ECONOMICS & SOCIOECONOMIC ANALYSIS REVIEW
26 April 2020

EXECUTIVE SUMMARY

The various technical analyses and appendices prepared in support of the SEPA Draft Environmental Impact Statement (DEIS) for the proposed Flood Retention Expandable (FRE) facility project (Proposed Project) under that State Environmental Policy Act (SEPA) were reviewed by a qualified team of senior economists, resource social scientists, wildlife biologists and resource management specialists. Team members supporting the project include Julie Ann Gustanski, PhD, LLM, AICP; Matthew M. Hayes, MS; David Scarsella, MS; and David T. Taylor, PhD.

All sections of the DEIS and its appendices were reviewed, with a focus on; Land Use, Recreation, Environmental Justice, Tribal Resources, Wetlands, Wildlife, and Fisheries Discipline Reports, the Chehalis River Basin Flood Control Combined Dam and Fish Passage Supplemental Design Report, FRE Dam Alternative (September 2018), and the Chehalis Basin Strategy PEIS Draft Economics Study Update (September 2016). Explicit attention was given to the development of estimates surrounding costs for the proposed FRE facility, presentation of cost-benefit analysis, and any economic and social impact analyses presented in these documents, and allied costs of potential impacts to the human and natural environment.[1]

These analyses were assessed for the extent to which they contribute accurately and substantively to findings presented in the DEIS, inclusive of identification and quantification of the resultant direct, indirect, and cumulative impacts associated with construction and operation of the proposed FRE facility.[2]

Table 1 provides the consolidated list of DEIS review team comments focused on the inclusion, analyses, and related presentation of essential economic and social impact information. Comments are expanded upon within the 'Findings' section of this review.

[1] The regulatory definition of the term **human environment** at 40 CFR 1508.14 –impacts on the quality of the human environment being the subjects of any EIS – includes "the natural and physical environment and the relationship of people with that environment."

[2] Within the discipline of economics, and specifically in the context of economic impact analysis, the terms direct, indirect, and induced impacts are used. Interpretation should not be confused with and is not equivalent to "direct, indirect and cumulative impacts" as used in the context of analyses developed for NEPA/SEPA environmental impact statements. Relevant to Chehalis Basin and against the background of economic impacts: Direct impacts result from direct economic activity (employment, income, etc.) from area businesses and their activities; Indirect impacts result from regional economic activity (employment, income, etc.) arising from direct economic activity, and; Induced impacts are derived from economic activity resulting from the indirect impacts of basin-wide business spending and indirect household spending. This includes the interaction of all businesses (such as B2B supply chain purchases) within the Chehalis Basin and the larger region.

Table 1. Summary of Disicpline Relevant Comments by Resource Dimensions' DEIS Review Team

No.	Review Team Comment
	Significance - High
Deficiencies	
1	Economic benefit of project is unclear; cost-benefits are not developed; uncertainty is not considered in analysis.
2	Economic and social impacts of construction, operation and potential catastrophic failure are not developed or assessed.
3	Future costs of anticipated mitigation strategies is not included; feasibility to compensate for impacts is not demonstrated.
4	Feasibility of mitigation needed to compensate for the impacts on fisheries resources is not demonstrated.
5	Limited scope of economic analysis; benefits of/damages to ecosystem services are not addressed.
6	Adaptive management plan lacks detail to ensure resources affected by the Proposed Project are duly mitigated.
Errors, Omissions, Incomplete or Underestimated	
7	Data gaps, errors, and omissions present significant uncertainties; costs cannot be relied upon for decision making.
8	Several significant costs are not included in projected estimates for the Proposed Project.
9	Equal, comparable cost-benefit, economic and social impact analysis across alternatives are not provided.
10	Economic and socioeconomic impacts correlated with changed ecosystem function are not considered.
11	Economic and social impacts that extend beyond geographical boundaries of study area are not addressed.
12	Impacts of Proposed Project, from an environmental justice perspective, are not properly analyzed or considered.
13	Important cost-benefit and economic impact analysis have not been provided for the airport.
14	Economic impacts associated with identified significant potential impact to region's fisheries are not addressed.
	Significance - Medium
Deficiencies	
15	The cumulative impacts analysis does not consider the value of ecosystem services that have diminished over time.
16	Detailed justification for not including potentially viable project alternatives from further consideration is not provided.

The following definitions were used to assign a significance level to each comment presented in Table 1.

1. **High:** Describes a fundamental problem that could affect the recommendation, success, or justification of the project. Comments rated as high indicate that the Team analyzed or assessed the absence of required information, methods, models and/or analyses and determined there is a potential critical issue that must be addressed.
2. **Medium:** Affects the completeness of the report in describing the project but will not likely affect project justification or recommendation. Additionally, comments rated as medium indicate that the Team did not find information presented sufficient to analyze or assess the methods, models, or analyses.

Extending in perpetuity, we find that the system-wide cumulative economic and socioeconomic impacts, and significant operational costs of the Proposed Project are appreciably underestimated or inadequately analyzed within the DEIS and its supplementary parts. The physical changes and resultant ecosystem impacts associated with the FRE facility will be vast and fish populations in the Chehalis River will be irreparably damaged, potentially extirpated, and potentially put the United States in non-compliance of an international treaty. Once constructed, risks to the downstream floodplain communities will increase and the public will be committed to the costs to maintain the facility indefinitely. And, while the impacts to Treaty Rights and related costs associated with the Proposed Project are difficult to quantify, they are vastly understated in the DEIS.

While we generally agree with DEIS findings that significant impacts will be incurred by the construction and operation of the FRE facility, it is our opinion that the inadequacies of the DEIS are such that it does not meet the standards required for an EIS for a project of this nature and significance. With specific regard to economics, we find the investigations presented – to the limited extent they are – in the DEIS do not adequately demonstrate that the proposed FRE facility is justified. The environmental and economic issues governing project feasibility are complex, and the analyses necessarily involve great uncertainties. Our review of the DEIS identified significant concerns regarding the breadth and detail of economic studies and the development of both projected FRE facility costs and compensatory mitigation plans. The Team also has concerns regarding the adequacy of the DEIS in addressing uncertainties in plan formulation and alternative evaluation.

Economics: The purpose of the project is primarily *"To reduce flood damage in the Chehalis-Centralia area by constructing a flood retention facility and temporary reservoir near Pe Ell and making changes to the Chehalis-Centralia Airport levee."* (DEIS, p. S-3). Estimating future economic benefits of flood risk management involves significant uncertainties that, in our opinion, have not been adequately addressed in the DEIS. The assessment of economic impacts of the Proposed Project on communities, businesses, recreation, land use, fisheries, cultural and tribal resources, and Treaty Rights are also not clearly presented.

The economic and environmental issues surrounding flood reduction in the Chehalis Basin are complex, and the analyses necessarily involve many uncertainties. We identify areas of concern in the DEIS and relevant appendices regarding the breadth and detail of the Economic Study. Overall, there is an absence of necessary cost-benefit, economic and social analysis presented in the DEIS. Where there are passing references suggestive of Proposed Project costs, economic implications or related social impacts, the fundamental supporting data, information, analysis, or assessment is absent.

The DEIS specifically 1) fails to fully disclose or include all major project costs and fails to conduct cost-benefit analysis of the Proposed Project or viable alternatives; 2) fails to present and systematically assess direct, indirect and cumulative economic impacts and related social impacts using consistent quantitative and qualitative frameworks required to logically present and compare impacts across viable alternatives; 3) does not provide substantive cost and schedule analyses for each alternative, including costs and timeline to mitigate expected impacts; 4) does not provide the public or decision makers with accurate, easily understood, and transparent findings on which to evaluate the range and extent of impacts to the natural and human environment of the Chehalis Basin associated with the Proposed Project or other viable alternatives.

INTRODUCTION

An expandable flood retention (FRE) facility has been proposed as an alternative to accomplish flood damage reduction on the Chehalis River, Washington. Several alternative concepts were proposed, but the Flood Retention Expandable (FRE) facility has been advanced for environmental review under SEPA. The purpose of the facility is to store water in the upper watershed to alleviate flood damage to developed areas of the lower floodplain near the towns of Centralia and Chehalis.

Our review assesses the DEIS, relevant discipline reports, and technical documents with explicit focus on economic and socioeconomic elements interwoven throughout. In particular, our process addresses the soundness of DEIS assumptions, methods, analyses, and calculations and identifies the need for additional data or analyses to aid decision makers in making sound decisions regarding the Proposed Project or implementation of alternatives and recommendations.

Core areas of review include 1) development of project cost estimates for the proposed FRE facility and alternatives; 2) systematic evaluation of the economic impacts associated with the proposed FRE facility and alternatives; 3) accuracy, completeness and technical soundness of assumptions, methods and analyses related to economic, socioeconomic and cost-benefit analysis conducted for the proposed FRE facility and alternatives, and; 4) scope and range of analysis pertaining to impacts on the human and natural environment associated with the Proposed Project.

