-Stream Flows for Fish Needs
Project: Restore River Flows

Fish Impacts

<u>Assumptions</u>

- Flow recommendations for creeks, streams, and rivers can be as low as 30 cfs to enable spawning, and as low as six cfs to support fish rearing.
- Coho salmon smolt yield ... ranged from 16 to 67 smolts per 100 m^2 ... ranged from 5.5 to 16.9 smolts per 100 m^2 of rearing area ... It is possible that yields in streams receiving adequate water all year could produce runs approaching these levels, if other environmental conditions were favorable.

- The flow of the river is essentially zero during the late summer and early fall season, and therefore provides no survival for most salmonids (e.g. coho, spring Chinook, steelhead) that require about a year of inland life.
- The Oregon coho plan, for example, specifies a minimum of 40 wild spawners per mile. A productive coastal stream may provide year round habitat for up to 160 wild spawners. (Lawson 1999.)
- Alternative water sources may require "construction of dams or reservoirs to contain water for use during low-flow periods."
  - A watershed timber management program may increase water availability in late summer and fall.
  - Not logging a watershed may provide more "usable" water. Non-logged watersheds act as a reservoir for water in the crucial low-water periods of July to September.
  - Unlogged areas act as natural reservoirs and may avoid the constriction of additional reservoir and treatment capabilities.
  - If reservoir storage were required, reservoir storage may cost about $3,500 per acre foot. The amortized 50 to 80 year annual cost of such a capital project is $165 to $350 per year (depending on the interest rate).
  - The economic impact of such a reservoir should be considered neutral (after the construction period). The household payment for the reservoir would be offset by a decrease in other household spending.

<u>Effects</u>

- For coho, a spawner may produce 2,500 eggs at three percent survival from egg to smolt = 75 smolts. At 2.5 to 7.5 percent ocean survival, as many as six adults may be produced. At a 50 percent harvest rate, about three fish per spawner may be harvested. At an economic impact of $22.49 per harvested fish, a spawner may generate $67.47 of income to the Pacific Northwest. Therefore, 40 spawners (male and female) have the potential for producing $1,349 of impacts (20 x 67.47 = 1,349). That may be considered the economic impact of one mile of productive stream at Oregon Coho Plan level of 40 spawners per mile. At a rate of 160 spawners per mile, the economic impact per productive coastal stream may be $5,398.
- For the Lewis and Clark River (historically a very productive stream), 10 miles of stream may be affected. Therefore, the economic impact of restoring this stream may be as high as $53,980, if these salmon are harvested directly.
- If this river system is utilized by wild coho smolts, the additional surviving adults may be used to provide access to nine additional hatchery wild coho fish. This may amount to additional $485,820 of annual income to the Pacific Northwest (10 miles x $5,398 x 9 = $485,820).
- According to the Water System Master Plan, water use for 1996 was 2.4 mgd, with a projected use for the year 2016 of 3.5 mgd.
- City staff have indicated that there have been periods (up to two months in late summer and early fall) in each of the last six years when the entire flow of the Lewis and Clark River was diverted by the City's intake and no water passed over the established fish ladder.
- A 645 acre foot reservoir would be required to store enough water for a 60-day period. The estimated cost of such a storage is $2,257,000.

- Amortized over 30 years, at seven percent, a $181,923 annual payment would be required to repay the capital cost of reservoir construction.
- The local economic impact of such cost is uncertain. It may be neutral and depends on what local spending is curtailed resulting from higher water fees.
- The local household multiplier is 0.77; therefore, up to $140,081 of personal income to the region may be lost resulting from these water payments.

