S. HRG. 114–142

S. 1694, TO AMEND PUBLIC LAW 103–434 TO AUTHORIZE PHASE III OF THE YAKIMA RIVER BASIN WATER ENHANCEMENT PROJECT FOR THE PURPOSES OF IMPROVING WATER MANAGEMENT IN THE YAKIMA RIVER BASIN, AND FOR OTHER PURPOSES

HEARING

BEFORE THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE

ONE HUNDRED FOURTEENTH CONGRESS

FIRST SESSION

ON

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TUESDAY, JULY 7, 2015

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TUESDAY, JULY 7, 2015

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The Committee met, pursuant to notice, at 10:09 a.m. in room SD–366, Dirksen Senate Office Building, Hon. Lisa Murkowski, Chairman of the Committee, presiding.

OPENING STATEMENT OF HON. LISA MURKOWSKI, U.S. SENATOR FROM ALASKA

The CHAIRMAN. Good morning, the Committee will come to order. We are meeting today to discuss Senate Bill 1694, which is the Yakima River Basin Water Enhancement Project Phase III Act of 2015, sponsored by Senator Cantwell.

As we have discussed in this Committee and as we were just having a conversation about, drought conditions prevailing in the West, including the State of Washington, are significant. For those of us from the Pacific Northwest or the North it is quite unusual to be experiencing any level of drought. My hometown of Ketchikan in the Tongass Rainforest is short on water. People are buying water all the way down to Washington State. Certainly we have had many discussions in this Committee about the situation down in California, but it is not just limited to the Pacific Northwest or to the coastal areas. It is clearly west-wide.

The legislation that we are going to discuss today presents an opportunity to build on the success of a significant example where water users, Federal and state officials and others, are working to ensure the delivery of water where it is needed.

S. 1694 authorizes the first of three phases of the Yakima River Basin Integrated Water Resources Plan, and its goal is to ensure sufficient legal authority to achieve an integrated approach to water management for the Basin.

I will ask Senator Cantwell to describe her bill more fully, but before I turn to her, there are a couple things that I would like us to keep in mind as we consider this legislation.

First, in this bill and in any legislation we consider we need to evaluate and fully understand the financial commitment expected of our Federal agencies. The Federal Government can play a role in addressing water supply needs, but we also need to know, up front, what each bill would have us contribute.

Secondly, it is critical that we have a good understanding of local support and any concerns that may exist as well as to ensure that state and private involvement is maximized both financially and in terms of decision making.

As I look at those who have come east today to speak to us, it looks like a cross-section of interests are represented. I appreciate that. I think that will bode well for the discussion that we will have this morning.

Senator Cantwell, thank you for your work on this piece of legislation, and I look forward to working with you on it.

STATEMENT OF HON. MARIA CANTWELL, U.S. SENATOR FROM WASHINGTON

Senator CANTWELL. Thank you, Madam Chair, and thank you for holding this very important hearing and for being here this morning.

As you mentioned, both of our states are feeling the impact of drought and climate impacts. I know that this legislation is an example of how some of the best and brightest are working hard on solutions at a local level, so thank you for having a hearing on S. 1694.

Before I start, besides thanking the witnesses that are here from Washington, obviously representatives of the state and the tribe, the agricultural community and the fishing interests of our state, we are also joined by Yakima County Commissioner, Michael Leita, and Yakima Nation Council Member, Joe Lewis. I thank you both for being here as well.

S. 1694, the Yakima River Basin Water Enhancement Project Act of 2015 is critical for the State of Washington. It ushers in a new era of water management for the State, and I believe, it is a management model for the entire West.

This legislation is a major accomplishment for people who have been working on this issue for decades. Drought in Washington and across the West has caused billions of dollars in impacts this year alone, and it is predicted to cost billions more in the coming years.

In a report released last July, the White House concluded that confronting climate catastrophes requires taking prudent steps now to prevent more severe consequences later. I could not agree more.

As the Yakima Basin faces continued drought and climate impacts, the Federal Government has a responsibility to act now to prevent future impacts and costs in meeting its legal responsibilities in the Basin which include managing extensive Bureau of Reclamation projects, treaty and trust responsibilities with the Yakama Nation and Federal responsibilities in managing lands and endangered species. Failure to act now, I think, as mentioned, could have catastrophic economic impacts in moving forward. In contrast, an ounce of prevention could go a long way.

Some of the issues here affect some of the most impacted agriculture lands and productive agriculture lands in our country as well as some of the most important sockeye salmon runs in the United States.

S. 1694 authorizes the initial phase of a long term water resources plan for the Yakima Basin and recognizes the responsibilities and the imperative to act now. The bill would dramatically enhance the sustainability and resilience of the Basin, from snow-fed streams in the Cascade Mountains to the farms of the Yakima Valley, which are famous for apples, cherries, hops and vineyards. The Yakima Integrated Plan is designed to provide a balanced approach to long-term water supply and environmental issues in the Basin. It will provide more dependable water supplies to meet agricultural and municipal needs and significantly restore the fisheries and ecosystems of the Yakima River and its tributaries.

The plan was developed through an extraordinary collaboration between local stakeholders who are represented by the witnesses here today. This work group includes state, local, tribal officials, agricultural interests, and environmental groups. And I have to say, it is amazing to see how much progress they have made working together. They have really created a bond which I think is exemplary in keeping the task at hand. Working together they have developed an integrated approach to managing water that could not be accomplished without cooperation. The result is what is before us today, a holistic approach.

Without this plan the Yakima Basin will face continued water shortages and economic impacts, estimated by the state this year to reach $1.2 billion in crop loss due to drought. This summer the Basin is facing unprecedented drought. In some cases irrigation districts are delivering only 25 percent of normal water supplies. Low stream flows and warm water throughout the Basin are also threatening fish, such as steelhead and sockeye salmon. Protection of these species is critical to our community and particularly important to the Yakama Nation.

Science tells us that drought conditions are likely to persist in the Basin in coming years. Low snowpack and heat are predicted to intensify with climate change and are likely to become the new normal. As such, we must do everything to avoid catostrophic impacts later. The Yakima Integrated Plan puts in place the necessary steps for the future sustainability and resilience of the Yakima Basin.

The State of Washington is already investing in the Yakima Integrated Plan. Just last week the state appropriated $30 million for the plan after approving $137 million in the last budget. In spite of severe budget constraints, the state recognizes that investing now will avoid more economic loss in the future.

The Bureau of Reclamation's statutory mandate to manage the Basin's dams, hydropower facilities, and irrigation infrastructure, and legal requirements to manage stream flow for tribal and other needs means that the Federal Government is part of the solution. Without an integrated approach in the Basin, the Federal Government will face significant challenges including litigation costs in meeting responsibilities. So it is good to see Mr. Iseman here today and that in his testimony he supports an integrated approach, as you say in your testimony, which includes water storage, water conservation, stream flow management, fish passage, and habitat improvements to provide the best opportunities for moving forward.

S. 1694 does just that. It includes provisions for improved infrastructure for water storage and conservation, ecosystem restoration and construction of permanent fish passage. Nearly every part of this plan will help both farmers and fish in the Yakima Basin. Projects will provide water to support the region's $3.2 billion agricultural economy while also restoring salmon runs that have been blocked for more than 100 years. This includes helping to restore one of the largest sockeye salmon runs in the lower 48.

Because of local interests and their willingness to sit down to make a plan, I hope this does become a model for integrated water management plans and holistic approaches. I think it is a new paradigm in water management that could be replicated in other parts of the country.

Here in the Energy and Natural Resources Committee we hear of divisive water conflicts in other parts of the West leading to gridlock which is ultimately destructive to the economy and environment. I think this approach points us down a different path.

I look forward to hearing the witnesses today, and again, I thank all of the local individuals who have worked so hard on this project at moving it forward to where we are today in this legislation of S. 1694. I also want to thank my colleague, Senator Murray, for being an original co-sponsor on this legislation.

Thank you.

The CHAIRMAN. Thank you, Senator Cantwell.

Let us go to our queue of witnesses. I would ask that you each limit your comments to no more than five minutes, and your full statement will be included as part of the record. Once each of you have given your statements, we will have a few questions for you.

We will begin with Mr. Tom Iseman, who is the Deputy Assistant Secretary for Water and Science at the Department of the Interior. Next is Mr. Derek Sandison, who is the Director for the Department of Agriculture with the State of Washington. Mr. Urban Eberhart is a farmer and manager of the Kittitas Reclamation District. Mr. Michael Garrity is the Director of Rivers of Puget Sound and the Columbia Basin for American Rivers. Rounding out the panel is Mr. Phil Rigdon, who is Superintendent for the Department of Natural Resources with the Yakama Nation.

Gentlemen, welcome to the Committee this morning. Thank you for traveling as far as you have. We will lead off with you, Mr. Iseman. Welcome.

STATEMENT OF TOM ISEMAN, DEPUTY ASSISTANT SECRETARY FOR WATER AND SCIENCE, U.S. DEPARTMENT OF THE INTERIOR

Mr. ISEMAN. Thank you, Madam Chair, Senator Cantwell. I am Tom Iseman, Deputy Assistant Secretary for Water and Science at the Department of the Interior.

I thank you for the opportunity alongside our partners to provide the views of the Department on S. 1694, legislation to implement Phase III of the Yakima River Basin Water Enhancement Project or YRBEP. I'm joined by Wendy Christensen of Reclamation's Area Office in Yakima, who can assist with any technical questions that come up, and my written statement has been submitted for the record.

YRBEP, Phase III, results from decades of congressionally-sanctioned work in the Yakima River Basin and the collaboration of the Bureau of Reclamation, Washington State Department of Ecology, the Yakama Nation, irrigation districts, local governments, non-governmental organizations and several other state and Federal agencies. Along with the project's previous two phases, Phase III as authorized in S. 1694, aims to further the goals of protecting, mitigating and enhancing fish and wildlife habitat, increasing operational flexibility to manage in stream flows to meet ecological objectives and improving the reliability of the water supply for irrigation, municipal and domestic uses in the Yakima Basin.

This legislation will facilitate construction of fish passage at Chelan Dam and at least one other Yakima Basin reservoir. Restoration of fish passage in the Yakima Basin is extremely important and culturally significant to the Yakama Nation and highly valued by Federal and state fish agencies.

S. 1694 also allows for the irrigation districts to construct a facility to access a significant amount of water stored in the inactive pool of the Kachess Reservoir providing junior irrigation districts the additional water needed to increase their supply in drought years from possibly as low as 20 to 30 percent to up to 70 percent of their supplies. Further, this bill allows additional funds for water conservation on the Yakama Reservation, the largest irrigator in the Basin.

And in addition to a host of further benefits to water users in the Basin, S. 1694 enables the Secretary of the Interior to accept cost share for many of the authorized projects allowing their completion at a significant savings to the Federal budget. This kind of fiscal collaboration is particularly noteworthy as the Government strives under tight budgetary constraints to address the challenges posed by drought in a changing climate.

S. 1694 has been introduced after many years of collaboration among a diverse group of stakeholders, who have traditionally held opposing views, but are now cooperatively working together to achieve real, tangible results to address these challenges.

The Department appreciates the efforts of Senator Cantwell and the Committee staff to address concerns identified in earlier legislative drafts. As stated in my written statement we would like to continue to refine some specific provisions in the bill to clarify the Department's authorities and address potential problems with interpretation. We appreciate you and your staff's willingness to engage with us on those issues.

In closing, we recognize that this bill takes into account the affects of multiple projects and activities working in unison over the long term to improve the health and vitality of the Yakima River Basin, to the benefit of communities, agriculture and the environment.

I want to thank the working group, the partners who are here today and commend them for their work, their collaboration over time to bring this plan to fruition and the efforts, their continuing efforts, to move these projects forward.

And I also want to thank you, Senator Cantwell, for your leadership on this bill.

With that, Madam Chairman, the Administration is pleased to support the integrated plan and the goals of S. 1694, and I'm happy to answer your questions at the appropriate time.

[The prepared statement of Mr. Iseman follows:]

Statement of Statement of Tom Iseman
Deputy Assistant Secretary for Water and Science
U.S. Department of the Interior
before the

Energy and Natural Resources Committee
United States Senate
S.1694, the Yakima River Basin Water Enhancement Project Phase III Act of 2015
July 7, 2015

Chairman Murkowski, Ranking Member Cantwell and members of the Committee, thank you for the opportunity to provide the initial views of the Department of the Interior (Department) on S. 1694, legislation to implement Phase III of the Yakima River Basin Water Enhancement Project (YRBWEP). I am Tom Iseman, Deputy Assistant Secretary for Water and Science at the Department of the Interior. The Department continues to review the recently-introduced version of S. 1694 and as such would like to work with the sponsor and this Committee to offer additional input on the bill and to address some initial concerns with the bill as discussed later in this testimony. The Department is an ongoing federal participant in Phase III, also known as the Integrated Plan, and this testimony will address areas where S. 1694 is consistent with that role. The Department supports the goals of S. 1694, which are consistent with the Department's ongoing coordination with our State partners and all Basin interests to find solutions to the long-term imbalance between water supply and demand in the Yakima Basin.

The YRBWEP Workgroup, formed in 2009, developed the Yakima River Basin Integrated Water Resources Management Plan, which is a partnership between Bureau of Reclamation (Reclamation), Washington State Department of Ecology, the Yakama Nation, irrigation districts, local governments, non-governmental organizations, and several other Federal and state agencies. It is exactly the kind of broad-based, consensus-driven cooperation that is essential to successful modern water resources management. As a long-term, collaborative process, the YRBWEP helps Reclamation continue to implement the Yakama Nation Settlement Agreement, and has progressed through two prior phases to arrive at Phase III, the Yakima River Basin Integrated Water Resources Management Plan, or Integrated Plan.