As appropriate, we identify additional requirements, data or analyses needed to help assure that the final EIS documents meet the standards required for an EIS environmental review and will provide decision makers with sufficient information on which to make determinations regarding the proposed FRE facility. The review team used the following questions to guide its independent assessment of the DEIS:

1. Are appropriate methods used to evaluate the extent of economic and social impacts of the proposed actions?
2. Are viable alternatives consistently developed and analyzed using appropriate cost development methods, cost-benefit and economic impact analysis to assure comparability of the Proposed Project against other viable alternatives (e.g. FRO, Local Actions).
3. Are the reviewed DEIS sections, discipline reports and supporting technical analyses internally logical, complete and consistent?
4. To what degree does DEIS accurately identify and quantify direct, indirect, and cumulative economic impacts associated with the Proposed Project?
5. Does the DEIS adequately address impacts/effects of alternatives on the Quinault Indian Nation's (QIN) utilization of treaty resources?
6. Does the DEIS address mitigation measures for potential damage to treaty resources?

FINDINGS

The construction and operation of a dam is a major project with a significant regional impact footprint extending across built and natural environments, and enormous costs. The DEIS identifies several impacts that have economic consequences, which should be examined to give decision makers an accurate understanding of the potential impacts of each alternative on local economies. *WAC 197-11-440(6)(a) states that the affected environment, significant impacts, and mitigation sections of an EIS shall "analyze significant impacts of alternatives including the proposed action."*

This independent review draws the following major findings regarding the DEIS.

MAJOR DEFICIENCIES

Independent review has identified several important deficiencies of high significance. Specific limitations and deficiencies that affect the validity of the DEIS are:

1. **The economic benefit of the proposed FRE project is unclear as costs and benefits are not developed and uncertainty is not considered in analysis.**

   The proposed FRE project is not developed in the Chehalis Basin Strategy Final Programmatic Environmental Impact Statement (PEIS), in which a suite of actions to address flooding and degraded aquatic species habitat throughout the Chehalis Basin were evaluated. Thus, information from the earlier PEIS and related analysis surrounding cost-benefit, uncertainties, and risk cannot be relied upon as substitutes relative to the proposed FRE facility.

   Assessment of the net benefits of the proposed FRE facility is dependent on a variety of factors, the most basic of which relies upon identifying all associated costs and benefits; monetizing those that can reliably be monetized. Such assessment should incorporate information regarding uncertainties; uncertainty in the costs and benefits should be calculated and reported, together with the distributional consequences (who gains and who loses). While the Proposed Project provides potential benefits 100 years into the future, the DEIS neither addresses the cost-benefits of the Proposed Project, or uncertainties, the level of mitigation needed, and the costs related to that mitigation. **The lack of such analysis in the DEIS presents an egregious flaw.**

   Similarly, the DEIS for the Proposed Project does not explore the effects of risk, which would be applied to the benefit estimates if they existed. Risk is defined in terms of expected probability and frequency of the hazard occurring, the people and property exposed, and the potential consequences. To estimate future damages (and the benefits of avoiding them), the probabilities of future events must be considered. The probabilities of future events profoundly affect whether a Proposed Project is cost effective. This same procedure should also be applied to future mitigation and monitoring costs, which also involve current and future uncertainties. For instance, habitat needed for mitigation cannot be estimated as

point estimates with certainty, rather must reflect the uncertain and constantly changing costs associated with mitigation efforts.

As both costs and benefits for the Proposed Project involve risk, they each involve probability distributions; given that there are a range of probabilities involved with the potential risk, the costs and benefits inherently have a distribution. The full range of associated costs and benefits are not developed, quantified, or analyzed using cost-benefit analysis (CBA) for the proposed FRE facility or potentially viable alternatives and risk outcomes are not presented in the DEIS. Thus, the estimated economic benefits of the proposed FRE project cannot be quantified. Justification for the project requires *"… that environmental amenities and values will be given appropriate consideration in decision making along with economic and technical considerations."* RCW 43.21C. 030(2)(a) and (2)(b) (emphasis added).

Failure to fully develop the associated costs and benefits for the Proposed Project and potential alternatives is a significant deficiency of the DEIS. **Additionally, uncertainty analysis must be incorporated for a full understanding of the Proposed Project's economic benefits.** The DEIS does not include a clear presentation of the uncertainties associated with the scale and complexity of the proposed FRE facility, or potential alternatives. A comprehensive examination of uncertainty is critical to understanding and accurately comparing alternatives (Apel et al., 2004).

To address deficiencies outlined here, the DEIS should:

a. Conduct a CBA and report cost-benefit ranges that correspond to the uncertainties for the project using either models that directly incorporate uncertainty, or ex-post risk analysis of point estimates.

b. Local economic benefits from reduced future flooding can be consistently measured in terms of residential benefits (population and households); business benefits (economic value added at risk in the floodplain); and property values.

c. Document sources of uncertainty for benefits for the Proposed Project at present and into the future (50 years forward).

d. Document uncertainties related to mitigation costs. These arise from both the quantity of mitigation habitat that is needed, and the variation in future expected costs of that mitigation.

e. Explain the robustness of final decisions regarding project implementation to uncertainties. Discuss the range or extent to which the basic assumptions and information supporting the economic analyses can vary without affecting the ultimate conclusions and recommendations of the study.

2. Economic and social impacts of FRE construction, operation and potential catastrophic failure are not developed or assessed.

Economic and social impact analysis is particularly important for the DEIS as the Proposed Project would have significant impacts on the economy and social structure within the study

area because the hydrological effects are predicted to occur across more than 100 miles of the Chehalis River and its floodplain. (DEIS, Appendix J, 2.1; p. J-2).

The DEIS has totally ignored the vast economic and social implications of the Proposed Project and has even further ignored addressing the potential range of related benefits associated with the Local Actions alternative, as well as the restorative approach. **Significantly, the human dimension has not been appropriately considered – a fatal error of the DEIS.** While there are many dimensions to evaluating infrastructure projects as the proposed facility Proposed Project, the human dimension is a critically important consideration.

Economics

No economic analysis has been conducted – a fatal error of the DEIS. Economic impacts, to the extent they are even presented, are discussed using qualitative judgments instead of quantitative measurements, leading to unsubstantiated inferences and interpretations of impacts that are difficult to reasonably judge, and impossible to compare for the proposed FRE facility and other reasonable alternatives. The comparison of results across alternatives relies on the use of a consistent approach. Standard practice includes the reporting of financial returns in the evaluation of costs and benefits of each alternative. Returns to investments for flood risk reduction strategies may be reported in a variety of ways (e.g., NPV, cost-benefit ratios, avoided costs, IRR).

Decision makers are expected to use the information in the SEPA EIS, along with other information, to inform their recommendations for the long-term Chehalis Basin Strategy to address the social, environmental, economic, and other public health and safety considerations related to both flood damage reduction and aquatic species habitat restoration objectives. **The DEIS reflects a total lack of any substantive analysis that could be used to inform the Chehalis Basin Board in any meaningful way on the economic impacts associated with the Proposed Project or viable alternatives.**

Social Impact

The DEIS correctly finds that construction and operation of the Proposed Project would have unavoidable adverse direct, indirect and cumulative impacts on fish, wildlife, aquatic and terrestrial habitat, recreation, earth, water, air, wetlands, people, local economies, and more. The interrelated social, cultural, and economic dimensions of such impacts are significant and far reaching. From the permanent loss of important river resources that provide various recreation and tourism related opportunities (e.g. fishing, kayaking, etc.) that support the region's economy, to effects on important subsistence species and sites that will directly and permanently affect traditional and cultural uses and resources. And, despite acknowledging the range of impacts, the DEIS provides nothing in the way of either identifying appropriate mitigation strategies and related costs, or acknowledging the costs that may be associated with the National Historic Preservation Act (NHPA) Section 106 review process (DEIS Appendix L, p.L-24).

The total absence of a section or discipline report dedicated to assessing the social and/or socioeconomic impacts of the Proposed Project within the DEIS is a fatal flaw.

Thus, the DEIS fails to address or employ widely accepted professional standards to ensure a thorough, objective and transparent evaluation of the Proposed Project, and any alternatives.

Overall, the DEIS does not provide decision makers with an accurate understanding of the potential impacts of the Proposed Project or any alternative. The lack of appropriate detail and analysis across resource area discipline reports and appendices (e.g. Appendix B Cultural Resources, Appendix D Environmental Justice, and Appendix L Tribal Resources) suggests a lack of concern as to whether or not people who live in and rely upon the Basin's natural resources are better off as a result of the Proposed Project – or how local and regional economies are likely to be impacted by the Proposed Project . WAC 197-11-440(6)(a) states that the affected environment, significant impacts, and mitigation sections of an EIS shall "analyze significant impacts of alternatives including the proposed action."