Table III.4
Possible Economic Impacts From Modifying Minimum Flows to Meet In-Stream Fish Needs

	Possible Economic Impacts	
Resource Affected	Total Personal Income	Annual Jobs (FTE)
Fish (coho) enhancement	$1,349 to $53,980	0.05 to 2.2
Alternative water storage	$0 to <$140,081>	0 to <5.6>
Net gains <loss>	$53,980 to <$138,732>	2.2 to <5.5>

4.2.4 Improve Water Quality
Project: Eliminate Bioaccumulative Chemicals From Pulp and Paper Manufacturing Water Discharge

Assumptions

- Cluster rules released by EPA in 1997, requiring shift to Elemental Chlorine Free (ECF) process for pulp and paper mills. The rule affected all pulp and paper mills that have bleached paper grade Kraft processes. The rule combines standards for air and water. Today, all but a few bleach plants, with special exceptions, have implemented compliance projects (Rooks 2003).
- The ECF process is currently being adopted in parts of Europe. The implication is therefore that all pulp and paper mills will be required to meet these standards.
- The technology standards will cut toxic air pollutant emissions by almost 60 percent and virtually eliminate dioxin discharged from pulp, paper, and paperboard mills into rivers and other surface waters.
- EPA (1997) estimated that the industry needed to invest approximately $1.8 billion in capital expenditures and approximately $277 million per year in operating expenditures to comply with this rule.

Table III.5
Cost Summary for 96 Pulp and Paper Mills Affected by Cluster Rules
(Cost in Millions)

	Elemental Chlorine Free	
Capital Cost	All mills	Per mill
EPA estimate	$2,100	$21.9
Industry estimate	3,575	37.2
Post Tax Annualized Costs		
EPA estimate	216	2.3
Industry estimate	457	4.8

Notes: 1. Capital cost is an estimate of construction cost.

2. Post tax annualized costs are annualized costs needed to retire the capital costs.
Source: EPA (1997).

Effects

- Two scenarios may happen from the new standards for bioaccumulative chemicals: (1) mills may close, or (2) capital costs will be incurred and water quality will improve.

(1) Mill closures

EPA (1997) estimates per mill costs to adopt ECF technology at $21.9 million per mill and industry estimates $37.2 million to respond to Cluster rule requirements. Companies may shut down specific processes to cope with rule requirements rather than making the required upgrades to equipment.

- Pulp and paper mills in Oregon and Washington annual payroll averaged $50,000 to $55,000 in 1997. The personal income multiplier for these two sectors for the lower Columbia area is 3.06 for pulp mills and 2.27 for paper mills. (Capital extensive manufacturing tends to have higher multipliers.) The overall effect of a pulp or paper mill closure on the lower Columbia economy may range from $113,500 to 168,300 for every direct job that is lost in the pulp or paper mill industry. The annual effect of a 400 employee mill closure may be a loss of up to $67,200,000 of income. For an economy such as Columbia County, this would be about eight percent of the estimated 800,000,000 1999 personal income. Not all of this impact may be realized in any one period. The total impact on the supporting industries will depend on substitute sales. Loss of employment may also not be in direct proportion. The potential loss should be viewed as something that may happen, if everything else is static.
- Increases in costs are borne by all pulp and paper mills
  - The impact on the paper and pulp industry is across the board. We would expect that costs would increase (for all pulp mills), which in effect may increase the amount of income generated.
  - Annualized costs over time range from $2.3 to $4.8 million, which are assumed to be passed on to the consumer in terms of sales increases. At an annual rate, these additional costs may generate from $1.04 to $2.64 million of additional total personal income in the region annually per mill.

(2) Implement Construction Costs

On a one time basis, the construction of additional treatment facilities at a cost of $21.9 to $37.2 million may generate a one time increase of total personal income of $18 to $30.5 million (total personal coefficient for construction of 0.82) in new personal income for the region.

The effects from the cleaner water are:

- The result of removing chemicals may be a benefit to communities' water systems (those that are using or are contemplating using the Columbia as a municipal water source).
- A water quality treatment plant may cost about $119 per acre foot of water. Some of these costs may be avoided if chemicals are not present. Some of these costs may be avoided as a result of lower pollutant emissions. However, treatment plants will be required eventually by EPA regulation. Therefore, any calculation of income impacts resulting from increased standards on water treatment are not possible.
- Dioxin and furan compounds are considered carcinogenic and are believed to cause reproductive effects. Environmental persistence and biomagnification are possible with these compounds, so they are likely to affect all levels of the food web, including salmon, bald eagles, otters, and mink. It appears that the most common source of these compounds in the pulp and paper industry, since the chlorine (Cl_2) and hypochlorite used during elemental chlorine bleaching procedures react with the wood lignin and produce chlorinated pollutants such as chloroform, dioxins, and furans in the plants' wastewater stream. Elimination of these compounds from the waste stream could result in increased reproductive success of sensitive invertebrates species associated with the river systems, and increased sport fishing and resulting tourism from the lifting of fishing advisories in river sections near pulp and paper facilities. For instance, in their Health of the River 1990-1996 report, the Lower Columbia River Bi-State Program identified 12 locations of concern in the lower Columbia River where concentrations of dioxins and furans in crayfish and fish tissue exceeded tissue burden reference levels of 0.003 µg/kg wet weight. In most cases, exceedences were observed in bottomfeeding fish, such as large-scale sucker, peamouth, and white sturgeon. It is not clear commercially important fish or shellfish, such as salmon or crab, should be included in the lower Columbia River advisories, nor is there definitive proof that implementation of the Cluster Rule would enhance these resources in the near future.
- Not enough is known about possible effects on harvestable quantities of fish or viewable wildlife. Personal income effects related to marine harvests or recreational activity are not estimated.

Table III.6
Possible Economic Impacts From Elimination of Bioaccumulative Chemicals in Pulp and Paper Manufacturing Water Discharges

	Possible Economic Impacts	
Resource Affected	Total Personal Income	Annual Jobs (FTE)
Mill closure	<$67,200,000>	<2,208>
Construction impacts (one time event)	$18,000,000 to $30,500,000	720 to 1,220
Clean water effect on fish	(not enough information to calculate)	
Net gains and <losses>	may increase jobs during construction; could result in loss of up to 2,208 local jobs	

4.2.5 Reduce Outmigration Predation
Project: Provide a Sport Reward Fishery Program to Harvest Northern Pikeminnow

Assumptions

- The total Columbia/Snake River System produces about 200 million smolts. The river system losses are estimated at 115 million. Predation is a part of these losses. Northern pikeminnow consume about 16 million smolts. A northern pikeminnow harvest program (NPMP) reduces this predation by about 3.8 million.

Effects

- Commercial and recreational activity throughout the West Coast dependent on Columbia/Snake River system fish production.
  - Net valuation
    - + Net value of commercial catch 70 percent of ex-vessel value
    - + Net value per angler day $52 to $63
    - + Passive uses not included.
  - Regional income impacts
    - + NPMP administrative program - depends on labor
    - + Pikeminnow harvests
      - > Highliners $7 per fish
      - > Recreation anglers $30 per day
    - + Salmonid - from Alaska to California
      - > Commercial harvests 70 percent of ex-vessel value
      - > Recreational harvests per day $51 to $63
- Northern pikeminnow management program economic evaluation results: The program's NEV creates an estimated $2.2 million in wealth to the nation because of the northern pikeminnow fishery and another $1.4 to $5.7 million from anadromous fish fishing. This does not include any measurement of passive use value for the increased salmonid adult returns or negative passive value associated with the exploitation of the northern pikeminnow. A program budget of $3.3 million will generate about $2.2 million in REI's and about $1.8 million in the regional economies when northern pikeminnow fishing takes place. Fishing for salmon and steelhead resulting from increased adults surviving to harvest will generate another from $2.2 million to $8.3 million in economies from Alaska to California on the West Coast and inland in the Columbia River Basin. In total, the act of fishing for northern pikeminnow and anadromous fish may create up to $10.1 million in REI. In terms of full time equivalent jobs at $30,000 each, this is equal to the employment of about 337 people. Since many of these jobs will be seasonal, the actual number of positions may be much higher than the stated full time equivalent job estimates.
- Any program that expands commercial or recreational opportunities from production of the Columbia/Snake Basin has implications throughout the West Coast.

Table III.7
Northern Pikeminnow Management Program Economic Evaluation

	Net Economic Value	Regional Economic Impacts
NPMP budget		
Northern pikeminnow fishery	$2.2	$1.8
NPMP administration		$2.2
Subtotal NPMP		$4.0
Anadromous fish fishing	$1.4 to $5.7	$2.2 to $8.3
NPMP at existing program level	$3.6 to $7.9	$6.2 to $12.3

Notes: 1. Table values are in millions.
Source: Radtke et al. (2004).