YRBWEP and the Integrated Plan have their roots in the original authorization of a joint Federal-state feasibility study in 1979 (PL 96-162). In this statute, Congress directed Reclamation to conduct a feasibility study of the Yakima River Basin Water Enhancement Project and develop a plan that would provide supplemental water for currently irrigated lands, water for new lands within the Yakama Indian Reservation, increased instream flows for aquatic life, and a comprehensive plan for efficient management of existing basin water supplies.

Early in the YRBWEP study process, fish passage problems were identified as needing immediate attention and in 1984, Congress authorized YRBWEP Phase I (Section 109 of PL 98-381), which primarily involved rebuilding fish ladders and constructing fish screens on river diversions. The YRBWEP study proceeded through the 1980s, but was not fully completed primarily due to uncertainties associated with the adjudication of basin surface water rights that began in 1977. Consequently, Congress passed additional legislation in 1994 (PL 103-434), for what is generally referred to as YRBWEP Phase II. This legislation provided for significant water conservation and acquisition activities, studies to define the long-term water needs of fish and current irrigators, improvements to the Wapato Irrigation Project, and development of a plan for management of basin water supplies.

The broad-based, consensus-driven nature of YRBWEP Phases I and II has been established through the development of many relationships, building diverse support for continued implementation of a broad range of projects as part of Phase III. The elements of this plan, and associated activities, were never envisioned to be stand-alone, individual efforts, but rather broad-based collaborative efforts that strive to integrate elements of interests held by each stakeholder. Still, while prioritizing Federal support, both financially and administratively, we have a responsibility to ensure that available resources are put to their highest and best use, utilized for the most cost-effective elements that have a strong Federal interest. This has been the approach used in the Administration's recent Budgets, as discussed below. As a corollary to this Federal support, in June 2013, the Washington State Legislature affirmed their support for the Integrated Plan in statute (SSSB 5367) and provided $132 million to begin implementation of the plan.

The current lack of facilities in which to store the full water supply of the basin, operational constraints, and legal framework affecting water resources in the Yakima River Basin illustrate the challenges for residents, businesses, tribal communities, and ecosystem resources. The Integrated Plan is aimed at addressing these challenges, which include:

- Water reliability for the Yaka~~i~~ma Nation: the Integrated Plan approach will help assure the ability to meet Tribal water supply needs, and offers an alternative to expensive and time-consuming litigation to resolve treaty issues.
- Proratable water users receive sharply diminished supplies from the Yakima Project during severe drought years, in one year as little as 38% of their full allotment. Junior users can be cut off completely. This reduces agricultural production and associated jobs in the basin. For those who grow tree fruit, this could cause early loss of trees, which could have remained economically productive, sometimes for many additional years.
- Most municipal and domestic water users in the basin rely on junior water rights for their drinking water supplies. The Yakama Nation and irrigation users, including proratable irrigation users, hold water rights and entitlements that are senior to most municipal and domestic uses. Municipal and domestic users live with a very real risk that their supplies could be cut off as a result of litigation brought by senior water users under drought conditions. This affects current residents and also limits the ability of local communities to grow and develop. The State of Washington and local governments have identified averting such litigation as a key objective.
- Scientists studying the effects of global climate change on the Columbia River Basin project that less water will be stored in the Cascade Range snowpack in future decades compared with current conditions. Snowpack currently provides a substantial portion of runoff to the Yakima River basin, and reduced snowpack in the future would compromise water supply, streamflow, and aquatic habitat conditions. There is no single type of action that can address the multiple effects of climate change on snowpack, runoff conditions, water temperature, aquatic life, and forest health. Reclamation and Ecology

believe that an integrated approach that includes consideration of water storage, water conservation, streamflow management, fish passage, and habitat improvements offers the best opportunity to mitigate climate change impacts on the Yakima basin's aquatic habitat and economy.
- Forest resources, land and terrestrial habitat of the Yakima basin also face risks from climate change, large wildfires, fragmented ownership, and land-use practices. These risks exacerbate the other risks to water resources and aquatic habitats. The Integrated Plan includes approaches to coordinate land management and water management to help manage these risks.

The Integrated Plan encompasses seven elements: habitat and watershed protection and enhancement; reservoir fish passage; surface storage; enhanced water conservation; structural and operational changes; groundwater storage; and the use of market-based forces to reallocate water and habitat among willing buyers and sellers. The goals of the Integrated Plan are to protect, mitigate, and enhance fish and wildlife habitat; provide increased operational flexibility to manage instream flows to meet ecological objectives; and improve the reliability of the water supply for irrigation, municipal supply and domestic uses.

Because of this history, a strong foundation of planning, study and diverse support underlies the YRBWEP and the Integrated Plan. Reclamation and Ecology completed a final Programmatic Environmental Impact Statement (PEIS) for the Integrated Plan in March 2012, and a Record of Decision (ROD) was signed in 2013.Under Phase II, Reclamation completed eight basin conservation plans and five feasibility-level conservation plans with two more feasibility plans to be completed this year.

The President's FY 2016 request is $12.8 million for currently authorized YRBWEP activities consistent with Phase II and the Integrated Plan that are cost-effective and have a strong Federal interest. The YRBWEP has been part of the President's request consistently each year because of its nexus with several mission areas for the Department, and because of the multiple benefits that the current process makes possible, such as avoiding water resources conflicts that might otherwise occur and achieving both ecological and economic benefits in the basin. By linking several elements together for shared progress, YRBWEP is meaningfully increasing the reliability of the irrigation water supply and benefitting anadromous fish in the Yakima River basin. Dozens of activities are underway and in various stages of implementation. For example, the river levee set-back project in Yakima, Washington, is now complete and was jointly funded by Reclamation, the U.S. Army Corps of Engineers (Corps) and the City of Yakima, and provides multiple local benefits including fish and wildlife benefits, increased flood protection and improved water quality. Reclamation is currently in the design phase of a similar project near Ellensburg, Washington.

Additionally, Reclamation, along with several Federal, state, local and private partners, completed the Manastash Creek Conservation and Tributary Enhancement Project, which was the first construction project included in the Integrated Plan, and was completed in 2014. This project is considered a major success because portions of the stream that have been seasonally dewatered for over 100 years are now flowing year-round, and steelhead can be found in the stream. Other projects include providing permanent fish passage at Cle Elum Dam; construction is scheduled to begin this year and is being co-funded by Reclamation and the State of Washington, which will help meet Reclamation's obligation for fish passage under the Yakama Nation Settlement Agreement, in addition to continuing acquisitions of land and water on the Yakima River and its tributaries where there exists a high potential for improved fisheries and watershed conditions. As of 2015, approximately 40,000 acre-feet (af) of water has been acquired for instream flows by Phase II projects and over 13,000 af has been conserved to improve irrigation supplies in drought years. These diverse projects combine planning, grant-making and direct construction through many partnerships.

This legislation specifically directs the completion of construction of fish passage at Cle Elum dam and at least one other Yakima Basin reservoir within the next ten years. This is extremely important to the Yakama Nation and various federal and state fishery agencies. Restoration of fish passage in the Yakima Basin is culturally significant and fish passage at the dams will open up tens of miles of pristine fish habitat currently inaccessible above the dams.

The Department would like to work with the sponsor's office and this committee to clarify the authorities that are utilized in the Yakima River Basin and altered by this bill, particularly those in Section 4(c) and Section 5. As currently drafted, we do not interpret the authorization provided in this bill to extend to the construction or raise of any large dams in the Basin, with the exception of Cle Elum Dam, despite their inclusion in the overall Integrated plan, the provision in Section 2(b)(8), and the provisions added by Section 5. In general, we interpret authorities added by this bill to be limited to carrying out those elements currently identified as the 'Initial Development Phase' of the Integrated Plan. We would also like to work with the committee regarding the fish recovery language at sections 2(b)(1) and 4(b)(3) [bill pages 2 and 15], the treaty language at 4(b) [bill page 12], and the instream flow language at section 4(b)(2) [bill page 14].

This legislation also allows for the irrigation districts to construct a facility to access a significant amount of water stored in the inactive pool of Kachess Reservoir. This will provide proratable irrigation districts with the additional water needed to increase their supply in drought years from a climate-model estimated low of 20-30% up to 70%. This legislation will also allow additional funds for water conservation on the Yakama Reservation, which is the largest irrigator in the basin and has a significant conservation need, to be able to help the entire basin with more efficient use of limited water supplies. Additional funds for the Cle Elum pool raise project are authorized which will allow control of another 14,600 af of water that can be used in ways beneficial to fish. There are many other benefits to this legislation, but the last I will mention here is that it allows the Secretary to accept cost share for many of these projects which allows Federal dollars to be leveraged to achieve more conservation.

The Integrated Plan has also provided for unprecedented collaboration between irrigation districts, the Yakama Nation and fish agencies, which can best be described by the recent example of Kittitas Reclamation District's (KRD) efforts to relieve hardships to local streams from drought. KRD has turned on siphons and water gates in its canals that provide flows to Manastash Creek and five other upstream Yakima River tributaries. Under an agreement with Reclamation, Ecology, the Yakama Nation and in consultation with the state Department of Fish & Wildlife, Yakima Project water is being routed through KRD canals on its way to downstream diverters and passed through these small creeks. It then flows back to the same river it came from and it is available for diversions further down the Yakima River. This is being done in a manner that has no impact on the total water supply and still improves flow, fish habitat and vegetation lining creek banks.

Implementation of the YRBWEP is based on a funding strategy that includes the premise that projects with Federal participation will be cost-shared by Federal and non-Federal entities. For example, the State of Washington and Reclamation have signed a Memorandum of Agreement to provide 50-50 cost-share for the Cle Elum Dam Fish Passage Project, and the beneficiaries of the Kachess Drought Relief Pumping Plant have suggested that they will fund both capital and operations and maintenance (O&M) costs of that project. Additionally, several habitat enhancement and agricultural conservation projects are being funded by Federal, state, and local governments.

S. 1694 is being introduced at an opportune time when stakeholders understand the urgency in implementing many elements of the Integrated Plan and are willing funding partners, able to take on the operations and maintenance (O&M) of various elements of YRBWEP projects, thus taking the full funding and O&M burden off the federal budget. This unique opportunity is a result of many years of collaboration with a diverse group of stakeholders who have traditionally held opposing views but are now cooperatively working together to achieve real, tangible results. This legislation is essential in maintaining the momentum that has been built.

As stated above, while the Administration supports YRBWEP activities that are cost-effective and have a strong Federal interest through its budget request and through ongoing activities at other agencies, the Department is still completing its review of the introduced version of S. 1694. We understand it has undergone several recent revisions up through the preceding days, and we appreciate having been part of some of those revisions. The Department still needs to closely complete review of the introduced bill to determine its consistency – both from a budgetary perspective as well as a programmatic view – with the agreed-to elements in YRBWEP and the Integrated Plan. While the Department supports the sponsor's intention to authorize continued federal participation in the implementation of the Integrated Plan (a.k.a YRBWEP Phase III), we look forward to working with the bill's sponsor and the Committee to address specific elements of the bill once we have had the opportunity to conduct further analysis. The Department supports the goals of S. 1694; however, we reserve the right to submit additional comments on the bill in the future.

This concludes my written statement. I would be pleased to answer questions at the appropriate time. #

STATEMENT OF DEREK SANDISON, DIRECTOR, WASHINGTON STATE DEPARTMENT OF AGRICULTURE

Mr. SANDISON. Thank you.

Chairman Murkowski, Ranking Member Cantwell, thank you for the opportunity to testify in support of Senate Bill 1694. While I am currently the Director of the Washington State Department of Agriculture, until recently I served as the Director of the Washington State Department of Ecology's Office of Columbia River where I led the state's involvement in the collaborative effort that is addressed in S. 1694.

The Washingtonians recognize that there's a dry side of our state, Eastern Washington, and a wet side of our state, Western Washington. But this year both Eastern and Western Washington, like many other parts of the West, are suffering from drought. These conditions are creating great challenges for our farmers, our fisheries and for our communities. However, throughout Washington a number of efforts are underway to respond to those challenges. For example, the unique collaboration that has emerged in the Yakima Basin focused on developing a vision for a future where there is water for farming, water for fish, water for our communities, even in drought years. S. 1694 is a vital step in making that possible.

The CHAIRMAN. Thank you, Mr. Sandison. Welcome.

Mr. SANDISON. By way of background the Yakima Basin is an approximately 6,000 square mile drainage basin in South Central Washington. It's a source of population for about 360,000 people, and it's home to the Yakama Nation. The Yakima Basin contributes over $3 billion annually to the agricultural economy of the State of Washington and to the nation and exports many of its farm products to the ports of Seattle and Tacoma. It is also important to recognize that historically the Yakima Basin was the second largest producer of salmon and steelhead runs in the entire Columbia River system.

Since 1905 the Bureau of Reclamation has managed surface water flows in the Yakima Basin. Reclamation operates five reservoirs with a total capacity of about a million acre feet which is about a third of the annual runoff, on average, in the Yakima Basin. The Yakima Basin is heavily dependent on the Cascade Range snow pack to supply water to the semi-arid lower basin during the summer months. In other words, the snowpack is our sixth reservoir.

Management of water in the Yakima Basin has historically been contentious. The surface water resource of the Yakima Basin are over-appropriated and have been undergoing court adjudications since 1977. The state closed the Yakima Basin to additional ground water rights in the 1990s. Frequent droughts over the last several decades have demonstrated the vulnerability of the Yakima Basin's water supplies. During droughts in 2001 and 2005 and now in 2015, the irrigation districts served by the Bureau of Reclamation received or are receiving only about 40 percent of their supply.

Aquatic resources of the Yakima Basin have also continued to suffer. Salmon and steelhead runs that historically numbered around 800,000 fish declined to about 8,000 fish by the 1980s. Several stocks were extirpated and the Basin's steelhead and bull trout are currently listed as threatened species under the Endangered Species Act.