Given the magnitude of the Proposed Project, the state abused its discretion in electing not to conduct any meaningful analysis surrounding the economic and social impacts attributable to the Proposed Project.

Socioeconomic and sociocultural impacts associated with the Proposed Project and alternatives should be fully assessed and disclosed in the DEIS, including, but not limited to, the following:

a. Evaluation of potential changes to the region's economy as a result of dam construction and operation (e.g., changes to sectors as commercial and tribal commercial fishery, recreational fishery, recreation, and tourism, etc.).

b. Assessment of impacts associated with economic changes to families, communities, and cultures, including potential changes to those aspects of the area's economy that are currently subsistence-based.

c. Evaluation of replacement costs from reduced subsistence harvest of traditional foods if access or availability are impacted by the Proposed Project.

3. **Future costs of proposed mitigation are not included and strategies to compensate for impacts is not demonstrated.**

In the general failure of the DEIS to reasonably address mitigation for various resources (e.g. wetlands, streams, aquatic, terrestrial and riparian habitat, fish and wildlife species and habitat, surface water quality, recreation) it similarly does not acknowledge or include future costs associated with mitigation strategies presented. Each type of mitigation strategy also has risks for achieving successful mitigation, which should be addressed within cost estimates.

Compensatory measures are presented to increase the feasibility of an alternative. The absence of cost information for mitigation presented contributes significantly to the underestimation of projected costs by obfuscating or simply not including major costs (e.g.

monitoring and management, land and easement acquisitions).[3] For example, wetland mitigation for an estimated minimum of 24 acres will be subject to a management plan that will include maintenance, annual and long-term monitoring for established success criteria, and adaptive management. The EPA estimates that the typical Section 404 enforcement monitoring period ranges between five and ten years.[4] Developing, updating and enforcing management plans and conducting required monitoring will require a substantial investment over time. Other requirements may continue for the life of the Proposed Project. Yet, as with its general approach to addressing mitigation, the DEIS does not provide cost estimates for any of the mitigation measure likely required for the Proposed Project. Thus, making it impossible to either assess whether potential mitigation strategies for the Proposed Project, or any other alternatives, are prohibitively expensive or otherwise not economically "feasible" or "practicable." As a result, it is not possible to assess whether or not a particular alternative could be deemed to be impracticable under the Clean Water Act. The DEIS does not provide an economic feasibility study or any other type of economic assessment for the Proposed Project or for any of the other alternatives referenced throughout.

The failure to include estimated mitigation costs also complicates comparability across alternatives and offers decision makers no information on which to meaningfully assess whether mitigation measures proposed in the practicability determination.

Overall, the DEIS does not sufficiently address costs and effects on the range of mitigation measures identified.[5] ***Mitigation as presented in the draft DEIS fails to meet the requirement of WAC 197-11-440(6)(e), generally as well as specific to impacts on treaty reserved rights.***

4. **Limited scope of economic analysis; benefits of and damages to ecosystem services are not addressed.**

The DEIS discloses that virtually all resource areas (e.g., earth, fish species and habitats, land use, recreation, tribal resources, water, wetlands, wildlife species and habitat), *could* or *would* experience direct or cumulative effects as a result of the Proposed Project. Yet, the DEIS fails to assess the considerable economic consequences of these impacts.

Related to the limited scope of actual economic analysis, the DEIS does not include an evaluation of the ecosystem services that will be directly or indirectly affected by the Proposed Project. Additionally, an economic value has not been apportioned to compensate for the loss of these services. For instance, the DEIS states there will be economic benefits to cropland when water levels are decreased; however, there is no corresponding estimate of the loss in ecosystem services to forests and wetlands associated. Further, the indirect impact of the Proposed Project on downstream ecosystem services, such as flood mitigation or water quality improvement, is also not included in the DEIS.

[3] The regulatory definition of the word "significantly" at 40 CFR 1508.27 – as in "major federal action significantly affecting the quality of the human environment" – includes as measures of impact intensity:
[4]U.S. Environmental Protection Agency. "Section 404 of the Clean Water Act." 33 U.S.C §§ 1251 et seq EPA
[5] The definition of "effects" at 40 CFR 1508.8 – as in "effects on the quality of the human environment" – includes changes in the human environment that are "aesthetic, historic, cultural, economic, (or) social."

The Chehalis Basin provides a variety of ecosystem services. Resource Dimensions (2020) estimate that ecosystem services in the basin provide a value of $35,000/acre to upwards of $250,000/acre, Table 2. Ecosystem services such as flood prevention and water treatment are an important part of the true value of Chehalis Basin natural ecosystems. With the value of many of the ecosystem services that would be altered by the proposed project, such as water regulation, water treatment, etc., in the thousands of dollars per acre category, omitting a review or study of the regions ecosystem services is a serious concern and will leave decision makers with inadequate information on which to gauge how the Proposed Project will further impact the capacity of the Basin's natural systems to support the provision services such as flood and erosion control, purification of air and water, regulation of hydrologic flows, recreation opportunities, fish and wildlife habitat, and more.

Table 2. Summary of Chehalis Basin ESVs, by Service (2019$)

	Low		High	
Ecosystem Services Provided	Min	Max	Min	Max
Provisioning				
Food	$794	$2,832	$826	$2,969
Water Supply	$557	$3,983	$614	$4,397
Regulating				
Biological Control	$60	$72	$65	$77
Gas & Climate Regulation	$35	$206	$37	$217
Natural Hazards Mitigation	$441	$2,239	$458	$2,438
Pollination	$2,805	$49,520	$2,969	$53,313
Erosion Control	$73	$2,245	$76	$2,337
Soil Formation	$245	$5,847	$269	$6,322
Waste Treatment	$153	$20,436	$165	$22,735
Water Treatment & Quality	$444	$13,937	$513	$15,155
Water Regulation	$4,764	$7,148	$5,358	$7,946
Societal/Cultural				
Aesthetic/Amenity	$2,175	$61,737	$2,273	$65,566
Recreation/Tourism	$22,020	$40,696	$23,490	$43,539
Supporting				
Habitat and Nursery	$192	$7,638	$241	$9,296
Biodiversity/Genetic Resources	$46	$1,081	$53	$1,138
Total Annual Value ($/acre/year)	***$34,806***	***$219,617***	***$37,408***	***$237,446***

To address deficiencies outlined here, the DEIS should:

a. Explicitly identify the nature and degree of effect of the Proposed Project on the aquatic ecosystem, including the severity or significance of those effects.

b. Include ecosystem services valuation analysis and other analyses that determine impacts on ecological function.

c. Include the cost of protecting the existing wetlands from potential impacts from Proposed Project and reasonable alternatives in the cost-benefit calculations.

d. Include benefits in the project alternatives that could enhance Chehalis Basin ecosystems and the provision of goods and services (e.g. forest conservation/management, wetland restoration, aquatic habitat restoration, etc.).

5. The feasibility of mitigation required to compensate for the impacts on fisheries resources is not demonstrated.

The DEIS does not, and cannot, properly assess the extent to which adverse impacts on fisheries can be avoided through mitigation because it does not implicitly assess the extent and range of direct, indirect, and cumulative adverse impacts that will result from construction and operation of the Proposed Project. **Thus, the DEIS fails to meet the requirement of WAC 197-11-440(6)(c)(iii)**, which states "clearly indicate those mitigation measures, if any, that could be implemented or might be required, as well as those, if any, that agencies or applicants are committed to implement."

Failure of the DEIS to assess the extent that fisheries would be impacted, including the economic and ecological changes which would occur under the Proposed Project, results in an inability to assess the feasibility of mitigation that would be required. The economic value of the fisheries in the Chehalis river region are not inconsequential sums of money. Gislason et al. (2017) estimated that commercial and recreational salmon fishing accounted for an annual average of more than $1.39 billion in GDP and supported more than 26,000 jobs in the U.S. economy. Locally in the Chehalis region, Resource Dimensions (2015a, b) estimated the economic value of fisheries in the Chehalis county region to be worth more than $55 million ($2020 dollars), directly affecting more than $9 million of personal income for more than 250 individuals and more than 40 indirect jobs worth more than $2 million annually.

There are also farther reaching national and international impacts for which mitigation has not been addressed. The current DEIS does not allow these impacts to be mitigated, let alone assess the mitigation needed, due to the lack of analysis on the economic and cultural value of the fishery. These oversights in the DEIS are egregious in and of themselves but are compounded by recent history where salmon have been threatened, populations have declined rapidly in many areas and Endangered Species Act (ESA) lawsuits abounded. No Proposed Project would escape litigation without a thorough accounting of the proposed impacts to a fishery, demonstration of feasibility to actually complete mitigation and a plan for constant monitoring and adaptation to ensure mitigation was successful.