4.3 COST-EFFECTIVENESS ANALYSIS

As previously explained, CEA differs from NEV and REI economic analysis approaches. CEA instead asks the question: given a particular objective, which is the least cost way of achieving it? Thus, it facilitates choice among options, but cannot answer whether or not any or all of the options are worth doing. CEA is used instead of NEV and REI analysis when there are difficulties in associating monetary values with outcomes, but where the outcomes can be defined or quantified in non-monetary fashion (Pearce 1992).

An example application for CEA is the current consideration of achieving targeted levels of juvenile salmonid survival with reduced dam spill by offsetting the impacts using other techniques to reduce mortality. The IEAB (2004) used the CEA approach to compare the costs (or benefits the case of spill generating revenues through power production) against the biological objective for increasing outmigration juvenile salmon survival by one percent (Table III.8).

Table III.8
Cost-Effectiveness Analysis Using Selected Downstream Migration Survival Improvement Actions

Selected Passage Actions	Fall Chinook	Species Spring/Summer Chinook	Steelhead
August spill at Ice Harbor	$600	No effect	No effect
Extended length screens at Lower Granite	$12	$3	$6
Extended length screens at Little Goose	$23	$7	$14
Corner collector at Bonneville	$95	$95	$158

Notes: 1. Table values are annual costs (millions of dollars) per one percent increase in salmonid downstream migration survival.
Source: IEAB (2004).

4.4 LIMITATIONS

NEV, REI, and CEA all have their applicability in evaluation actions. REI results are indicators of the amount of dislocation costs which may occur in the event of reductions in fisheries, but are not indicators of the net loss to the nation from such reductions. If sufficient quantitative information and defensible analytical models are available, net gain or loss to the nation determined through a benefit-cost analysis is the value suggested by Executive Order 12866 and the Regulatory Flexibility Act (5 U.S. C. 601 *et seq.*) for analyzing actions of federally managed fisheries (NMFS 2000).[1,2] In general, there is no particular relationship between changes in NEV derived in a benefit-cost analysis and regional economic impacts and certainly are not additive with NEV. However, both are useful to decision makers for showing the consequences of plan recovery actions.

REI estimates measured by personal income provide a value that is comparable to similar values often used to describe activities in nonfishing sectors of the economy. If the fishing activity is reduced, personal income is not necessarily reduced by a proportional amount. The effect on personal income in the local and national economies will depend on alternative activities available and the location of those activities. If there were a reduction in the ocean fisheries, over the long run workers in the commercial and recreational fisheries, vessel and processing plant owners, and food fish consumers would be expected to adjust to the reductions by changing the activities in which they engage. The type of the alternative activity in comparison to the fishing activity determines the net effect of changes in ocean fisheries. For example, if a worker on a vessel or processing plant goes on government assistance as a result of lost ocean fishing opportunity and there is no new job or income created elsewhere in the economy, then the net loss to the nation and local economy with respect to the workers job would be the entire wages for that worker. However, if additional income is generated elsewhere either through the increased harvest in other fisheries or through the consumers redirection of food expenditures from West Coast caught fish to another food source such as fish from other areas or chicken (with the consequent generation of additional income or jobs for some of those in the other fishery or chicken producing industry), then size of the net negative effect of the lost employment income would have to be reduced by some portion of the value of the increased economic activity elsewhere in the economy. The effect on the local economy would differ from the effect on the national economy to the degree the alternative activities were located outside the local community.

The REI estimates provide information on a representative year basis and are an indicator of the possible redirection of money between nonfishing-dependent and fishing-dependent sectors that may occur with changes in the fishery. The amount of redirection represents a dislocation which may have economic and social costs that would not be reflected in a typical NEV analysis. However, it should not be a substitute for a proper assessment using benefit-cost framework.

1. Other laws, such as the Magnuson-Stevens Fishery Conservation and Management Act, the National Environmental Policy Act, and the Endangered Species Act also have economic analysis requirements.
2. The benefit-cost analysis from management actions includes the sum of expected changes in: (1) potential changes in consumer surplus derived from recreational fishing, (2) potential changes in consumer surplus derived from non-consumptive use, (3) existence value, (4) consumer and producer surplus from commercial fishing landings, and (5) less management costs (administration, monitoring, and enforcement).

Appendix D, Chapter 5
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