In 2009 the State of Washington and the Bureau of Reclamation began collaboration with the Yakama Nation and Basin stakeholders to formulate a comprehensive strategy to address the Basin's critical resource needs. That collaboration builds on the 1979 Federal Yakima River Basin Water Enhancement Project Act, or YRBWEP, and the 1994 Phase II amendments to that act. The strategy took shape in mid-2011 when consensus was reached on the Integrated Plan.

The Integrated Plan is being proposed as Phase III of the YRBWEP. The Integrated Plan proposes major ecological restoration of the Yakima Basin through measures such as construction of fish passage at all in-basin reservoirs and implementation of mainstem and tributary habitat enhancements.

The Integrated Plan also calls for substantial improvements in water supply for both in-stream and out-of-stream uses. Efficiency of existing use will be improved through expanding water markets and investing in additional agricultural conservation.

The objectives of the Integrated Plan cannot be met without significant improvements in water storage. Additional capacity in the form of modified and new storage facilities will be needed to provide drought relief for existing irrigators in the Yakima Basin, secure water supplies for municipal needs and adequate water for fish migration.

The importance of expanding water storage capacity is underscored by climate modeling that predicts substantial reductions in snow pack depth and duration, in other words, exactly what we're seeing in 2015.

In 2013 Washington Governor Jay Inslee signed legislation that authorized the Department of Ecology to implement the Integrated Plan in conjunction with Reclamation and in collaboration with the Yakama Nation and Basin stakeholders. To date, the Governor and the legislature have made over $160 million in capital investments to meet the multiple goals of the Integrated Plan, so we believe S. 1694 represents a similar commitment by our Federal partners to this special and powerful collaborative effort.

We're deeply appreciative of your consideration of this legislation and very much appreciative of Senator Cantwell's leadership in this area.

Thank you very much.

[The prepared statement of Mr. Sandison follows:]

Written Testimony

Submitted to the

United States Senate

Committee on Energy and Natural Resources

On

S. 1694

Yakima River Basin Water Enhancement Project Phase III Act of 2015

July 7, 2015

By Derek Sandison

Director, Washington State Department of Agriculture

Chairman Murkowski, Ranking Member Cantwell, and Members of the Committee, thank you for the opportunity to testify and to express the State of Washington's support for the bill before the Committee this morning – S. 1694, The Yakima River Basin Water Enhancement Project Phase III Act of 2015.

My name is Derek Sandison; I am currently the Director of the Washington State Department of Agriculture. Up until one month ago, when Governor Inslee appointed me to this position, I served as the Director of the Washington State Department of Ecology's Office of Columbia River, where I led the state of Washington's involvement in the collaborative effort that is the basis for the S. 1694. While representing the Department of Agriculture, I am also testifying today on behalf of the state natural resource family of agencies: the Department of Ecology, Department of Fish and Wildlife, and the Department of Natural Resources. All of our agencies have played vital roles in the development and implementation of efforts to restore watershed health in the Yakima River Basin (Yakima Basin).

When most people think of Washington State, they visualize a place with dark green forests, high mountains and constant rain. While that perception is at least partially accurate, the rain forests on our Olympic Peninsula receive on average about 140 inches of rainfall a year, much of the eastern half of the state, which lies in the rain shadow of the Cascade Mountains, has a semi-arid climate. The total annual precipitation in some portions of eastern Washington is measured in single digits.

And this year, that image is not accurate at all. Washington like many other parts of the West is suffering from drought. These conditions are creating great challenges for our farmers, for our fisheries, and for the families of Washington State. However, throughout Washington a number of efforts are underway to prepare for and improve the response to these new and, what we expect to be, more common conditions.

For example, over the last six years, a unique collaboration has emerged in the Yakima Basin focused on developing a collective vision for the future of water in the Yakima Basin; a future where there is water for farming, water for fish, and water for families even when we have years like 2015 is shaping up to be. S. 1694 is a vital step forward in making that future possible. We are tremendously grateful to Senator Cantwell and her co-sponsor Senator Murray for introducing this legislation and to this Committee for giving it due consideration. Today, I would like to paint a bit of geographic picture of the Yakima Basin and provide a short history on how the people of the Yakima Basin have come together to create this vision, a vision that we call the Yakima Basin Integrated Plan (Integrated Plan). Following my presentation, a number of the State's partners in the development and implementation of the Integrated Plan will provide a deeper sense of what this vision means for all of us.

The Yakima Basin is an approximately 6,000 square mile drainage basin in south central Washington State. It supports a population of about 360,000 people and is home to the approximately 10,000 member Yakama Nation. The Yakima Basin contributes over $3 billion annually to the agricultural economy of the State of Washington. Yakima County ranks 12th nationally in the total value of agricultural products sold. Yakima County ranks first nationally among counties in apple, mint, winter pears, and hop production. The Yakima Basin exports around $1.8 billion in farm products through the ports of Seattle and Tacoma annually. Historically, it is important to recognize that the Yakima Basin was the second largest producer of salmon and steelhead runs in the entire Columbia River system. Those runs numbered close to 800,000 salmon and steelhead each year.

Since 1905, when the state granted rights for all unappropriated surface water in the Yakima Basin to the Bureau of Reclamation (Reclamation), surface water flows in the Yakima Basin have been managed by Reclamation. Reclamation operates five existing reservoirs with a total capacity of about 1,000,000 acre-feet, which is about one-third of the average annual runoff in the Yakima Basin. The Yakima Basin is heavily dependent on east-slope Cascade Range snowpack to supply water to the semi-arid lower basin during the summer months.

Water law in Washington State is based on the doctrine of prior appropriation, the basic premise of which is water use priority is determined based on first in time, first in right. Water users in the Yakima Basin are a combination of the pre-1905, senior surface water right holders, direct customers of Reclamation served water under Reclamation's 1905 state water right, a small number of post-1905 junior surface water right holders, and groundwater right holders, mostly with post-1905 priority dates.

Management of water in the Yakima Basin has historically been highly contentious and marked by protracted legal battles. The surface water resources of the Yakima Basin are over-appropriated, and a state court adjudication of those water rights has been ongoing since 1977. The state closed the Yakima Basin to additional groundwater rights in the 1990s. Recently, the U.S. Geological Survey concluded that the Yakima Basin's groundwater aquifers are in continuity with surface waters. Based on that conclusion, it is likely that most of the post-1905 ground water rights, upon which most of the Yakima Basin's municipalities depend, will be determined to be junior to Reclamation 1905 water right and, therefore, subject to curtailment in water short years.

Frequent droughts over the past several decades demonstrated the vulnerability of the Yakima Basin's water supplies. During droughts in 2001 and 2005, the irrigation districts served by Reclamation, referred to as the "proratable" irrigation districts, received only about 38 percent of their water supply. In the current drought of 2015, the level of proration is expected to be about the same.

Instream flows and aquatic resources of the Yakima Basin have also continued to suffer. A combination of out-of-basin and in-basin factors, including diminished stream flows and lack of fish passage at existing reservoirs, have combined to drastically reduce the numbers of salmon and steelhead. Runs of salmon and steelhead that, as previously noted, once numbered at least 800,000 fish declined to about 8,000 fish by the 1980's. Sockeye, coho, and summer Chinook salmon stocks have all been extirpated; although efforts are underway, led by the Yakama Nation, to reintroduce new stocks of those species. The Yakima Basin's steelhead and bull trout are Endangered Species Act listed threatened species.

Thus, since 2009, the Department of Ecology's Office of Columbia River and the Bureau of Reclamation have been collaborating with the Yakama Nation and Yakima Basin stakeholders to formulate a comprehensive strategy to address critical resource needs. That collaboration focused on expanding the work of the 1979 federal Yakima River Basin Water Enhancement Project (YRBWEP) and the 1994 Congressional Amendments that created Phase 2 of YRBWEP. That strategy took shape in mid-2011 when consensus was reached on the Integrated Plan.

The Integrated Plan, as embodied in S. 1694, is being proposed as Phase 3 of YRBWEP. Development of the Integrated Plan was facilitated by additional federal support resulting from the Yakima Basin being selected as the recipient of one of Reclamation's first Basin Study grants.

The Integrated Plan proposes major ecological restoration of the Yakima Basin through a number of bold measures. The Integrated Plan provides for construction of fish passage at all major in-basin reservoirs to open high basin spawning and rearing areas that have been blocked for a century. It will provide substantial mainstem and tributary habitat enhancements. Substantial portions of the upper watershed will be restored as habitat for both terrestrial and aquatic species. In addition, the plan provides for operational modifications to improve operational efficiency and flexibility.

The Integrated Plan also calls for substantial improvements in water supply for both instream and out-of-stream uses. About one-half of eastern Washington's out-of-stream water needs and one-third of our unmet instream flow needs are in the Yakima Basin. Water supply improvements will come in several different forms. Efficiency of existing use of water will be improved through reducing barriers to the transfer of water between willing buyers and willing sellers. Municipal and agricultural conservation efforts will be enhanced. For example, the plan calls for supplementing the 72,000 acre-feet of conserved irrigation water achieved as under the 1994 YRBWEP Phase 2 efforts with another 170,000 acre-feet of conservation savings. Studies are also underway to better understand the potential role of aquifer storage in providing passive recharge to the mainstem and tributaries of the Yakima River in targeted locations.

However, the objectives of the Integrated Plan cannot be met without significant improvements in surface water storage. The Office of Columbia River and Reclamation have determined, based on an analysis of water supply needs, that supplementing the Yakima Basin's existing 1,000,000 acre-feet of water storage capacity with an additional 450,000 acre-feet of capacity in the form of modified and new surface storage facilities will be needed to provide:

- Drought relief to existing irrigators in the Yakima Basin;
- Secure water supplies for our municipalities with junior water rights and to meet their future needs, and
- Adequate water for fish outmigration and pulse flows in all years.

The importance of expanding water storage capacity is underscored by climate modeling conducted by the University of Washington Climate Impacts Group and the federal River Management Joint Operating Committee that predicts substantial reductions in snow pack depth and duration as we move towards mid-century. In other words, the current drought in the Yakima Basin, which is being referred to a "snowpack drought," reflects expected future conditions. The Integrated Plan recognizes that the only effective means of offsetting snowpack reductions in the Yakima Basin are improving floodplain aquifer storage potential and increasing surface storage capacity. Sensitivity analysis modeling of the Integrated Plan indicate that, at full Integrated Plan buildout, about 500,000 acre-feet more water would be available under mid-century drought conditions than is available in the current drought.

Conservation is often suggested as a substitute for water storage; however, there are severe limitations to the role of conservation as a source of additional water supply. As noted previously, the Integrated Plan proposes to accomplish another 170,000 acre-feet of irrigation conservation savings. Those savings will provide valuable flow improvements in targeted stream reaches resulting in improved conditions for fish. However, it must be remembered that most conservation efforts focus on reducing the amount of water that leaks from conveyance systems (for example, canals or ditches) or from irrigation practices that result in more water being applied than is needed by the crops being grown. The leaked water returns through runoff or through groundwater to the river at a point downstream of where it was diverted. We refer to this as "return flow." Along the Yakima River mainstem, return flows rejoin the river within days or a few weeks after diversion and contribute to downstream river flows. If through conservation measures, the leakage or over-application of water is reduced or eliminated, the amount of water diverted can be reduced accordingly. Those diversions savings add more flow to the river, but only between the point of diversion and the point at which return flows previously rejoined the river. Below the return flow point, there is no residual benefit to the river. If the conserved water described in the preceding example was used for some other out-of-stream purpose, flow below the return flow point would be permanently diminished. The surest way to dry up the river would be to employ such a practice on a widespread basis.

With bipartisan support, Washington Governor Jay Inslee signed legislation on June 30, 2013, that authorized the Department of Ecology to implement the Integrated Plan in conjunction with Reclamation and in collaboration with the Yakama Nation, other state and federal agencies, local governments, and basin stakeholders. In addition to establishing the policy framework at the state level for implementation of the Integrated Plan, the Governor and the Legislature made a significant capital investment, approximately $132 million, for implementing the Integrated Plan in 2013. Just last week, the state Legislature made an additional $30 million capital investment in projects that meet the multiple goals of the Integrated Plan.

We believe that S.1694 represents a similar commitment to this special and powerful collaborative effort by our federal partners in the Integrated Plan. We appreciate the committee's consideration of this legislation and look forward to working with you as you consider it merits.

The CHAIRMAN. Thank you, Mr. Sandison.

Mr. Eberhart, welcome.

STATEMENT OF URBAN EBERHART, GENERAL MANAGER, KITTITAS RECLAMATION DISTRICT, AND FARMER

Mr. EBERHART. Thank you.

Chairwoman Murkowski and Senator Cantwell, my name is Urban Eberhart, and I'm the manager of the Kittitas Reclamation District in the irrigation district serving 60,000 acres of prime farmland in the Yakima River Basin. I'm also a farmer. I was raised on our family farm near Ellensburg, and I'm still growing apples, pears and hay in Badger Pocket in the Kittitas Valley.

I've been working on water issues in the Yakima Basin, have been following the Yakima River Basin Water Enhancement Project, ever since I went to my first Yakima Enhancement meeting with my father in 1979. I worked on the 1994 Yakima Basin Phase II legislation prior to its passage by Congress. It was intended to be an interim step to additional storage.

In the Basin when we were asked to implement conservation measures authorized in the act we were told if we still could not meet the water supply needs of the Basin through conservation after they were implemented then we could come back and ask for additional storage.

We've now created the Basin-wide Integrated Plan that is an example for other river basins throughout the country to look to. It is a template for others to follow on how diverse interests can come together to prepare a pathway for surviving drought and climate change and to impacts into the future.

I support the enactment of S. 1694 authorizing Phase III of the Yakima River Basin Water Enhancement Project. The Yakima River Basin is one of the most productive agricultural areas in the nation. Principle crops grown in the Basin include fruit, vegetables, forage, hops and mint with many highly productive dairies, fruit packaging plants and other related businesses and industries tied to our Basin's bountiful harvests. These industries in the Basin alone produce more than $1.8 billion in crops and $1.4 billion in food processing sales.