To provide vital information on which decisions regarding the Proposed Project, or any alternative can be made, mitigation measures must be identified and assessed for feasibility. The DEIS does not identify or assess mitigation measures that are "reasonable and capable of being accomplished." RCW 43.21C.060. Further, the DEIS does not discuss reasonable mitigation measures that would significantly mitigate impacts identified. WAC 197-11-440(4). The DEIS does not indicate what the projected environmental benefits of mitigation measures are for significant adverse impacts, nor does it discuss their technical feasibility or their economic practicability, provides no indication as to concern about whether a

mitigation measure is capable of being successfully accomplished, and does not have a study area that accounts for the expansive potential impact to resources outside the narrowly defined study area.

In addition, no mitigation of impacts to the United States obligations to the Pacific Salmon Treaty were addressed. Certainly, a firm understanding of the United States responsibilities to this international and legally binding treaty are required before proper mitigation could be determined, and the feasibility of this mitigation could be assessed.

By failing to demonstrate the feasibility of mitigation to compensate for impacts to fishery resources the DEIS fails the requirement of WAC 197-11-440(6)(c)(i-iiV).

6. **Adaptive management plan lacks detail to ensure resources affected by the Proposed Project are duly mitigated.**

Adaptive management is a widely accepted practice, allowing for mid-course corrections when the original mitigation goals are not achieved. Use of adaptive management can significantly increase the effectiveness of mitigation efforts. However, it requires considerable data input on project conditions because the data are used as the basis for future mitigation decisions. Effectively implementing adaptive management requires a commitment to collect data on which to base ongoing management decisions.

The use of adaptive management as described in the DEIS, is supported. However, the cost to implement adaptive management can be high, given the need for repeated iterations of management action, collection of field data on site conditions, and reanalysis of approaches required to provide the necessary mitigation.

Significant additional detail is needed on the type of parameters to be monitored and what criteria will be used to determine if mitigation strategies have reached their desired objectives. Further, the adaptive management approach requires both a monitoring and response phase. There is no indication as to what type of modification would occur in the mitigation plan (e.g., increase in mitigation acreage) if the mitigation actions do not meet objectives. The DEIS does not include costs associated with implementation or identify funding sources. **The source of funding is a critical aspect of the adaptive management plan that needs to be identified to ensure that the project goals are achieved**.

To address deficiencies discussed here, the DEIS should:

a. Specify the funding source(s) to support ongoing adaptive management of the mitigation projects and include these costs in the overall cost of the project.

b. Provide a sufficiently detailed monitoring plan that at a minimum outlines frequency of specified monitoring, identifies specific parameters that will be monitored, objective criteria or thresholds for assessment of success, and potential responses if mitigation does not reach objectives (e.g., additional mitigation).

ERRORS, OMISSIONS, INCOMPLETE OR UNDERESTIMATION

Several important errors, areas of incomplete work, and related underestimation and omissions were identified in our review. Comments framed in Table 1, are presented in order here:

7. Failure to Assess Economics of Future Expanded Dam FRE-FC) Alternative

The DEIS fails to conduct any assessment, inclusive of cost-benefits or economic impacts, associated with the expanded dam "future expanded dam (FRE-FC)" alternative presented in the FRE Dam Alternative Supplemental Design Report (September 2018). Exclusion of analysis of the FRE-FC alternative suggests a "phased review" approach given the specific design features of the proposed FRE (flood retention expandable) dam.

Direction from WAC 197-11-060 (5) (e), which provides *"(e) When a lead agency knows it is using phased review, it shall so state in its environmental document,"* the SEPA Handbook, states *"Whenever phased review is used, the SEPA document must clearly state that the proposal is being phased."* (WSDOE, 2018, p.11). The DEIS for the Proposed Project has not been presented as a phased review.

Further, WAC 197-11-060 (5) (d) (ii and iii) expressly states that, phased review is not appropriate when … *(ii) It would merely divide a larger system into exempted fragments or avoid discussion of cumulative impacts; or (iii) It would segment and avoid present consideration of proposals and their impacts that are required to be evaluated in a single environmental document under WAC 197-11-060 (3)(b) or 197-11-305 (1)."*

As the DEIS solely considers the FRE alternative, the failure to fully analyze the cost-benefits and economic effects associated with the FRE-FC is a gross omission of the DEIS.

Additionally, as noted in comment #9 of this review, each alternative should be assessed using consistent methods and metrics to provide for comparability of impacts (direct, indirect and cumulative), across alternatives.

Lastly, as with the estimation of costs for the proposed FRE facility, to avoid underestimating costs for the FRE-FC inflation-adjusted estimates should be presented using the time period in which construction is projected to occur (e.g. 2025 to 2030). Similarly, inflation-adjusted estimates should be provided for operation and maintenance costs from the first year of projected operation through the expected life of the Proposed Project.

8. Several significant costs are not included in projected estimates for the Proposed Project.

There are numerous costs associated with the proposed FRE project. Yet, as noted in this review, the DEIS does not include CBA or economic impact analysis, either of which would have required a systematic development of all Proposed Project costs, as well as those associated with alternatives. The result is a scattering of cost and economic information buried within various sections of the DEIS and its many discipline and technical reports. Further complicating interpretation and understanding of cost development are the

inadequate detail about the extent of Proposed Project costs. For example, certain construction, land acquisition, mitigation actions, and adaptive management costs over the life of the project are at best fleetingly referenced, though largely absent.

The information referencing Proposed Project costs throughout the DEIS neither provides adequate defensible calculations of costs and/or analysis of costs, or any comparative format in which to evaluate costs, changes to local and regional economy, socioeconomic impacts, or impacts that may affect the future possibility for members of the Quinault Nation to exercise their treaty rights (economic, socioeconomic and cultural). The absence of such information provides no sound platform for decision-making with regard to the social, environmental, economic, and other public health and safety considerations related to the proposed FRE project, or other potentially viable alternatives.

Areas of significant costs **not included** within the development of the cost estimate for the Proposed Project are below. It should be noted that the list is not intended as inclusive.

- All Mitigation (e.g., compensatory mitigation, wetland creation, etc.) and ongoing monitoring and/or adaptive management.
- Consultation with affected tribes.
- Plan development (e.g., mitigation, adaptive management, and contingencies).
- Local Actions Alternatives (no costs or benefits).
- Teardown and rebuilding costs for the Proposed Project. The projected lifespan of the Proposed Project is 100 years. At the end of the 100 years, the dam will have to be torn down or significantly rehabilitated. Excluding these costs is misleading; and will leave the next generation with a significant bill.
- Quarry development and access roads (e.g. land acquisition, quarry development and road construction). Costs for new road construction and road crossings required for quarry access should be included in project costs. (DESI, Appendix O, 2.4.1.1; p. O-9 and O-21).
- Stream crossings - 36 new stream crossings associated with the proposed action are identified. Quarry access road construction together with the required stream crossing structures will contribute significant costs to the project. Estimates developed from current studies indicate significant cost variation, depending on the variables (e.g. stream indicated as fish habitat, slope, bridge required, etc.) and associated requirements. Given the number of crossings, required permits, engineering and road construction costs, the total costs could easily reach into the millions.
- Public Services: water supply system Pe Ell (DEIS, Summary, Significant Impacts Summary; p. S-13, Exhibit S-6).
- Costs for Construction equipment operation and maintenance staff and cumulative economic and social impacts were not included in development of project costs for the proposed FRE facility.
- Cost of development of Airport Levee Changes (e.g. permits as flood hazard zone, earth moving, right of way, NPDES) and ongoing monitoring and maintenance.

Misrepresentations of Proposed Project Costs

Related to the cost development errors and omissions previously identified, the DEIS does not provide project inflation-adjusted cost estimates for the Proposed Project. To avoid underestimating the costs of the proposed FRE project, inflation-adjusted estimates should be presented using the time period in which construction is projected to occur (e.g. 2025 to 2030). Inflation-adjusted estimates should be calculated for operation and maintenance costs from the first year of projected operation through the expected life of the Proposed Project.

For example, using the information developed for the FRE Dam Alternative Supplemental Design Report (September 2018), the weighted/middle estimated capital costs to construct the proposed FRE facility, in 2017 US$ as reported is $401 million. Adjusting for inflation for the period during which construction is anticipated, between 2025 and 2030, the weighted/middle estimate is $ $484.8 million, using an average annual rate of inflation of 2.4% (Table 2). Similarly, operation and maintenance (O&M) costs for the FRE alternative are estimated at $628,000 per year (in 2017$), starting in 2030, if permitted. Inflation-adjusted to 2030, the first projected year of operation, the annualized O&M costs are estimated at $858,954 or approximately 26% greater, assuming average annual rate of inflation of 2.4%.

Table 2. Estimated Direct Project Costs for FRE Option (2025$)

	Lower Bound ($million)		Weighted/Middle ($million)		Upper Bound ($million)	
Feature	2017$	2025$	2017$	2025$	2017$	2025$
FRE RCC Dam	$307	$371	$358	$432.8	$419	$506.5
Upstream Fish Passage: CHTR Facility	$32	$38.7	$43	$51.9	$65	$78.6
Total	**$339**	**$409.8**	**$401**	**$484.8**	**$484**	**$585.1**

Adapted from Table ES-1. Estimated Total Direct Project Costs for FRE Option.

While a rough estimate on the incomplete cost estimates offered, when adjusted to the assess true future costs, a more realistic current cost estimate is about $ 526 million.

The following should be completed to address errors and omissions pertaining to development of Proposed Project costs estimates, as well as any alternatives presented:

a. Conduct a thorough CBA and economic impact analysis. Present detail on all costs and benefits monetized and included in Proposed Project calculations. Justify reasons for not including any costs not incorporated into calculations.

b. Provide economic models underlying benefits analysis, inclusive of all data used.

c. Define all variables used in any empirical model and explain relevant equations that quantify relationships between them. Explain whether tests for serial correlation were conducted in the analysis and if so, what corrections were made.

d. Clarify the role of crop and flood insurance assumed in the agricultural economics model and explain any assumptions about risk preferences.

e. Itemize all costs (including mitigation and adaptive management) and all benefits for each year of the project, both in nominal and in present value terms.

f. Discuss in text the content of all tables that provide numbers with economic relevance.

9. Equal and comparable analyses, across alternatives, are not provided.

Requirements for the contents of an EIS are addressed WAC 197-11-440. Section (5) specifically speaks to *"Alternatives including the proposed action,"* wherein subsection (5)(b) advises that *"Reasonable alternatives shall include actions that could feasibly attain or approximate a proposal's objectives, but at a lower environmental cost or decreased level of environmental degradation".*

Further, subsection (5)(c) provides that, among other things, the *"…EIS shall:*
(v) Devote sufficiently detailed analysis to each reasonable alternative to permit a comparative evaluation of the alternatives including the proposed action.

(vi) Present a comparison of the environmental impacts of the reasonable alternatives, and include the no action alternative."

To ensure comparative evaluation per WAC 197-11-440 (5)(c)(v) economic benefits from reduced future flooding can be consistently measured in terms of:

- Residential benefits (population and households)
- Business benefits (economic valued added that is "at risk" in the floodplain)
- Property valuation benefits (measures of assessed values)

The DEIS must have sufficient detail to inform decision makers (Chehalis Basin Board) about the impacts, including economic impacts, that can be reasonably anticipated if the Proposed Project is approved. And, as further discussed in Comment #16, the DEIS must provide a reasonable range of alternatives so the Board can evaluate whether there are other options available that would meet the stated objectives of the project. Is there an alternative, for instance, that provides 90% of the benefit but only 50% of the harm? That comparative analysis cannot be undertaken if the DEIS is too general and fails to clearly identify the magnitude and character of the impacts and the difference in impacts among the alternatives.

Failure of the DEIS to conduct essential analysis required to provide comparable results for the evaluation of the Proposed Project, or any alternative, results in the inadequate disclosure of the full extent of impacts associated with each alternative. By extension, there is no clear understanding of the potential economic benefits provided by Alternatives.

To address the issues noted and ensure the DEIS is prepared in such a way as to "permit a comparative evaluation" by decision makers, the DEIS should:

- Make a substantial, objective effort to study, analyze, and present information on economic impacts and socioeconomic consequences relevant to the actions considered in a format that allows for straightforward comparative evaluation.
- Fully disclose all relevant information, and provide full transparency to the decision-making process, to enable the public and decision makers to understand the rationale for selecting a preferred alternative.

10. Economic impacts correlated with changed ecosystem function are not considered.

Significant degradation is measured by substantial adverse impacts on: (a) human health or welfare, including municipal water supplies, plankton, fish, shellfish, wildlife, and special aquatic sites; (b) life stages of aquatic life and other water-dependent wildlife; (c) aquatic ecosystem diversity, productivity, and stability, such as loss of fish and wildlife habitat or loss of the capacity of a wetland to assimilate nutrients, purify water or reduce wave energy; and (d) recreational, aesthetic, and economic values.

Ecosystem services are products and services provided by the environment. Any improvements or damages to the environment have impacts on the nature's capacity to deliver ecosystem services. The DEIS outlines a series of environmental impacts, yet, makes no attempt to quantify the values associated with those impacts.

The Proposed Project and each alternative (FRE-FC and Local Actions) has a different portfolio of impacts. To fully evaluate the economics of each alternative, the DEIS should look at improvements and damages (near- and long-term) to ecosystem services and their associated monetary values. Inclusion of non-market valuation is well-established in environmental decision making (e.g. Atkinson and Mourato, 2004; Brown, 2009; Fisher et al., 2009).

The recent ecosystem service valuation conducted for the Chehalis Basin, reveals the magnitude of the region's ecosystem services. Study results indicate that the Basin's natural capital provides an estimated minimum of $1.1 to upwards of $15.7 billion in ecosystem service benefits annually, Table 3 (Resource Dimensions 2020).

Acknowledging natural capital as a transitory economic asset, similar to roads and other infrastructure, conservatively the asset value of the Basin over 100 years is between $49.1 billion and $206.2 billion at the lower bound and between $53 billion and$223.7 billion at the upper bound.

Table 3. Summary Asset Value of the Chehalis Basin

	ASSET VALUE			
	Low		High	
	2%	7%	2%	7%
Minimum	$49,148,681,066	$16,272,428,654	$53,023,502,383	$17,555,326,832
Maximum	$622,911,396,122	$206,237,095,910	$675,692,683,790	$223,712,228,898
Periods (years)	100	100	100	100
Annual Value	***$1,140,384,242***	***$14,453,253,371***	***$1,230,290,727***	***$15,677,924,052***

Source: Resource Dimensions, 2020.

The natural capital and correlated ecosystem services in the Chehalis Basin are extremely valuable – the natural capital of the region underpins the region's economy. Any damage to the current function of the basin's ecosystems will result in changes to the economic contributions provided through diverse ecosystem services, as well as the basin's asset value.

The DEIS correctly identifies *"…probable significant adverse environmental impacts from both construction and operation."* (DEIS, p. S-11) associated with the Proposed Project, including those as *"…impacts on the Town of Pe Ell's water supply, environmental health and safety, environmental justice populations, and wetlands from the Airport Levee Changes."*, and the elimination of *"…peak channel-forming flows downstream, (which would) reduce input of large woody material, and significantly affect habitat."* (DEIS, p. S-8).

Omission of non-market values leaves substantial economic impacts out of the decision-making process and ignores important differences between the proposed action and other viable alternatives.

11. Economic and social impacts that extend beyond the geographical boundaries of the study area are not addressed.

The DEIS states that several species of salmon are expected to be significantly and adversely affected if the Proposed Project proceeds. Chinook and coho salmon originating in the Chehalis Basin are harvested by commercial, recreational, and subsistence fisheries within the Chehalis Basin and the Grays Harbor estuary. Additionally, these species are harvested over an extensive marine geographic area. The marine fisheries that depend on these salmon range from southern Oregon to British Columbia. In addition, there are important inter-regional linkages in the salmon industry, both within the U.S. and between the U.S. and Canada. The fishing activity in one region can have beneficial impacts on the economy of another region. Seattle and Washington State are major economic beneficiaries of important inter-regional linkages in the salmon industry, both within the U.S. and between the U.S. and Canada. In addition, any impacts to salmon in this region will lead to subsequent updates to the Pacific Salmon Commission for updating to the Pacific Salmon Treaty as decreases to stocks must be reported within that body (Pacific Salmon Treaty 2020).

Although the DEIS states that "significant adverse impacts" will occur (DEIS Section 5.3, page 71), no economic analysis or impact analysis has been conducted to understand the economic

or social implications relative to any change in abundance of Chehalis Basin salmon. Furthermore, the DEIS does not provide an equitable economic analysis of fisheries as a commodity. Both ocean and in-river fisheries that depend on the health of Chehalis River salmon stocks provide millions of dollars in economic activity annually. From 2012-2015, Gislason et al. (2017) estimated that commercial and recreational salmon fishing accounted for an annual average of $1,996 million in GDP and supported 26,700 FTE jobs in the U.S. economy. Resource Dimensions (2015a, b) estimated the economic value of fisheries in the Grays Harbor county region to be worth more than $55 million ($2020 dollars), directly affecting more than $9 million of personal income for more than 250 individuals and more than 40 indirect jobs worth more than $2 million annually.

The DEIS analysis does not include impacts to fish populations outside the Chehalis Basin. Use values occurring outside of Washington are likely substantial, given the percentage of mortality that occurs north of the U.S./Canada border. The 2018 Pacific Salmon Commission (PSC) Joint Chinook Technical Committee's Chinook Salmon report indicates that 90% of U.S. stocks are harvested in Alaska and Canada (PSC 2019). Fishery Use Values reported in the Appendix C Economic Study Update account for at most 10% of the Chinook Use Value (PEIS 2016). Any impact to Chehalis Basin salmonid populations will have significant implications for the entire economy of Pacific Rim fisheries.