The KRD is a fully proratable irrigation district which means our district is one of several (like the Roza, Wapato and Kennewick districts). We are receiving 44 percent of our supply this year. The farmers in the Garrity will be out of water the first week of August instead of the middle of October. Our water will be cut off two and a half months earlier than normal.

The Roza irrigation district was forced to shut down its entire water delivery system for three weeks during the prime growing season this year.

A critically important and creative component of S. 1694 includes providing innovative authorities for our non-Federal, proratable districts to be able to design, construct and maintain water storage access facilities contemplated by the first phase of the Integrated Plan. The bill would authorize the Secretary of the Interior to enter into long term agreements with the proratable irrigation entities in the Yakima Basin including KRD to plan, design, construct and maintain projects like the Kachess Drought Relief Pumping Plant on Federally-owned lands. I believe this effort could be the first of its kind and is innovative enough that other areas of the West could benefit from similar arrangements.

Under S. 1694 the proratable districts in the Basin would enter into long term agreements with the Secretary and Reclamation to provide non-Federal ownership, management and financing in the construction of these facilities bringing emergency drought relief water supplies to the Basin quicker and with no burden on the Federal budget.

We have some additional suggested improvements to the language of S. 1694 as introduced to further clarify the provisions in Section 1214, and we look forward to working with the Committee on improving this section.

Another important provision in S. 1694 deals with restoring water flows in the tributaries in the Basin. We have found a way for farmers and fish to help each other. The pilot concept implemented in the Manastash Creek project converted 3.2 miles of the KRD canal to a pressurized pipeline conserving over 1,200 acre feet of water annually that is used to keep water flows in the creek during critical fish migration periods.

The Manastash project resulted in multiple in-stream and out-of-stream benefits that conserved water, increased in-stream flow in the lower Manastash. Benefits in addition to flows for fishing include reduced seepage, improved local irrigation system reliability and increased on-farm efficiencies and water conservation through the use of pressurized sprinkler systems. Farmers are still farming and the creek is now flowing opening up habitat for salmon and steelhead species in the process.

In closing, I believe we have a good start with S. 1694. And as the irrigation districts in need of additional dry water supplies, we are stepping up to the plate in financing and constructing new water supply infrastructure in innovative ways. The State of Washington has provided over $130 million over the past two years to assist in implementing the Integrated Plan. Our proratable irrigation districts are contemplating non-Federal investments to build new water supply infrastructure.

We look forward to the enactment of S. 1694 to assist in implementing the Plan, improving habitat for fish and wildlife, and creating new emergency storage water supplies for the future of the Yakima River Basin.

Thank you for the opportunity.

[The prepared statement of Mr. Eberhart follows:]

Testimony of Urban Eberhart
General Manager – Kittitas Reclamation District
Farmer in the Yakima River Basin

Before the Committee on Energy and Natural Resources
United States Senate

Legislative Hearing
On S. 1694
"A bill to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project for the purposes of improving water management in the Yakima River basin, and for other purposes."

Washington, D.C.
July 7, 2015

Chairwoman Murkowski, Senator Cantwell, and Members of the Committee, my name is Urban Eberhart and I am the General Manager of the Kittitas Reclamation District (KRD), an irrigation district serving 60,000 acres of prime farmland in the Yakima River Basin in the vicinity of Ellensburg, Washington. I am also a farmer in the Yakima River Basin. I was raised on our family farm near Ellensburg and am still growing apples, pears and hay in the Badger Pocket area of the Kittitas Valley.

I have been following and working on the Yakima River Basin Water Enhancement Project (YRBWEP) ever since I went to my first Yakima water enhancement meeting with my father back in 1979, the year Congress authorized a feasibility study to address the water resource needs of the Yakima River basin; the Act of December 12, 1979 (93 Stat. 1241, Public Law 96-162). An outgrowth of this study was the implementation of Phase I (fish ladders and fish screens) and Phase II (water conservation and other measures) of the YRBWEP.

I was an active participant in the development of the 1994 YRBWEP Phase II legislation. I have also been intimately involved in the development of the Yakima River Basin Integrated Plan, a forward looking holistic approach to dealing with the expected problems in the Basin to help meet all water demands over the next several decades. I support the enactment of S. 1694 authorizing Phase III of the YRBWEP and beginning the first ten years implementation of the Integrated Plan.

The Yakima Irrigation Project in the Yakima River Basin includes seven divisions: Storage, Kittitas, Tieton, Sunnyside, Roza, Kennewick, and Wapato serving irrigable lands totaling approximately 464,000 acres. The Wapato Division is operated by the Bureau of Indian Affairs, but receives most of its water supply from the Yakima Project for irrigation of 136,000 acres of land. Over 45,000 acres not included in the seven divisions are irrigated by private interests under water supply contracts with the Bureau of Reclamation. The six water storage dams and reservoirs on the Project are Bumping Lake, Clear Creek, Tieton, Cle Elum, Kachess, and Keechelus. Other Project features include five diversion dams, canals, laterals, pumping plants, drains, three hydropower plants, and transmission lines.[1]

The Yakima River Basin is one of the most productive agricultural areas in the Nation. Yakima County ranks first among all counties of the United States in the production of apples, mint, and hops. [2] Principal crops grown in the Basin include fruit, vegetables, forage, hops, and mint, with many highly productive dairies, fruit packaging plants, and other related businesses and industries tied to our Basin's bountiful harvests. These industries in the basin alone produce more than $1.8 billion in crops and $1.4 billion in food processing sales while supporting more than 5,700 jobs. And, a reliable supply of water for irrigation is a critical requirement for these industries.[3]

The Yakima River Basin is also home to significant fish and wildlife resources, including an anadromous fish population of steelhead, currently protected under the Endangered Species Act (ESA), and salmon runs. These fish runs are part of the important recreational and tribal resources in our basin. The Yakama Nation is also located in the basin, and has historically relied on these fish and wildlife resources for generations. These ancient fish runs declined precipitously during the mid-Twentieth Century, and were a source of contention over water supplies and water management in the basin for many years. Recent efforts to improve these fish runs through increased water conservation and improved water management have seen some marked success. But additional investments in improved water management and conservation in the basin are still needed, which S. 1694 supports.

The KRD is a fully proratable irrigation district – in other words, our district is one of several (Roza, Wapato and Kennewick Districts round out the group) in the Basin that is the first to be cut in a water short year. This year (2015) we are experiencing a significant water supply shortage in the Basin, and the proratable irrigation districts like ours are currently receiving only 44 percent of our normal supply. The term "proratable" is unique to the Yakima River Basin and, in our Basin, the proratable water users are much like junior water rights, in that we will not receive any water until the non-proratable (or senior) users are expected to receive one hundred percent of their supply for the water year. This year, the farmers in KRD will be out of water the first week of August, which means water will be cut off two and a half months earlier than normal. And, the Roza Irrigation District (another proratable district) was forced to shut down its entire water delivery system for three weeks during the prime growing season this spring/summer to ensure their farmers had water into September this year. In fact, the Washington State Department of Agriculture on May 11 came up with a forecast for a $1.2

[1] Source: Bureau of Reclamation.
[2] Ibid.
[3] Source: State of Washington

billion statewide crop loss due to the drought, mostly due to expected losses in the Yakima River Basin.

We have seen several of these water short years during the past two decades, and many of us are fearful this may become our new "normal" – low snowpacks during the winter, with average rainfall. We do not have enough water storage to capture all the rainfall events – snowpack has been our other reservoir to store our water and slowly release it during snow melt in the spring and early summer. Without the snowpack, our total reservoir storage capacity is diminished considerably. The Yakima Basin does not have enough water storage and is trying to meet over 2.4 million acre-feet of water needs annually with only about 1 million acre-feet of active storage capacity. The Yakima Basin is experiencing increased pressures and demands on our 1 million acre-feet of reservoir storage capacity which cannot make up for shortages like we are experiencing this year – we need more available water storage carrying capacity to meet our dry-year demands.

The frequency of drought in the Basin is expected to increase in the future, but estimating future drought conditions at the current frequency we have been experiencing, this equates to at least 20 droughts during the next 100-year time span.

To help plan for expanding our access to more irrigation and M&I water storage capacity and to help relieve tensions in the basin over water supply management, irrigation interests have worked with other water stakeholder interests and the Yakama Nation in developing the Yakima Basin Integrated Plan, a well thought out, long-term comprehensive set of solutions to restore ecosystem functions and fish habitat and improve long-term reliability of water supplies for stream flows, agricultural irrigation and municipal supply. The Integrated Plan was developed in a public, collaborative process involving local, state, federal and tribal governments plus stakeholders representing environmental, irrigation and business interests.

The consensus achieved by this diverse group represents a major and unprecedented accomplishment for the Yakima Basin and for water management in the western United States. The Integrated Plan offers a means to avoid a tangle of litigation and hardship for water interests in future years. The Yakima Basin Integrated Plan is believed to be the first basin-wide integrated plan in the United States to reach the level of success that it has achieved.

Prior efforts to increase water storage in the Yakima Basin have failed, in part due to a lack of consensus among the key stakeholders. The Integrated Plan offers the best opportunity in decades to resolve long-standing problems afflicting the Basin's ecosystem and economy. In addition, making available increased water storage for farms, fish and our communities is a key component of the Plan. When implemented, the Plan will greatly improve operational flexibility to support stream flows while meeting the basin's basic water supply needs under a wide range of seasonal and yearly snowpack and runoff conditions, both now and under possible future hydrologic conditions.

Overall, S. 1694 would provide the Secretary of the Interior with the authorities necessary to carry out first ten years of the Integrated Plan. But a critically important and creative component of the bill includes providing innovative authorities for our non-federal proratable districts to be able to design, construct and maintain the much needed water storage access facilities contemplated by this phase of the Integrated Plan. The bill would authorize the Secretary of the Interior to enter into long-term agreements with the proratable irrigation entities in the Yakima Basin, including KRD, to plan, design, construct and maintain the Kachess drought emergency pumping plant and the Keechelus-to-Kachess pipeline on Federally-owned lands to allow these districts to access the inactive surface water storage during drought years. Our view is for the Secretary to operate the facilities in order to fully integrate their benefits into the Project operations, while protecting the resources of the Basin. I believe this effort could be the first of its kind, and is innovative enough that other areas of the West could benefit from similar arrangements. Under S. 1694, Section 1214, the proratable districts in the Basin would enter into long-term agreements with the Secretary and Reclamation to provide non-federal ownership, management and financing in the construction of these two facilities, bringing emergency drought relief water supplies to the Basin quicker and with no burden on the federal budget. While we have some additional suggested improvements to the language of S. 1694, as introduced, to further clarify the provisions in Section 1214, we understand that we will have an opportunity to provide such language and look forward to working with the Committee in improving this section of the bill.

Another important provision in S. 1694 deals with restoring water flows in the tributaries in the Basin. These tributaries offer some of the best cold water habitats to native anadromous fisheries in the watershed, but access to these upper watersheds have been degraded over the years by water withdrawals and lack of streambed management. S. 1694 would authorize the Secretary to work in partnership with local irrigation districts, the State of Washington, the Yakama Nation and other stakeholders in providing the additional technical and other resources necessary in restoring these tributaries and enhancing fish habitat for the benefit of the Basin.

The pilot concept implemented on Manastash Creek in the upper watershed is a great example of success that the legislation would emulate in other creeks and streams in the Yakima Basin. Manastash Creek, a tributary of the Yakima River, provides irrigation water to approximately 4,500 acres of farmland through diversions from the creek. The creek also once served as important habitat for steelhead and coho salmon. Before the completion of this pilot project, a 3.25-mile reach of lower Manastash Creek was seasonally dewatered by irrigation water withdrawals. The Manastash Creek Project converted 3.2 miles of a KRD canal to a pressured pipeline, conserving over 1,200 acre-feet of water annually that is used to keep water flows in the creek during critical fish migration periods.

The Manastash project resulted in multiple instream and out-of-stream benefits. The conserved water increased instream flow in the lower Manastash Creek by around 3.5 cubic feet per second and significantly improved access to approximately 25 miles of important habitat for steelhead, coho, bull trout, and spring Chinook. Other benefits include reduced seepage, improved local irrigation system reliability, and increased on-farm efficiencies and water conservation through the use of pressurized sprinkler systems. In other words, farmers are still farming, and the creek is now flowing opening up miles of habitat for salmon and steelhead species in the process.

In closing, we are currently benefiting from our forefathers' vision and accomplishments in building our highly productive and valuable agricultural economy through the federally developed water storage and delivery projects in the Yakima River Basin. Our communities, schools, and businesses have all been built around these investments and depend on our water supplies more today than ever before. Now we must find ways to continue to improve this infrastructure to meet the problems of tomorrow, including the impacts of severe drought years on our communities, our river, and our economy. I believe we have a good start with S. 1694 and, as irrigation districts in need of additional dry-year water supplies, we are stepping up to the plate in financing and constructing new water supply infrastructure in innovative ways.

Also, as an irrigation community, we have come to recognize that, in order to protect and enhance our ability to farm and to raise families in our communities, we must work with our neighbors, the Yakama Nation, as well as the other important stakeholders in the basin, to successfully plan for our collective future. That is what we have accomplished in creating, and now implementing, the Yakima Basin Integrated Plan.

The State of Washington has provided over $130 million over the past two years to assist in implementing the Integrated Plan, our proratable irrigation districts are contemplating a non-federal investment in the hundreds of millions to build new water supply infrastructure and water conservation improvements under the Plan, and we look forward to the enactment of S. 1694 to assist in implementing the Plan, improving habitat for fish and wildlife, and creating new emergency storage water supplies for the future of the Yakima River Basin, the State of Washington, and the arid West. Thank you for the opportunity to provide this testimony and I would be happy to answer any questions.

The CHAIRMAN. Thank you, Mr. Eberhart.

Mr. Garrity, welcome.