Further, analysis related to the economic importance of the commercial, recreational, and subsistence fisheries, must take into account marine fisheries along coastal Oregon and Washington waterways. In addition, analyses must be conducted to understand what the potential loss of the potential loss of genetic diversity within the salmon population will have for the species across a wider geographic area. Impacts to international treaties, specifically the Pacific Salmon Treaty, dictates that the geographic scope for analyses on specific fishery resources must expand to any marine fishery that depends on salmon which require the Chehalis river for spawning.

By excluding analysis of the economic and socioeconomic impacts associated with the Proposed Project, the DEIS fails to address the extent and range (spatial and temporal) of direct, indirect and cumulative impacts that extend beyond the Basin's boundaries.

12. Impacts of Proposed Project, from an environmental justice perspective, are not properly analyzed or considered.

Environmental justice is defined by the United States Environmental Protection Agency (EPA) as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."[6]

To guide our assessment of the soundness and appropriateness of the DEIS treatment, we consulted two principal sources: Executive Order (EO) 12898 and the *Environmental Justice,*

[6] U.S. Environmental Protection Agency. Environmental Justice. What is Environmental Justice? Accessed March 24, 2020. Available at: http://www.epa.gov/environmentaljustice/.

Guidance Under the National Environmental Policy Act composed by the Council on Environmental Quality (CEQ, 1997).

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, was issued by President Clinton on February 11, 1994. This Order "*directs federal agencies to identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law.*"[7]

Section 3-302 of EO 12898 directs Federal agencies to "*collect, maintain, and analyze information assessing and comparing environmental and human health risks borne by populations identified by race, national origin, or income. To the extent practical and appropriate, Federal agencies shall use this information to determine whether their programs, policies, and activities have disproportionately high and adverse human health or environmental effects on minority populations and low-income populations.*"[8]

CEQ (1997) states in the memorandum accompanying transmission of EO 12898, President Clinton directed Federal agencies to "*analyze the environmental effects, including human health, economic and social effects, of Federal actions, including effects on minority communities and low-income communities, when such analysis is required by [NEPA].*"[9] It furthers states that "*Environmental justice concerns may arise from impacts on the natural and physical environment, such as human health or ecological impacts on minority populations, low-income populations, and Indian tribes, or from related social or economic impacts.*"[10]

CEQ (1997) sets forth that:

> "*the question of whether agency action raises environmental justice issues is highly sensitive to the history or circumstances of a particular community or population, the particular type of environmental or human health impact, and the nature of the proposed action itself. There is not a standard formula for how environmental justice issues should be identified or addressed. However, the following six principles provide general guidance.*
>
> *Agencies should consider the composition of the affected area, to determine whether minority populations, low-income populations, or Indian tribes are present in the area affected by the proposed action, and if so whether there may be disproportionately high and adverse human health or environmental effects on minority populations, low-income populations, or Indian tribes.*"[11]

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[7] U.S. Environmental Protection Agency. Summary of Executive Order 12898 – Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. Accessed March 24, 2020. Available at: http://www2.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice.

[8] Clinton, William J. Executive Order 12898. 59 Federal Register 7629. February 16, 1994. Accessed March 24, 2020. Available at: http://www.archives.gov/federal-register/executive-orders/pdf/12898.pdf.

[9] Council on Environmental Quality. 1997. Environmental Justice, Guidance Under the National Environmental Policy Act. P. 1. Accessed March 24, 2020. Available at: http://www.epa.gov/environmentaljustice/resources/policy/ej_guidance_nepa_ceq1297.pdf.

[10] *Ibid.* P. 8

[11] *Ibid*. Pp. 8-9

While SEPA does not require environmental justice analysis, guidance comes from NEPA in the implementation and application of SEPA. Given the magnitude of the Proposed Project, the composition of the population, extent of environmental impacts, and likely engagement of federal funding an environmental justice analysis should be a requirement of the DEIS.

In applying NEPA, agencies are required to conduct environmental justice analysis in to assess the potential that a proposed action would have disproportionate impacts affecting minority or low-income groups. Following directives of Executive Order 12898 on Environmental Justice, actions should be taken to conduct adequate public outreach and participation that ensures that the public and Native American tribes understand possible impacts to their communities and trust resources.

While the DEIS presents an Environmental Justice Discipline Report (Appendix D), we find several of its conclusions flawed Appendix D. Most significantly, the Quinault Indian Nation has not been included within the study area defined. While the Nation's reservation lands do not fall within the boundaries defined by WRIAs 22 and 23, which comprise the Chehalis River Basin, the Quinault people have lived on the lands and relied upon its rich resources since time immemorial. The DEIS correctly recognizes the Nation's Treaty Rights to fish and hunt in the Basin. Though, in its exclusion of the Nation the DEIS completely fails to recognize the economic, cultural and subsistence importance of these resources to the Quinault people.

The DEIS further fails to identify and assess the interrelated environmental justice impacts associated with the significant and unavoidable environmental impacts to fish and habitat and water quality. For example, children in tribal communities may consume as much as fifteen times more fish than children in the general population (U.S. EPA, 2011). Additionally, some population groups may eat food predominantly from specific locations. Likewise, subsistence fishers may consume fish far more frequently and obtain it exclusively from local waterways.

The DEIS also incorrectly concludes that environmental justice populations will not be disproportionately impacted as "… impacts on land uses from the Proposed Action would occur where people do not live." Generally, current marginal lands within the flood zone will increase in value. The location of these lands correlate to several areas where populations of concern live. The relationship between poverty and proximity to areas most susceptible to natural disaster is well documented. (Thiede, et al. 2018; Lichter & Johnson, 2007). The 2011 Chehalis River Basin Flood Authority Flood District Formation Study found assessed values of real property are approximately 40% higher outside the floodplain than inside the floodplain. (FCS Group 2011). The determination made by the DEIS that environmental just populations will not be disproportionately impacted is flawed. (DEIS, Appendix D, 3.2; p. D-27, D-32).

The DEIS analysis associated with this section fails in several important regards, and specifically does not address the fact that population in poverty both gravitates to areas of high flood risk (potentially for jobs or because of marginalization into high risk areas) and are less likely to recover from economic losses of flooding. Carmiento and Miller (2006) affirm that a population that lives in poverty is most significantly likely to be affected by flood hazards. **The economic and socioeconomic impacts to populations of concern are not appropriately addressed.**

The DEIS correctly acknowledges that catastrophic failure of the facility would have a significant and disproportionate impact on the study areas environmental justice populations. Further, the DEIS acknowledges that the cumulative impacts of the Proposed Action (in combination with construction, operations, catastrophic failure) would contribute to cumulative impacts disproportionately affecting populations of concern. However, mitigation proposed are insufficient; outreach efforts do not constitute mitigation. Mitigation should consider economic impacts as well as risk factors. Similarly, the DEIS makes the appropriate linkage between risk to populations of concern and the matter of public health and safety. Though, again the DEIS fails to identify essential mitigation measures.

The above should not be construed as a complete list of failures or shortcomings of the DEIS in its environmental justice assessment for the Proposed Project. To correct issues identified as well as others inherent in the incomplete and insufficient approach employed in the DEIS environmental justice assessment, we recommend:

- Inclusion of Native American communities, both located in and with Treaty Rights in the Chehalis Basin, that may be impacted by the project;
- Describing the efforts that have been or will be taken to meaningfully involve and inform affected communities about project decisions and impacts;
- Disclosing the results of meaningful involvement efforts, such as community identified impacts;
- Evaluating identified Proposed Project impacts for their potential to disproportionately impact low income, minority, or Tribal communities, relative to a reference community;
- Disclose how potential disproportionate impacts and environmental justice issues have been or will be addressed by the State's decision making process;
- Propose mitigation strategies for unavoidable impacts that will or are likely to occur; and
- Include a summary conclusion that concisely expresses how environmental justice impacts have been appropriately avoided, minimized, or mitigated.

Further, particular attention should be given to consideration of the dependence of local communities on local and regional subsistence resources, access to those resources, and perception of the quality of those resources.

13. Important cost-benefit and economic impact analysis have not been provided for the airport.

Related to the Centralia-Chehalis Airport, essential cost-benefit and economic impact elements have not been addressed within the DEIS. The Proposed Project includes modifications to the current levee around the Centralia-Chehalis airport. Proposed changes include increasing levee height by 4 to 7 feet along its 9,511 foot length with earthen materials or floodwalls; raising 810 feet of NW Louisiana Avenue along the southern extent

of the airport; replacing utility infrastructure; widening portions of the existing levee base, and other more minor improvements. DEIS, p. 22.

There is a long history of applying CBA to the evaluation of airport investment analysis, infrastructure investment analysis, transportation and flood risk management projects. Economic analysis provides important rational information to support the decision-making process. The basic principle of CBA requires that a project results in an increase of societal welfare – that is, the benefits to society generated by the project exceed the costs. Every effect of a project can be systemically estimated and, wherever possible, given a monetary value. Additionally, CBA gives an overview of distribution effects, alternatives, and uncertainties.