STATEMENT OF MICHAEL GARRITY, DIRECTOR, RIVERS OF PUGET SOUND AND THE COLUMBIA BASIN, AMERICAN RIVERS

Mr. GARRITY. Thank you.

Thank you, Chairwoman Murkowski, Ranking Member Cantwell and members of the Committee. Thank you for the opportunity to testify and share American Rivers' support for the bill before the Committee, S. 1694, the Yakima River Basin Water Enhancement Project Phase III Act of 2015.

American Rivers protects wild rivers, restores damaged rivers and conserves clean water for people and nature. And since 1973 we have protected and restored more than 150,000 miles of rivers through advocacy efforts and on-the-ground projects.

My name is Michael Garrity. I'm Director of Rivers of Puget Sound and the Columbia Basin for American Rivers, so I'm based out of Tacoma, Washington. I've worked on long standing issues of water supply reliability and fishery restoration in the Columbia and Yakima Basins for about 15 years.

Just as for many Western river basins, controversy is no stranger to the Yakima, and American Rivers has been part of some of those controversies. Today is different. We join others in testifying in support of S. 1694. We're not asking you to choose sides. We're asking you to help us work together for an innovative, integrated plan to support the Yakima Basin's fish, farms, families and forests.

The Yakima Plan, at its heart, is a set of pragmatic actions that address the Yakima Basin's major water supply and ecosystem challenges through seven integrated elements. The plan is envisioned to be completed over the next 30 years in a way that helps the Basin's major stakeholders. It authorizes the Initial Development Phase of the plan, the projects that make the most sense to do and are ready to do over the next ten years.

We support the entire 30-year Yakima Plan. However, we note that some projects will be subject to environmental and economic review that may make them infeasible or uncover issues that could cause us to reconsider support.

The Yakima Plan stitches together many elements, some previously authorized in Federal legislation and some undertaken by non-Federal actors. S. 1694 addresses the parts of the Initial Phase which require Federal authorization and it clarifies authority where that authority may be ambiguous.

Some of the most important elements of the Initial Phase are construction of the Plan's first major water surface storage projects such as the Kachess Dry Relief Pumping Plant and the Keechelus to Kachess Conveyance Facility, construction of fish passage projects both upstream and downstream at Reclamation reservoirs, increasing storage at Cle Elum reservoir by three feet, continued water conservation and efficiency projects, continued and expanded habitat projects to benefit salmon, steelhead and bull trout and ground water recharge programs.

Now I'll discuss American Rivers' perspective on the bill in more detail. We look for opportunities to advocate for new ways of doing business to promote healthy rivers in a variety of settings including water supply and water management. The Yakima Plan in S. 1694 fosters innovative and integrated water management and watershed restoration. Specifically the plan and the bill embrace integrated approaches including making better use of existing infrastructure before building new reservoirs, embracing water conservation, conjunctive use of ground and surface water, water markets and viewing problems and solutions from a watershed perspective. It also embeds fishery restoration into water management and makes fishery restoration a co-equal purpose with water supply reliability.

It's also innovative. New approaches are needed in solving Western water problems. The art of fighting water issues to a science standstill must end given the present threats to ecosystems and water supplies.

American Rivers and other conservation groups have long fought new Federal water projects, in part due to Federal subsidies that have provided artificial incentives for their construction. To their credit the Yakima Irrigation Districts have proposed and the bill authorizes private financing for water supply projects. We strongly support this approach, and we believe it addresses the criticisms that have been raised about some of the Plan in general from a Washington State University Economic Study because the irrigators are taking on the risk themselves rather than the taxpayers. The plan also innovatively links land conservation with management of Reclamation reservoirs, and it addresses not only drought but the impacts of climate change over the long term. As this year demonstrates with its low snow pack, actions taken for drought response will also help us as the climate warms.

There are a number of details and bill elements that we hope will be refined through the legislative process. We hope to work with bill sponsors and this Committee to address lingering substantive issues and move S. 1694 forward.

In conclusion we believe that the bill is a major step toward a workable 21st century framework for water management in the West and that it offers major environmental benefits for the Yakima River Basin. For these reasons we urge you to support S. 1694, strongly support it, and are looking forward to working with you to pass this legislation.

Thanks.

[The prepared statement of Mr. Garrity follows:]

Testimony of Michael Garrity,
Director, Rivers of Puget Sound and the Columbia Basin, American Rivers
July 7, 2015

Written Testimony
Submitted to the
United States Senate
Committee on Energy and Natural Resources

On

S. 1694
Yakima River Basin Water Enhancement Project Phase III Act of 2015
July 7, 2015

Respectfully Submitted By Michael Garrity
Director, Rivers of Puget Sound and the Columbia Basin
American Rivers

Testimony of Michael Garrity,
Director, Rivers of Puget Sound and the Columbia Basin, American Rivers
July 7, 2015

Introduction

Chairman Murkowski, Ranking Member Cantwell, and Members of the Committee, thank you for the opportunity to testify and share American Rivers' support for the bill before the Committee – S. 1694, The Yakima River Basin Water Enhancement Project Phase III Act of 2015.

American Rivers is the nation's leading voice for healthy rivers and the communities that depend on them. We believe that rivers are vital to our personal and community health, safety and quality of life. American Rivers mobilizes an extensive network comprised of tens of thousands of members and activists located in every state across the country.

I am Michael Garrity, Director, Rivers of Puget Sound and the Columbia Basin for American Rivers, my office is in Tacoma, Washington. I have worked personally on the longstanding issues of water supply reliability and fishery restoration for the Yakima River for more than {**ten** }years. American Rivers' Northwest Regional Office has worked on these Yakima River issues for more than [**twenty five**]years.

Just as it is for many Western river basins, controversy is no stranger to the Yakima. My organization's long involvement in the Yakima often has been through adversarial relationships with the Bureau of Reclamation, the State of Washington, the irrigation districts and the Yakama Nation – not to mention other stakeholders such as the counties, cities, and interest groups including other environmental groups. And we were not the cause of most of that controversy–everyone was adverse to everyone else.

Today is different – American Rivers joins in the testimony you hear today in strong support of S. 1694. We are not asking you to choose between fishery restoration and water supply in urging you to pass S. 1694. We are asking you to help us work together in executing an innovative, integrated plan to support our fish, farms, families and forests.

The Yakima Bain

The Yakima River is located on the arid east side of Washington State, nestled between the Cascade Mountain crest and the Columbia River. Water development in the basin has worked spectacularly well to grow crops and the Yakima basin's agricultural economy. In the 6,155 square mile basin, there are about 500,000 acres of irrigated land, supporting an agricultural economy valued at $3.4 billion. Average annual water supply is about 3.3 million acre-feet, with deliveries of about 1.7 million acre feet. Notable crops include apples, sweet cherries, most of the hops grown in the U.S. and increasingly well regarded wine grapes, along with a variety of other crops.

This irrigated economy was based on repeated rounds of irrigation development. Starting in the 1850s, private and then railroad-sponsored irrigation projects were built, which by the turn of the century fully consumed the Yakima River natural flow. The next phase was the 1905 authorization of the Bureau of Reclamation's Yakima Project, claiming all unappropriated water to augment supplies through construction of five main storage reservoirs.

What worked well for the irrigation economy was disastrous for the fish. All the Reclamation reservoirs were built without fish passage, sealing the fate of sockeye salmon which depend on the glacial lakes dammed by Reclamation, and blocking access to higher elevation, cold water spawning habitat for spring chinook, coho, and steelhead, as well as isolating bull trout populations above or below the dams. Pre-settlement salmon runs are estimated at 300,000 to 960,000, but with irrigation and other development, sockeye, summer Chinook and coho were extirpated, and the average annual returns for all salmonids during the 1980s dropped to as low as 8,000, roughly one percent of pre-development levels.

A 1945 Consent Decree created an unusual water rights structure in the Yakima Basin. Every year Reclamation determines the Total Water Supply Available (TWSA). Pre-1905 rights amounting to about half of the basin's surface water rights receive their full water supply before junior right holders receive any. Next up are users whose rights date to the 1905 Reclamation appropriation. These rights are termed "proratable," and are cut back equally in any shortage. Post-1905 rights receive no water if the proratable rights are shorted and there is a call. Senior rights holders have little concern about their water supplies because they historically have never been shorted. However the largest and most economically productive water districts rely in large part on proratable rights. Until the historic 1977 drought, proration was a modest concern for the Reclamation irrigators – there was rarely a serious shortage of water that resulted in significant proration. Since 1970, there have been eight years, including this year, where proratable rights holders received less than 70% of their water, the threshold irrigators see as causing real economic pain.

The regionally significant 1977 drought prompted renewed interest in new storage to improve the reliability of the proratable supply. Federal legislation in 1979 and then 1984 authorized what is known as the Yakima River Basin Water Enhancement Project (YRBWEP) Phase I, focused on installing fish screens and fish passage at irrigation facilities in the middle and lower parts of the basin. After additional severe droughts in 1992 and 1993, this was followed by YRBWEP Phase II in 1994. Phase II focused on water conservation and efficiency along with some habitat acquisition and restoration. It has resulted in significant system improvements and continues as funding permits. American Rivers strongly supported YRBWEP Phase I and Phase II.

Testimony of Michael Garrity,
Director, Rivers of Puget Sound and the Columbia Basin, American Rivers
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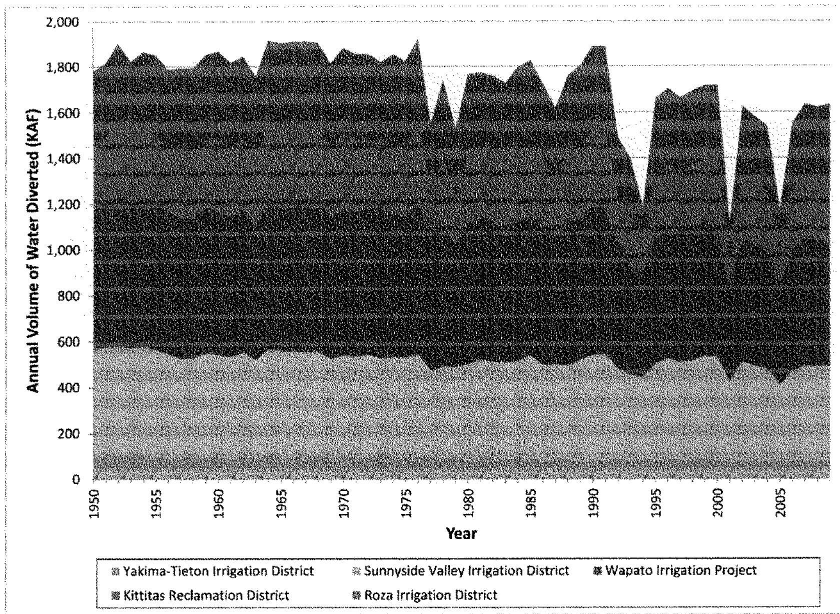


Proponents of YRBWEP Phase I and Phase II envisioned this work as preparing for a Phase III that would include significant additional storage. Congress authorized in 2003 a feasibility study for new surface supplies – a transbasin diversion of Columbia River water into the Yakima Basin coupled with development of a 1.3 million acre-foot off-stream storage facility known as the Black Rock project. The Black Rock proposal foundered in 2008, due to a benefit cost analysis that concluded the project returned only 13 cents on the dollar and had significant potential to speed the movement of radioactive groundwater on the Hanford Nuclear Reservation towards the Columbia River. American Rivers strongly opposed the Black Rock project.

The State of Washington, urged by unusual agreement among stakeholders including the Yakama Nation, irrigation districts and conservation organizations determined that a broader range of alternatives be evaluated. In a state EIS, it developed the nucleus of what became the Yakima Basin Integrated Plan, balancing fishery improvements, better water management, and supply enhancements.

At the same time, concern was growing in the Basin about the effects of climate change on the low to mid-elevation snowpack that both fish and farms rely upon as a so-called "sixth storage reservoir." Due to projected reductions in snowpack and earlier melt-off, and in spite of small expected increases in overall precipitation, modeling conducted by the University of Washington's Climate Impacts Group (CIG) concluded that the Yakima basin will be subject to increasingly severe instream and out-of-stream water shortages as the century moves forward. The CIG study scenarios show the chances of severe water shortages, now about 14% per year, doubling as soon as 2020 and becoming much higher thereafter.

Those climate change scenarios foreshadowed the water situation for the Yakima in 2015. This winter, the Yakima had near normal precipitation – but a warm winter caused the precipitation to fall as rain and not snow. The Yakima Basin ended the winter with full reservoirs and almost no snow pack. The result was that proratable water users face an irrigation season with 44% of the water they normally receive. 2015 looks very much like a water year from the CIG scenarios deep into the century when climate change profoundly diminishes the snowpack in the region.

For such a thoroughly plumbed river system, the Yakima is surprisingly sensitive to loss of snowpack. This is because compared to other developed agricultural river basins in the West, storage is quite limited compared annual flow -- a condition made possible by the historically reliable and abundant, but now threatened, Cascade snowpack. About 30% of the Yakima's average annual runoff can be stored in reservoirs, much less than major rivers in California where two-thirds to more than two times annual flow can be stored, and far less than the major storage systems of the Colorado River or the Missouri River where several times annual runoff can be stored. (See Table)

Western Rivers
TABLE
Impounded Runoff Index
(Surface storage divided by average annual flow)

Yakima River, WA	30%
Sacramento River, CA	80%
American River, CA	67%
Tuolumne River, CA	194%
Stanislaus River, CA	293%
Yuba River, CA	75%
Feather River, CA	129%
San Joaquin River, CA	120%
Merced River, CA	101%
Trinity River, CA	206%
Missouri River	222%
Colorado River	492%
Columbia River	28%

These themes were tied together under the Federal SECURE Water Act of 2009, which supported the Yakima as one of the first three basin studies selected to look comprehensively at the long term water supply, long term water demands, climate change and environmental issues. Because basin interests recognized that they had to work together and had extensive information developed as a result of the divisive Black Rock project as well as extensive fisheries recovery planning and knowledge of water conservation developed YRBWEP, the Yakima Plan moved quickly to a basic set of agreements hammered out by an unusually broad set of agricultural, tribal, environmental, and governmental (federal, state, and local) stakeholders. The Yakima Basin Study/Proposed Integrated Water Resources

Management Plan was released in April, 2011 followed by a Programmatic Environmental Impact Statement in March 2012 and Yakima River Basin Integrated Water Resource Management Plan: Framework for Implementation in October 2012.