Though, consistent in its approach, the DEIS does not include a CBA or any economic analysis of the airport in the context of the Proposed Project. Thus, assuring the absence of essential information required for decision makers to fully assess important dimensions of the Proposed Project. No consideration is given to the costs associated with the construction (e.g. permits, engineering, materials) required to accomplish the proposed Airport Levee Changes, or the associated ongoing maintenance costs.

Additionally, with regard to the stated purpose of protecting the airport against flood damage, there are other *"reasonable"* alternatives that should have been assessed, including moving the airport WAC 197-11-440(5)(b). Completion of a CBA as part of the DEIS would have provided the public and decision makers information needed to assess the economic benefits of the airport for the region versus the costs of protecting it from flood damage.

Related to the consideration of other alternatives, the DEIS fails to consider the airport levee in combination with any alternative other than the Proposed Project. Similarly, the DEIS fails to quantify possible benefits of building flood wall or levees around key infrastructure. Instead, flood proofing is considered, though very generally and without any assessment of costs or benefits to key infrastructure. As with other building level flood-damage risk reduction and adaptation measures, the decision on the use of flood proofing techniques, alone or in combination with flood protection requires cost-benefit analysis (de Ruig, et al 2019).

Given the lack of cost benefit analyses, economic impact analyses and the exclusion of assessing other reasonable alternatives to the proposed project, the DEIS fails to provide the public and decision makers with accurate and reliable information with which to make a decision about the Proposed Project, or any alternatives.

14. **Economic impacts associated with identified significant potential impact to region's fisheries are not addressed.**

From an economics standpoint, analyses of the impacts and values associated with salmonids and other fisheries of the Chehalis Basin are wholly absent in the DEIS. While there has been rigorous study and evaluation of the region's fish species and aquatic habitat, the DEIS shows no level of expertise in understanding fisheries economics. One of the primary economic concerns is the lack of information within the DEIS pertaining to the economic value and

impact analyses. This limitation makes assessment of the net marginal economic benefits of the Proposed Project or potential alternatives impossible.

Given the economic, recreational, subsistence and cultural importance of the region's fisheries, absence of a more robust analysis relative to the integrated economic and social impacts of the proposed FRE facility and potential alternatives is a grievous error of the DEIS. Guidelines require, for example, an evaluation of effects to recreational and commercial fisheries, which includes harvestable fish, crustaceans, shellfish, and other aquatic organisms used by man. 40 C.F.R. § 230.51.

We believe this issue can be resolved by quantifying the project-related changes in population size and estimating the economic value (or socioeconomic significance) of these population size changes.

Another prominent issue identified is that the DEIS does not explicitly identify the timeframe for effects of the Proposed Project, or any alternatives. Timing can affect the magnitude of the net present value of benefits and costs. The DEIS should clearly specify the full time period for which costs and benefits for each alternative are likely to accrue and provide an estimate of these costs and/or benefits. It is also suggested that details on the economic model and the assumptions and data sources used to calculate regional economic impacts be added to the DEIS. The net marginal economic benefits of the Proposed Project should also be calculated.

The economic contributions of commercial fishing, tribal and non-tribal, on the region's economy cannot be understated. We summarize below from recently completed studies.

Commercial Fishing

The QIN has registered many concerns about how the proposed action could interfere with treaty fishing activities. The DEIS documents discuss some of these impacts, but do not consider possible economic impacts. Quinault treaty fishing activities represent not only subsistence and cultural values, but an important revenue source for tribal commercial fishers. Quinault fishing activities have the following economic impacts (direct, indirect, and induced) on the Grays Harbor County economy:

- 355.5 jobs,
- $12.3 million in personal income,
- $28.8 million in business revenue, and
- $9.67 million in local purchases.[12]

Resource Dimensions (2015a) estimates that at the low end of the scale (minor disruptions in business activities), rail and vessel traffic could cost tribal members 5% of their annual income due to rail delays and 2.9% of their income from disrupted fishing activities.

[12] Resource Dimensions. 2015a. Economic Impacts of Crude Oil Transport on the Quinault Indian Nation and the Local Economy.

Non-treaty commercial fishing and aquaculture activities in the county have additional economic impacts (direct, indirect, and induced) on Grays Harbor County's economy:

- 1,099.6 jobs
- $37 million in personal income
- $81.5 million in business revenue
- $37.2 million in local purchases
- $4.2 million in tax revenue[13]

The magnitude of these business activities indicates that economic damages from fisheries disruptions could be substantial. **Additional study is warranted; analysis of the Proposed Project within the DEIS does not capture potential impacts on the local and regional economy.**

The DEIS fails to fulfill the standard of WAC 197-11-440(6)(a) to quantify potential revenue losses resulting from the proposed actions.

MODERATE DEFICIENCIES

Other deficiencies, that affects the completeness and validity of the DEIS relative to economic effects, were identified in our review. Discussion on comments 15-16, framed in Table 1, are presented in order here:

15. **The cumulative impacts analysis does not consider the value of ecosystem services that have diminished over time.**

    The DEIS does not assign values to, or otherwise discuss, ecosystem services (e.g., erosion control, pollination, flood control) provided by Chehalis Basin lands and appurtenant natural systems. While functions of the basin's ecosystems have been significantly changed over time, the ecological value of the remaining connection to the Chehalis River is high (Resource Dimensions 2020). The loss of this last remaining connection is an example where additional impacts, no matter how small, will have a disproportionate cumulative effect by exceeding the threshold where floodplain connection ecosystem functioning is eliminated.

    The analysis of cumulative impacts is incomplete without a proper consideration of the effect of the Proposed Project on the diminution over time of regional ecosystem services provided by this flood-dependent ecosystem. (Costanza et al. 1997).

[13] Resource Dimensions. 2015b. Economic Impacts of Crude Oil Transport on the Grays Harbor Economy.

To address deficiencies discussed here, the DEIS should:

a. Prepare analysis of cumulative effects that includes evaluation of the Proposed Project and viable alternatives in terms of ecosystem services that have diminished over time.

b. Evaluate each of the alternatives (including any new alternatives) in terms of cumulative impacts on ecosystem services.

16. Detailed justification for not including potentially viable project alternatives from further consideration is not provided.

The DEIS fails to provide detailed and supporting justifications for not including other "reasonable alternatives." WAC 197-11-440(5)(b) states *"Reasonable alternatives shall include actions that could feasibly attain or approximate a proposal's objectives, but at a lower environmental cost or decreased level of environmental degradation."* For example, the Restorative Alternative (Alternative 4), as presented in the September 2016 Chehalis Basin Strategy PEIS, would be a reasonable alternative under SEPA as it could attain the proposal's objectives while resulting in less overall environmental impact than the proposed alternatives analyzed in the DEIS. See also WAC 197-11-786.

Detailed justification for not advancing the Restorative Alternative from further consideration is not adequately stated in the DEIS. The apparent reason is hollow, and cost based; justified through a flawed and incomplete CBA, and without comparative assessment of the economic impacts, or non-market valuation of the economic contributions provided through ecosystem goods and services. The stated criteria are *"lower environmental cost or decreased level of environmental degradation"* WAC 197-11-440(5)(b). No reference is given to exclusion based on economic feasibility. Yet, this is the only justification for excluding certain alternatives, such as the Restorative Alternative from assessment in the DEIS.

Comparability of alternatives relies upon equitable treatment in the analysis and presentation of alternatives. Using these principles, the Local Actions Alternative, FRE-FC facility, and the Restorative Alternative should have been equally developed for evaluation against the Proposed Project. This point is more fully discussed in comment #9.

Additionally, the DEIS fails to consider the airport levee in combination with anything other than the Proposed Project and further miscarries any effort to quantify possible benefits of building flood wall or levees around key infrastructure. Flood-proofing is only briefly addressed, and discussion is devoid of any assessment of benefits to key infrastructure. (DEIS, Chapter 2, 2.4 and 2.7; p. 24 and 26).

Alternatives presented for evaluation in the DEIS are limited and no additional actions have been developed for evaluation. The legislative directive contained in RCW 43.21A.730(1)) to "to aggressively pursue implementation of an integrated strategy and administer funding for long-term flood damage reduction and aquatic species restoration in the Chehalis river basin" is not achieved through the limited scope of alternatives presented for assessment in the DEIS. See the definition of "scope" for the three types of alternatives to be analyzed in EISs. WAC 197-11-792. There are at least two areas of concern that are not addressed by the alternatives presented, both of which have significant future economic consequences.

The first, centers on relocation; moving people and structures out of harm's way. The goal of a relocation alternative includes working with communities to develop a comprehensive approach to improve resilience against flooding by removing or relocating people and structures from the 10, or 20-year floodplain.