The Yakima Basin Integrated Plan

YBIP at its heart is a set of pragmatic actions that address the major water supply issues and ecosystem restoration of the basin through seven integrated elements. These elements are envisioned to be completed over the next 30 years in a way that carefully orchestrates improving the position of each of the major interests in a balanced fashion. S.1694 authorizes the Initial Development Phase – the projects that make the most sense to do, and are ready to do, in the next 10 years, with more ambitious projects deferred.

Briefly, these elements include:

- Fish passage at all six of the Reclamation reservoirs. None of the Reclamation reservoirs included fish passage when built between 1910 and 1933. Reintroduced sockeye stand to benefit most from fish passage, because they relied upon glacial lakes that were inundated by building of the dams, although other anadromous and resident fish species, including bull trout, are anticipated to greatly benefit from access to good quality habitat on public lands in the higher elevation, cold water areas above the dams.

- Modification to make better use of existing facilities. These changes include: reducing water diversions for hydropower; raising Cle Elum Reservoir by 3 feet; and building the Ketchelus to Kachess Conveyance, a new tunnel that shifts water from a small reservoir on a more productive watershed to a larger reservoir with less flow, to make better use of existing reservoir capacity while reducing flows harmful to juvenile salmon rearing in the mainstem Yakima River.

- Increased surface water storage for both water supply and fisheries. These projects range from expensive to very expensive. Most economical is accessing inactive storage is the Kachess Drought Relief Pumping Plant which taps water below the reservoir outlet so that up to 200,000 acre-feet of water could be used during serious drought (proration greater than 70%). Expansion of Bumping Reservoir by building a new dam downstream is more expensive, and would yield an additional 165,500 acre feet; this project is controversial because it would inundate about 980 acres of old-growth forest, bull trout spawning habitat, and homes on leased U.S. Forest Service land occupied by vocal critics. The most expensive project is construction of Wymer Reservoir, a new off-stream, pumped-storage reservoir in the lower Yakima River canyon. The Wymer Reservoir would allow increased winter flows needed to support the fishery in the upper Yakima Basin to be captured and stored for summer irrigation use. It is a good example of integration in meeting the needs of the fishery and irrigation water supply. Reclamation and Ecology are looking at alternatives to reduce the size and cost of this project. The Bumping and Wymer are not authorized in S. 1694.

- Groundwater storage. Groundwater storage envisioned includes both pumped aquifer storage and recovery, and selective surface infiltration ponds where hydrogeology allows.

- Habitat protection and enhancement. In addition to significant habitat acquisition and restoration in the basin's rivers, streams and floodplains, YBIP included acquisition private forest lands in the tributary Teanaway River basin to support fishery restoration; 50,000 acres of this acquisition has been accomplished by the State of Washington. YBIP also includes targeted land designations to promote the linkage between land management and the water supply and fishery objectives of the plan. These designations include Wild and Scenic Rivers, especially where linked with fishery reintroductions, and designations on federal lands that promote both the goals of YBIP and a robust local economy.

- Enhanced Water Conservation. A major target was conserving up to 170,000 acre-feet annually in wet years through reduction in conveyance and operational losses through lining and piping canals and ditches, and application efficiency. While conservation does not "make new water" and works only when water is available, conservation does allow water to be managed much more effectively, and when water is available, will increase flows for fish.

- Market reallocation of water. Effective water marketing is a bedrock element of YBIP, but one which is a work in progress. Initially the effort will be to make the existing mechanisms more effective. In the process, we anticipate that changes to laws, policies and institutions will be needed to make markets work effectively and comprehensively. Largely because markets did not provide significant relief to junior water rights holders in prior droughts, water district are reluctant to rely heavily on water markets in future droughts.

Goals for YBIP are high. On the fishery side, current annual salmon returns are in the range of 25-40,000 fish; the goal is to expand that tenfold. On the water side, the goal is to meet the 70% proration threshold to the junior, Reclamation, water rights in even the dry years of record, as well as increase supplies for municipal, industrial and domestic use.

American Rivers supports the entire YBIP project; however, we note that some projects will be subject to environmental and economic review that may make them infeasible, or may uncover issues that would cause us to reconsider support for those specific projects.

S. 1694 and the Initial Development Phase of YBIP

The Yakima Basin Integrated Plan stitches together many elements, some previously authorized in federal legislation, and some undertaken by non-federal actors under their own authorities (such as the acquisition of the Teanaway River Basin lands by the State, and many fishery restoration projects by the Yakama Nation, various Districts, and conservation organizations). S. 1694 addresses the parts of the Initial Development Phase (IDP) which require federal authorization and clarifies authority where authorization may be ambiguous.

Some of the most important elements of the Initial Development Phase are:

- Construction of the first two major surface water storage projects – the Kachess Drought Relief Pumping Plant and the Ketchelus to Kachess Conveyance Facility. Both need federal authorization.
- Financing those water storage projects in a new way for federal Reclamation projects that relieves financial responsibility from the federal government – the water users will finance,

construct, maintain and be responsible for these projects, working in cooperation with Reclamation.
- Construction of fish passage projects, both upstream and downstream, at two of the Reclamation Reservoirs. Authorization is clarified for these projects
- Increasing storage at Cle Elum Reservoir by raising its level by three feet; this was previously authorized.
- Continued water conservation and efficiency project that would yield 85,000 acre feet of reduced use.
- Expansion of habitat and conservation projects into the tributaries, where significant fishery improvements can be made.
- Commencement of groundwater recharge programs.
- Adding project purposes to Reclamation's Yakima Project to reflect the new approach of YBIP. These include recovering and maintaining self-sustaining harvestable populations of native fish, both anadromous and resident, throughout their historic distribution.

American Rivers Perspective on S. 1694

American Rivers is an advocate for new ways of doing business that promote healthy rivers in a variety of settings, including hydropower, flood management, storm water management, and water supply. For all of these, our work has common themes, including integrated approaches, viewing problems and solutions from a watershed perspective, and embedding restoration of natural processes and ecosystems into the goals and outcomes of projects. Because YBIP and S. 1694 furthers these new themes and ways of doing business, and promises to achieve good results, American Rivers strongly supports S. 1694.

Integrated approaches: YBIP and S.1694 integrate all of the essential elements of modern water policy, including:

- Making better use of existing infrastructure before building new reservoirs. Three of the initial development phase exemplify this approach. The KDRPP project makes use of existing, but inactive, reservoir capacity. The K-2-K Conveyance helps shift water from one sub-watershed to another. The Cle Elem pool raise adds significant storage with minor investment.

- Using conservation and efficiency to make sophisticated water management possible. Because most water in the Yakima is reused, conservation does not directly yield "new" water. But it does allow less water to be diverted to meet a specified demand. This keeps water in storage or in rivers where it can provide fishery benefit as well as later irrigation benefit. Conservation in the IDP is intended to yield 85,000 acre-feet of water that can be managed more effectively.

- Conjunctive use of ground and surface water. In the IDP, conjunctive use is primarily in the pilot phase. As projects demonstrate how effective conjunctive use can be in this setting, additional or larger scale projects may be developed.

- Economists and conservationists have long argued that water marketing is an effective response to drought. Marketing is an important element of YBIP; with the 2015 drought, efforts to increase marketing are underway.

- Viewing problems and solutions from a watershed perspective is at the core of the YBIP. Actions are programmed from the headwaters in the high Cascade Mountains to the confluence with the Columbia River.

Embedding restoration: YBIP and S.1694 embed restoration of natural processes and ecosystems into the goals and outcomes of the projects:

- Fishery restoration is a co-equal purpose with water supply reliability for YBIP. S. 1694 reflects that in a new project purpose: to recover and maintain self-sustaining harvestable populations of native fish, both anadromous and resident, throughout their historic distribution.

- Flooding is a significant problem in the Yakima Basin, especially near the City of Yakima. In those same areas, expanding the floodplain would benefit anadromous fishery restoration by providing additional habitat for juvenile fish. YBIP solves both problems by promoting setting levees back to allow more room for flood waters and expanded fishery habitat.

- Two fish passage projects are part of the IDP. This will provide fish access above the two reservoirs that have the largest amount of potential habitat among the Reclamation reservoirs.

- Existing programs to restore fishery habitat and improve water management that affects fisheries will be expanded and extended to tributaries.

Innovation: New approaches are needed in solving Western water problems. Among the most interesting of the new approaches in YBIP and S. 1694 are:

- For decades, conservationists, taxpayer advocates and economists have pointedly noted that the original purpose of federal irrigation subsidies have long been accomplished - the West is settled. American Rivers and others have strongly opposed new federal water projects, in part based on opposition to large federal subsides embedded in new projects. To their credit, the Yakima irrigation districts acknowledge the issue and have proposed, and S.1694 authorizes, that they go to the private markets for financing. While there may be further refinements of the details needed through the legislative process, American Rivers strongly supports the approach.

- Linking land conservation with Reclamation water supplies and fishery restoration. While this linkage dates at least to the Forest Service's Organic Act, it is innovative for Bureau of Reclamation projects. The state acquisition and management as a Community Forest of the Teanaway property is one example. Others include proposals for Wild and Scenic River designations. First among those (but not included in S. 1.694) is designation of the Cle Elum River above the reservoir – this is linked with construction of the first fish passage that will allow sockeye salmon restoration. Future proposals will proposals to designate federal lands in ways that help YBIP achieve its goals, and promote a robust recreational economy.

- While the water supply elements of YBIP and S. 1694 are fundamentally designed to be drought responses, they and the entire package are also crafted to address adaptation to climate change. As this year demonstrates with its low snow pack, in the Yakima, actions taken for drought response will also help as the climate warms.

There are a number of details and bill elements that will be refined through the legislative process. We look forward to working with the sponsors and the Committee to finalize S. 1694.

Conclusion

American Rivers is known for leading efforts to remove obsolete and damaging dams from rivers across the nation. We ask you to support S. 1694 and the Initial Development Phase of a plan that we know is designed to lead to expanded or new dams in the Yakima in subsequent phases. To some this may be a contradiction, even heresy. To us it demonstrates a focus on our mission: The Yakima is a working river with both a huge threat from snow pack loss due to climate change, and a huge opportunity in restoration of hundreds of thousands of salmon and steelhead. To be healthy now and in the years to come, for the Yakima River and the communities that depend on it, change is needed.

We believe that S. 1694 embodies a major step towards that change. For that reason, we urge you to support S. 1694 and look forward to working with you on resolving remaining issues in the bill.

The CHAIRMAN. Thank you, Mr. Garrity.

Mr. Rigdon, welcome.

STATEMENT OF PHIL RIGDON, SUPERINTENDENT, DEPARTMENT OF NATURAL RESOURCES, YAKAMA NATION

Mr. RIGDON. Well, thank you, Chairwoman Murkowski, Ranking Member Cantwell.

I'm Phil Rigdon. I oversee the Department of Natural Resources for the Yakama Nation, and I'm also a member of the tribe.

Thank you for this opportunity to testify for the Yakima Basin Water Resource Management Plan and on Senate bill 1694. We greatly appreciate Senator Cantwell's leadership on this important issue and legislation.

The Yakama people have lived in the Pacific Northwest since Time immemorial. When we entered into the Treaty of 1855 we ceded 12 million acres of land to the United States. Most of that land, that would now describe Central Washington, in that treaty the United States guaranteed our people right to have and harvest salmon and other natural resources both on the reservation and in off-reservation use on custom fishing grounds.

Perhaps no one has ever more accurately described the importance of salmon to my people than the U.S. Supreme Court Justice and former Attorney General, Joseph McKenna, who—for an eight-one majority, the landmark decision of the U.S. versus Winans in 1905, stated that salmon were not much less necessary to the existence of Winans than the atmosphere they breathe. That decision established the reserved right doctrines of Indian Treaty law.

At the time of the treaty there were often 12 to 15 million salmon returning to the Columbia River Basin. In some years that figure approached 30 million returning salmon. The Yakima Basin was second only to the Snake in the fish it contributed to the Columbia every year. Salmon are not only an integral part of the Indian people, but they have been and are a major part of the economy of the Columbia Basin and provide a livelihood and means of recreation for tens of thousands of non-Indians as well.

As a result of the hydro dam, over fishing, destruction of habitat, including dewatering streams for the benefit of the irrigation by the early to mid-part of the 20th century, salmon runs that were in drastic decline with the returning numbers reduced from millions down to thousands while the Boldt decision and Belloni decisions of the 1960s and 70s confirmed our authority of self-regulating Treaty tribe with rights to half the fish in the Columbia River Basin and as co-managers of the resources half of nothing is nothing. Rather than waiting for our rights and resources to be restored, we have taken the active role in successfully rebuilding diminished runs and guaranteeing the existence of our Treaty fish.

In the Yakima Basin, the state fisheries agencies that basically had given up at one point. The Yakama Nation took a different approach. We spoke for those species that cannot speak for themselves. The Yakama Nation took the lead in securing a sweeping series of amendments from the Northwest Power Act and to make fish and wildlife an equal priority. We developed a scientifically-based program needed to restore runs from modern fish screens and ladders. We have worked successfully with farmers and local conservation districts to remove passage barriers and restore habitat. We began supplementing runs with a scientifically-based hatchery program. Our goal was to restore historically present stocks of salmon and other species of interest to the Yakima Basin. This includes reintroduction of three species that were extirpated from the Yakima, the Coho, Summer Chinook and Sockeye Salmon. This has led to a number of returning fish increasing from several thousand total adults in the early 1980s to over 25,000 for each of the past six years and a modern record number of 50,000 adults returned in 2014. Our effort has led to restoration of salmon fishing seasons for Indians and non-Indians alike.

After opposing each other in court for decades the tribes and the irrigators, environmental groups, the state and local, county governments rose up through cooperation and sitting down together and compromising we could save the salmon while simultaneously having a vibrant agricultural based economy. This successful history of cooperation has led us here today.

In 2015, in the midst of the most serious drought in decades, we're able to supplement stream flows by working with the Kittitas Reclamation District to use their canal to deliver water to fish streams. The spirit of cooperation exemplified by the Yakima Basin Integrated Plan gives us hope going forward to see full restoration of salmon runs and other natural resources vital to the Yakama people's needs while providing the sustainability to the agricultural sector.

Our work has shown some success, but the remaining challenges are great and require us to increase the scope of our efforts. Most of the best cold water habitat in the Yakima Basin remains blocked by impassable storage dams and many impassable irrigation diversions. The habitat is mostly publicly-owned and has relatively pristine habitat and stream flow conditions. As we face growing impact of climate change, restoration of salmon access to these higher elevation areas will be critical.

I am pleased to say the state is now a full partner with the Yakama Nation developing and implementing a plan to restore salmon. The coalition you see before you today represents a remarkable collaboration among long-time adversaries who have come together to develop a package of solutions to the big problems facing the Yakima Basin.

With the help of Congress we will succeed in this worthy endeavor.

Thank you.

[The prepared statement of Mr. Rigdon follows:]

Testimony of the Yakama Nation
Before the Senate Committee on Energy and Natural Resources
On S. 1694, the Yakama River Basin Water Enhancement Project Phase III Act of 2015
July 7, 2015

Chairman Murkowski, Ranking Member Cantwell and Honorable Members of the Senate Committee on Energy and Natural Resources

Thank you for the opportunity to testify in favor of the Yakima Basin Integrated Water Resources Management Plan and S. 1694. We greatly appreciate Senator Cantwell's leadership on this important issue and legislation.

I am Phil Rigdon, a member of the Yakama Nation. As the Superintendent of the Yakama Nation Department of Natural Resources I oversee programs dedicated to the sustainable management of the tribe's natural resource base. The Yakama people have lived in the Pacific Northwest since Time Immemorial. Throughout the millennia a bounty of natural resources has sustained our people's lives and culture. Salmon drove the first great economy of the region, and people from the coast to the Great Plains came to our homeland to trade. Celilo Falls, or Wyam as we say in my people's language, was arguably the single most prolific place of trade in the Pacific Northwest for thousands of years. It was also one of the oldest continuously inhabited settlements in North America. That changed dramatically when the Dalles Dam was constructed by the Army Corps of Engineers in 1957 inundating the great falls and the community itself and forever changing the economy of the Northwest.

When we entered into the Treaty of 1855, we ceded 12 million acres of land to the United States, most of the land that would now be described as Central Washington. In that Treaty the Unites States guaranteed our people the right to have and harvest salmon and other natural resources across much of what is now Washington and Oregon. The Treaty also promised a homeland including an agricultural livelihood on the Reservation. At the time of the Treaty, there were often 12-15 million salmon returning to the Columbia River every year. In some years, that figure approached 30 million returning salmon. It should be noted that the Yakima River was second only to the Snake in the numbers of salmon it contributed to the Columbia. That is a testimonial to the superb habitat that existed, and still does, in the Yakama basin. After the non-Indians constructed dams on both the main stem of the Columbia and its tributaries throughout the Northwest, engaged in farming and land use practices that blocked and dewatered streams and destroyed habitat, and allowed for overharvesting of salmon and steelhead, salmon runs dwindled to the thousands and some have gone extinct.

It would be an understatement to say that the promises – the legally binding commitments – made to my ancestors have not been met. Not so long ago our people were being arrested and prosecuted by the State of Washington for exercising their Treaty fishing Rights. Over a century of court battles beginning with the landmark US v. Winans decision 198 U.S. 371 (1905)[1] and the Boldt and Belloni decisions of the

[1] This case involving the Yakama Nation established two of the most fundamental principles of federal Indian law including that a "Treaty between the United States and the Indians... is not a grant of rights to the Indians, but a grant of rights from them—a reservation of those granted." This established for the first time the so-called "reserved rights" doctrine in American Indian law. The decision also established the concept that treaties were to be interpreted in the way the Indians would have understood them and contained the often quoted observation that salmon "were not much less necessary to the existence of the Indians than the atmosphere they breathed."

1960s and 70s confirmed our authority as self-regulating Treaty tribes with rights to half the fish in the Columbia River Basin and as co–managers of the resource. But half of nothing is nothing. Rather than waiting for our rights and resources to be restored, we have taken an active role in successfully rebuilding diminished fish runs and guaranteeing the existence of these Treaty fish.

In the Yakima basin, the state fisheries agencies had basically given up on salmon. The YN took a different approach. We spoke for those species that cannot speak for themselves. The Yakama Nation took the lead in securing a sweeping series of amendments to the NW Power act to make fish and wildlife an equal priority with hydropower. We developed the scientifically based programs needed to restore runs through modern fish screens and ladders. We have worked successfully with farmers and local conservation districts to remove passage barriers and restore habitat. We began supplementing runs with a scientifically based hatchery program. Our goal was to restore all historically present stocks of salmon and others species of interest to the Yakima basin. This included reintroduction of three species that were extirpated from the Yakima, coho, summer chinook and sockeye salmon. This has led to numbers of returning fish increasing from several thousand total adults in the early 1980's to over 25,00 for each of the past six years. A modern record number of over 50,000 adult salmon returned in 2014. Our efforts have led to restoration of salmon fishing seasons for Indians and non-Indians alike in the Yakima River.

An example of how far we have come and how far we still have to go is Sockeye Salmon. Sockeye were abundant in the Yakima basin historically, rearing in the glacial lakes in the headwater streams of the Yakima basin. The construction of storage dams blocked all access to Sockeye spawning and rearing grounds, and with the construction of Bumping Lake Dam in 1910, Sockeye disappeared from the basin. Through a recent history of litigation, good science, and cooperation with the Grant County PUD and the Okanogan Tribes of Canada on the Columbia River, we successfully reintroduced Sockeye Salmon in 2009. In 2013, the first year of adult returns from this reintroduction effort, 850 Sockeye successfully returned to the Yakima basin out of the 1000 that were introduced. In 2014 over 2700 adults returned from the 2500 that were released into the Cle Elum Reservoir in 2010. This is a remarkable and proud accomplishment for us after the presence of Sockeye had been missed for a hundred years.

This successful history of cooperation has led us here today. In 2015, in the midst of the most serious drought in a decade we are able to supplement stream flows by working with the Kittitas Reclamation District to use their canal to deliver water to fish streams. While it has been necessary to use the courts to have our rights recognized, we believe that the spirit of cooperation exemplified by the Yakima Basin Integrated Plan gives us hope going forward to see full restoration of salmon runs and other natural resources vital to the Yakama people's needs, while providing sustainability to the agricultural sector.

Our work has showed some successes, but the remaining challenges are great and require us to increase the scope of our efforts. Most of the best cold water habitat in the Yakima Basin remains blocked by impassible storage dams and many impassible irrigation diversions. This habitat is mostly publically owned, and has relatively pristine habitat and streamflow conditions. As we face the growing impact of climate change, restoration of salmon access to these higher elevation areas will be critical.

The ten year average for returns of adults of all species of salmon to the Columbia River was 1,391,378 fish. The two most recent years have been much higher with 1,787,021 returning in 2013, and 2,281,321adults returning in2014. While these past year have been a modern day record, it is still a far cry from the actual pre-development multiple-millions that all parties now strive for. With its components of fish passage at the federal reservoirs and restoration of passage, flow and habitat in the tributaries, and increased instream flow from conservation and new storage, the Yakima Basin Integrated Plan holds the greatest promise yet seen for restoration of harvestable levels of all native salmon species throughout their historic range as promised by our Treaty. The restoration of these runs would not only benefit the Yakama people but it offers the entire region an opportunity to diversify its economy through what could be a multi-million sports fishery and tourism industry.

On the agricultural side, the Yakama Nation's agricultural economy has been held back by decades of deferred maintenance on the BIA constructed Wapato Irrigation Project. Under YRBWEP Phase II, we developed a Priority Measures Plan to begin the long process of modernizing the irrigation projects, which promises benefits to tribal economic development and instream flow. Funding for implementation under YRBWEP III is needed to implement this project.

I am pleased to say that the State is now a full partner with the Yakama Nation in developing and implementing a plan to restore salmon while enhancing agricultural water supply. Unlike past plans that were developed with little or no opportunity for tribal involvement, the Integrated Plan was developed with full tribal participation and incorporates the measures the Yakama Nation believes are needed to solve the major fish problems in the basin. The coalition you see before you today represents a remarkable collaboration among long-time adversaries, who have come together to develop a package of solutions to the big problems facing the Yakima Basin.

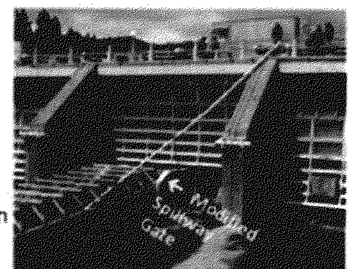
We want to thank Senator Cantwell for introducing this legislation. We look forward to working with the Senators and their staffs to refine and secure passage of this vital legislation. Our written comments include some edits we believe are necessary to reflect the consensus of the Integrated Plan partners.

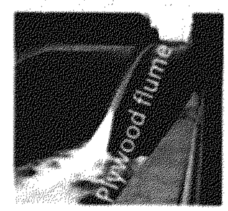
Yakama Nation Fisheries restoration projects include reintroduction of Sockeye Salmon to Cle Elum Lake.

In 2009, the Yakama Nation Reintroduced Sockeye to Cle Elum Lake.

1000 adults released in 2009
85,000 juvenile Sockeye outmigrated in 2011
800 adults returned in 2013
2514 adults returned in 2014

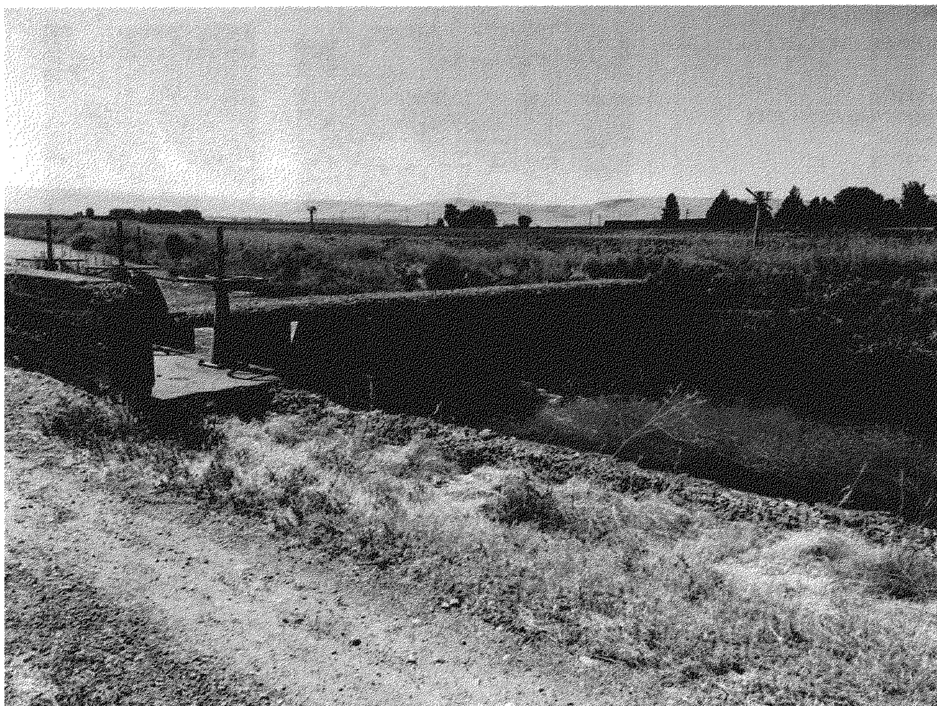
Interim passage is limited to juvenile outmigration at full pool. The Integrated Plan includes adult and juvenile passage at varied reservoir levels.





Temporary Passage

Examples of Deferred Maintenance on Wapato Irrigation Project

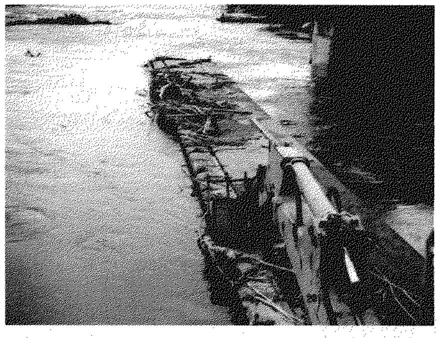


Main Canal Check Structure for Lateral 2 & Drain 2.

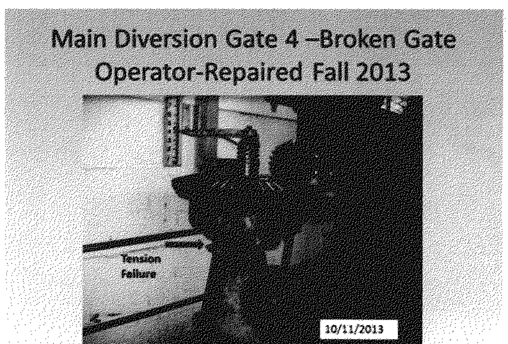
Concrete is compromised. Wooden flashboards are difficult & dangerous to adjust (no railing, spalled surface).