Across the county, relocation strategies are being successfully implemented as a solution that contributes to health and human safety, protects infrastructure investments, restores natural floodplain functions, and saves millions of dollars in avoided flood losses. For example, the community of Kinston, NC (pop. 25,000) located along the Neuse River. Following repeated flood damages resulting from hurricanes Fran, Dennis, and Floyd, the community embarked upon a relocation approach. Flood-prone properties were bought, and whole neighborhoods were relocated to higher ground. In total the program moved about 4% of nearly 10,000 households. Here, 95% of the property owners who received a buy-out offer accepted. It is estimated that the purchase of the first 100 homes saved approximately $6 million in avoided flood losses during the next big storm (Vreeland 2019; FEMA 2018).

Recent research has explored various aspects of buyouts, including social equity and cost effectiveness (Tate, et al., 2016). Several studies have shown that buyouts can reduce the losses from future floods (FEMA, 2009; FEMA 2016). These studies focus on "avoided losses," estimating the flood induced economic losses that would have occurred if homes had not been acquired and removed from flood hazard areas. For example, after major flooding in 2008, a study of avoided losses across eight communities in Missouri concluded that buyouts saved roughly $96 million in flood damages (FEMA 2009: 5-8).

The second, involves ensuring that alternatives developed and considered in the DEIS both achieve the goal of reducing environmental costs and further degradation to Chehalis Basin ecosystems and account for the foreseeable effects of climate change on both the freshwater and ocean ecosystems on which the Basin's fisheries depend. These alternatives should include both an analysis of the extent to which climate change may affect (e.g., erode the effectiveness of) any proposed mitigation measures, and specific actions to address the cumulative effects of climate change on fish species and their habitat.

The DEIS fails to comply with SEPA requirements to consider reasonable alternatives or to "Present a comparison of the environmental impacts of the reasonable alternatives and include the no action alternative." WAC 197-11-440(5)(b); WAC 197-11-440(5)(vi).

CONCLUSIONS

Based upon our analysis of cost estimates for the Chehalis River FRE project action and studies relevant to cost-benefit, economic and social analysis conducted, it is our conclusion:

- Cost omissions identified herein for project development, real estate acquisitions, capital costs of project development and construction, operation and maintenance, cumulative economic and social impacts, and required mitigation for the life of the project, create significant inaccuracies leading to unrealistic project cost estimates.
- No economic analyses have been conducted, thus the DEIS does not meet minimal sufficiency standards required to withstand an EIS environmental review for a project of this nature and significance. Generally accepted methodologies have not been used and there is no logical presentation of information to enable comparison of the Proposed Project against other potential alternatives.
- At best, the population at risk are identified, though there is no information about economic damages they would incur during a potential dam failure are clearly to support this project. Life safety risk and the annual probability of failure were discussed, as they should have been, though economic risk was given no consideration. The impact to the public is well-documented by the inundation maps. Yet, clear loss of life and economic impacts for the proposed FRE facility or viable alternatives are not presented either in the DEIS or the Environmental Health and Safety Discipline Report in the Baseline Consequences Analysis.
- The future costs associated with environmental mitigation plans are not adequately detailed. The DEIS should provide a clear explanation and presentation of the sensitivity of the estimated cost-benefit ratios, which are presented as point estimates, to the vast array of uncertainties inherent in dealing with future social, economic, climatic and environmental conditions.
- The analyses do not capture the full extent of economic and environmental impacts of the Proposed Project.
- The general and specific deficiencies, errors, omissions, and improper use of project cost development methods result in a document that only partially captures the costs of the FRE. The DEIS potentially reaches conclusions pertinent to the FRE or Local Actions alternatives that are not defensible by explanation and evidence presented.
- It is unclear if the costs for construction equipment operation and maintenance staff and cumulative economic and social impacts were included in development of project costs for the proposed FRE facility.
- The various omissions create incomplete information around the scale, intensity, risk/consequence of impacts and thus call into question the credibility of the DEIS analysis; and how these issues thus make it impossible to consider any potential for or adequacy of mitigation.
- The failure of the DEIS to engage in a transparent and complete independent economic analysis of the issues, alternatives and mitigations, leaves the public or decision makers with the burden of developing additional perspectives.

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ABOUT THE INDEPENDENT REVIEW

RESOURCE DIMENSIONS

Resource Dimensions is a multidisciplinary economic and policy consulting firm specializing in integrated analyses and the development of sustainable solutions. Drawing on extensive industry knowledge, distinguished professionals, and innovative analytics, we work with communities, tribal agencies, state and federal agencies, and private and non-profit sector partners to develop lasting solutions for a variety of programs, policies and plans.

Our analyses are informed by an understanding of the local, regional and national economy as well as attitudes, beliefs and values — the human/social dimensions. Thinking innovatively as we work to solve a range of complex issues, we lead the field in the use and expansion of methodologies to assess economic and social impacts at the state, regional and local levels. Since 1985, we have completed over 950 projects across the United States and seven other countries.

REVIEW TEAM

Julie Ann Gustanski, PhD, LLM, AICP. Dr. Gustanski has more than 30 years of experience in environmental and natural resource economics, with an emphasis on the valuation of ecosystem services and conservation programs, critical habitat impact analysis, economic and non-market dimensions of treaty protected resources, and land use and environmental policy regulatory review and litigation support. As Resource Dimensions' principal since 1995, she has completed economic, socioeconomic, environmental justice, land use analyses, and peer reviews for over 60 regulatory EIS or EA documents, dozens of ecosystem service valuations, and nearly 500 economic studies centered on diverse resource management and policy issues. Her work has resulted in the conservation and restoration of over two million acres of land and appurtenant resources, tangible policy changes, and shifts in government investment strategies leading to over $90 million in social and environmental investments.

Julie holds a BS in Legal Studies and Environmental Policy from the University of Minnesota (1995 summa cum laude); MEM, Natural Resource Economics & Environmental Policy, Duke University (1990); MPhil/MS, Urban Design & Regional Planning, University of Edinburgh (1987); LLM, Planning Law, University of Edinburgh / Duke University (1987); and PhD, Ecological Economics, University of Edinburgh (1999).

Matthew M. Hayes, MS, CWB. Senior Scientist/GIS Specialist. Mr. Hayes has over 10 years of experience working in natural resource management, large ungulate management, geospatial analysis, remote sensing, and applied data science with an emphasis on understanding spatial patterns in the context of human defined problems. Since 2012, he has worked on projects spanning the globe, lending expertise in programming, spatial modeling, machine learning, big data, modeling and teaching these techniques to others. Recent work has the potential to alter the way in which agriculture and natural systems come together, impacting hundreds of millions of square miles.

Matt holds a BS in Wildlife and Fisheries Biology and Management as well as an MS in Rangeland Ecology and Watershed Resources from the University of Wyoming (2010, 2012)

David Scarsella, MS. Research Economist/Analyst I. With more than 10 years of experience in natural resource and environmental policy, complex data management and economic studies centered on the interface between resource extraction and critical habitat, fisheries, agricultural resource lands and treaty-based resources, David is skilled in incorporating technical on-the-ground research into economic analyses. Mr. Scarsella recently assisted in the development and analysis of ecosystem service values and changes in contributions for a project in Grays Harbor County, Washington, as well as projects for the Quinault Indian Nation and the Lummi Nation. He is familiar with a variety of economic valuation methodologies, economic impact modelling and integrated policy analysis. Mr. Scarsella has also served as project manager for two efforts. The most recent was a statewide mental health program evaluation for the Montana Department of Public Health and Human Services. He also served as project manager for a study in Franklin, North Carolina, where he piloted a social capital assessment protocol for the National Oceanic and Atmospheric Administration and the U.S. Forest Service.

Dave holds a BS, Biology, from Seattle University (2003) and an MS in Environmental Policy from Drexel University (2008).

David "Tex" Taylor, PhD. Senior Applied Economist with Resource Dimensions since 2009, Tex also served on the faculty of the Department of Agricultural and Applied Economics at the University of Wyoming from 1985 until retiring in 2019. Dr. Taylor's areas of expertise include economic impact modeling and analysis; development of specialized input/output models; natural resource, agriculture and regional economics; economic development; public lands policy; general equilibrium modeling; and regional economic analysis.

Over the past 35 years, Tex has worked broadly on the diverse economic aspects of issues such as community development; critical habitat designations; fisheries; recreation; grazing and timber production. In these efforts, he has worked extensively with communities, local government officials, tribal and federal land management agencies, state government, and industry.

Recent projects have included an independent review and economic impact analyses for the Cook Inlet Beluga Whale and the Polar Bear, Shoshone National Forest Plan, the Bridger-Teton Forest Plan, and several BLM plan revisions, including the Lander Resource Management Plan (RMP), the Big Horn Basin RMP, and the Buffalo RMP. Related work includes impact modelling related to the proposed Gateway coal terminal and effects on treaty-protected fishing rights of the Lummi Nation.