Structure should be rebuilt and fitted with an automated gate to adjust the water surface level in the Main Canal at an estimated cost of $2.2million.

Pictures of the Wapato Irrigation Project Main Diversion which was constructed in 1916/1917



The dam crest was raised probably in the 1980's, but the trash rack was not raised and that allows debris to enter the headgate intakes.



Debris gets pinched between the headgates and the concrete floor as the gates are lowered at the end of the irrigation season and causes damage such as sheared gate operator pictured at left and bent gate stem in picture below.

In addition, much of the structural concrete is compromised.

Estimated cost to rebuild the trash rack and rehabilitate the Main Diversion Headworks is $3.3 million.

Bent gate stem

The CHAIRMAN. Thank you, Mr. Rigdon.

I appreciate the comments and the testimony from each of you this morning.

It is not very often that we have a whole panel that is in unison about a bill that we have in front of us which begs the question who opposes this? It is not possible that we could be sitting here having a discussion about fish and water and not have some opposition out there. So I would like a little bit of perspective here.

You have hit on it, Mr. Rigdon. There has been a history here, decades, where you have been working against one another and now we have come to this place where there is clearly a very collaborative effort going on. That is appreciated. We always like it when you come to us with solutions. But in terms of any pockets of resistance, there have been a couple of you that have mentioned that there needs to be some fine tuning to the bill. We need to work with some language here and some interpretation, some department authorities. But are there pockets of resistance that are out there?

I think, Mr. Garrity, you mentioned in your testimony that expansion of the Bumping Reservoir could be controversial because it would impact homes that are occupied by local critics. What opposition will we encounter with this or is this truly one of those measures where, because of the years of work and the collaborative nature, we have eliminated most of the criticism here?

Mr. GARRITY. I think that the bill is designed to focus on the first ten years of the plan, the Initial Development Phase, and it authorizes those projects only. And those projects are relatively uncontroversial on the water storage side, mostly the water storage projects that are controversial within the plan. There's some opposition among some homeowners around Lake Kachess that exist. So it's not—not everyone likes the Initial Development Phase necessarily, but like I mentioned in my testimony, it includes the projects that are most ripe for implementation and the least controversial of the suite of projects.

Another thing I mentioned in my testimony this morning is that there's been some criticism of the plan for—and the water storage projects in particular as potentially expensive for Federal and/or state taxpayers. And the way that Kachess and the Keechelus to Kachess Conveyance Project would be financed it basically renders that argument mute because the irrigators or other water users would pay for those projects and finance them themselves.

The CHAIRMAN. Let me ask then on the cost side of that because I mentioned in my opening remarks that that is something that we are looking to is what will the expense be?

I think it was you, Mr. Sandison, who mentioned the state had contributed about $160 million so far under the Integrated Plan. I think I heard somebody else say, maybe it was you, Mr. Eberhart, $130 million. So the state's participation is in that range.

What do you estimate the state contribution towards the project proposed under the legislation will be and again, when we are talking about cost, recognizing that we have a series of phases here? What are we looking at realistically?

Mr. SANDISON. Chairman Murkowski, so I'll respond.

The Initial Phase which is considered the first ten years of the Integrated Plan, this is a 30-year project. We've divided the project up into three 10-year phases.

In the first phase the estimated cost for the entire project is about $900 million.

The State of Washington in 2013, the state legislature in 2013, passed governor request legislation that committed the state to up to 50 percent of the total cost of the Integrated Plan over the 30-year period.

The—if we go back to the first phase and that $900 million, the biggest, single chunk of that would be the Kachess, Lake Kachess projects, the water storage project and the Associated Conveyance System. And that's the project that the irrigators have indicated they're willing to step up and arrange financing for it and pay for it. So not quite half, but close to half, of the total cost of the first phase is represented by that commitment.

The largest single project, other than the water supply project, is the fish passage project at Lake Cle Elum. The cost estimate, Bureau of Reclamation's estimates are at about $125 million. And again it's all anticipation that the state would manage half of that or the cost of that project.

So the exact number that was used in looking and evaluating the current legislation but it was in that neighborhood of, I think, about $140 million on the Federal side, again, matched with state money and with irrigator finance projects.

The CHAIRMAN. Mr. Iseman, is that your understanding in terms of how it would break down as well on the Federal side?

Mr. ISEMAN. Yeah, those are roughly comparable to our numbers, about looking at $900 million to $1 billion in infrastructure investment in total. Infrastructure as well as habitat and restoration, acquisitions, conservation, we're looking at about $350 to $375 million, potentially, for the Federal side of that.

One of the things, as we talked about in the testimony, that we find impressive or remarkable about this partnership, is the efforts to look at innovative ways of financing this including having the state step up as they have and also looking at other ways to bring private sector and other partners on board to finance parts of these projects.

And so, you know, there's a significant investment looking forward. But we believe that through these partnering and innovative financing mechanisms that we can get some of this, some of these, activities accomplished.

The CHAIRMAN. Thank you.

Senator Cantwell.

Senator CANTWELL. Thank you, Madam Chair.

Well, Mr. Iseman, we have already had a line item for the Yakima Basin for several years now, correct?

Mr. ISEMAN. Correct.

Senator CANTWELL. As the agency, how would you describe it best met the Federal obligations to try to mitigate the impacts and to manage the oversight of irrigation and conflict that is there?

Mr. ISEMAN. Could you rephrase the question, Senator?

Senator CANTWELL. How would you characterize the line item and the——

Mr. ISEMAN. Right.

Senator CANTWELL. Responsibility we have to our partners?

Mr. ISEMAN. Right. Right. So we do have a line item for the YRBEP activities, the Yakima Basin activities. A lot of it is for what we've done historically through the first phases of this partnership. We're also starting to invest more in the newer elements that are a part of this first phase of the Integrated Plan.

The total amount is about $12.8 million right now, and we have made some increases over the last several budget requests. The way we're looking at it is that we need to continue to make the investments to keep these projects moving forward, and that's the way we're thinking about our budget request.

Senator CANTWELL. Would you say that your agency, the Department of the Interior, might worry most about those Federal responsibilities as it relates to the Bureau of Reclamation and on irrigation and hydro and things of that nature, in responsibilities, trust responsibilities, to the tribe that someone else in the Federal Government might be more concerned about the state or Mr. Eberhart's issues about economic damage and crop loss? You may not be the agency for that information.

Mr. ISEMAN. Right.

Senator CANTWELL. Is that right?

Mr. ISEMAN. But I think that's right that—and one of the things that we have tried to do is bring the entire Federal family together because we know multiple Federal agencies have an interest in elements of this Plan including the U.S. Department of Agriculture and other potential partners that can be contributing to activities under the Integrated Plan.

And so, you're right. We focus on the elements that are most closely related to our water supply obligations and treaty responsibilities, and we're trying to bring in these other partners, including other Federal agencies that can make contributions towards the Plan.

Senator CANTWELL. So doing nothing is not free, I guess is the best way. Is that correct?

Mr. ISEMAN. Doing nothing is not free?

Senator CANTWELL. Right.

Mr. ISEMAN. That's right.

Senator CANTWELL. We will incur costs.

Mr. ISEMAN. Oh, absolutely. I mean, that's one of the things that I think is most important about this Plan is that we're looking into the future, and we face tremendous risks due to drought, and we need to make investments now. This Plan is identifying the activities and how we're going to fund them in partnership to build resilience to drought, and there's a lot of risk if we do nothing, absolutely.

Senator CANTWELL. Thank you.

Mr. Eberhart, you, I think, mentioned the $3.2 billion of economic activity associated with the Basin, related to agriculture. Is that Yakima County and——

Mr. EBERHART. It would be the Yakima Basin and it would be all the agricultural commodities that are produced directly at the farm gate and then all of the add-ons that are done to process them.

Senator CANTWELL. How many counties would you say?

Mr. EBERHART. Oh, that is Yakima, Kittitas and Benton, three counties, yes.

Senator CANTWELL. So three counties produce $3.2 billion worth of economic activity from agriculture on an annual basis?

Mr. EBERHART. And a lot of exports.

Senator CANTWELL. Yes, I know, it is pretty impressive. I definitely do not want to see the drought impacts, the lack of water, negatively impact that.

Mr. Garrity spoke to the fish issue, but I guess one of the things that it is safe to say is that for part of this project you guys did not hang out together. Is that right? [Laughter.]

Yet I feel like, while you didn't use duct tape, it is a little bit like Apollo 13, like you get this critical moment and you are like, we have to do something, right? We have to come up with a better plan. But what made that happen? What brought you all to come together on things that you may have been fighting each other on in the previous decades?

Mr. GARRITY. Thanks, Senator Cantwell. I think it was a confluence of events that came through a process. That, I think, sort of, came out of the original YRBEP legislation and then followed by a study of a large reservoir called Black Rock that concluded in 2008. And that project turned out to be infeasible because of expense and because of some issues in terms of its effect on contaminated ground water underneath the Hanford Nuclear reservation and as well as operating costs. And multiple stakeholders including, I think, all four of us on this, from the state, on this panel came together and had similar comments on where we should go forward with that.

And Mr. Sandison, when he was Director of the Office of the Columbia River, came up with a supplemental component to the storage study that was underway at that time that included, that basically laid out the initial, sort of, a general skeleton of the plan that the bill would help carry out.

I think that is just really a pragmatic recognition on the part of the Yakama Nation and the irrigation districts and American Rivers, Trout Unlimited, the Wilderness Society, National Wildlife Federation, that we needed a practical solution that addressed the urgent needs of the fisheries and river health in the Basin.

Senator CANTWELL. It seems to me that part of the issue here is that while it might have been great to have a solution, something that was, let us just say, simpler, I guess is one way to describe Black Rock and the concept about, here is an easy solution. Let's just add more storage.

Where we have ended up today is something that is much more integrated and much more elaborate in trying to solve the problem which, I think, is something to be recognized on a national basis, not just because it is holistic, although I definitely believe in that. That is what you represent, each of your interests. But the fact that the Plan says there are some things you can do today, and we should do those. There are some things that we can use that are market driven forces we should try to implement. Then the whole plethora of everything from conservation to utilization to increasing storage capacity.

So I don't know if you have a comment on that about that issue of the complexity of an Integrated Plan providing so much of the solution.

Mr. RIGDON. Thank you.

I think the whole context, what we're talking about, is the complexity of the Yakima Basin in its own right. We have the whole gamut. We have a tribe that's fighting for its Treaty rights and stream flow. You have the irrigators and the junior water right holders and the conservation and the needs aren't met. And we've gone through—the last 40 years realizing that the tribe and the irrigators aren't going to meet those things.

We've come together as a community to say for us to succeed we've got to work together instead of—and take on these complicated challenges. And I think that's the real important part.

Black Rock was an idea of pumping water from the Columbia that has its own series of issues that the tribe argues and fights on actually, but the idea let's look in house, let's find the solutions and let's work to get to these things. There was a real important part of that is that the tribe and Roza sat down and we actually sent a letter together which is—we've been adversaries for, you know, probably since Time immemorial in its own right. And we signed that letter saying we've got to change and these principles of what really needs to happen. And having Ecology and the Bureau of Reclamation willing to take on that challenge and be a part of that conversation was really an integral part of what happened.

Senator CANTWELL. Thank you.

The CHAIRMAN. You have mentioned that this Integrated Plan and the approach, the collaborative approach, can be viewed as a model in other areas. The word template has been used, but we also recognize that it is pretty tough to take a one size fits all approach to pretty much anything around this country because our regions are different, our needs are different and it complicates it a little bit.

How unique or what aspects of what you have put together with this Integrated Plan are unique to the Yakima Basin and thus would not be as easily replicated in other regions? For instance, look at the situation down there in California. They are clearly struggling for answers. How should they deal with fish and agriculture needs? We are trying to draft legislation that will be helpful to them.

Can you identify either any areas that are particularly innovative that help you with the approach that you have taken or that are so unique to the Yakima Basin that that is one of the things that has allowed this to gel? Mr. Iseman, you look like you want to jump in here.

Mr. ISEMAN. Well I had a few thoughts on that. There are some unique aspects to what we're seeing in the Yakima, and one of them that I'd appreciate comments from the rest of the partners is about how their relationship has developed over time. But clearly they've been working together for a long time, and I think that's been essential to getting them to the point where we are with the Integrated Plan and what we're talking about today.

But a few of the other things that are important. One is looking at a watershed scale and thinking about multipurpose objectives.

And as Senator Cantwell said, it's easy to think about a single solution but oftentimes that won't meet multiple objectives at a watershed scale. And so thinking at this scale, I think, is very important.

Looking at the long term to how they build drought resilience. You know, even this plan maps out 30 years, let alone these investments will be paying dividends for decades beyond that. And so thinking that long term drought resilience, oftentimes, we see places that are caught by surprise and maybe more reactive. So that's an important element.

And also the funding strategy is always a challenge in terms of how you fund things. And having the state step up as a partner, a lot of the local irrigators being willing to invest and other partners. Finding ways to bring the resources together to accomplish the objectives of the plan, those are some of the key lessons that I take from this.

And Bureau of Reclamation does try to foster this kind of collaboration through Basin studies is one of the activities where we try to bring stakeholders together to think about long term challenges and ways to address them. But I would say that this partnership is really mature and unique in terms of their accomplishments.

The CHAIRMAN. Does anyone else want to weigh in? Mr. Sandison?

Mr. SANDISON. Yes, I agree with Mr. Iseman's assessment that we looked at a watershed scale. I think one of our biggest hurdles to overcome in the first place was getting fundamental agreement on what the problem was. In the past we'd looked at water supply, what has been mentioned of a water supply project that was considered early on, but this, sort of, just add water approach to solving the problems of the Basin wasn't going to work. That we needed to understand that you had a whole suite of issues, problems that needed to be solved in the Basin and recognizing how those are interconnected was important in terms of general recognition of what the scope of what needed to be done to correct the problems of the Basin.

The other thing, and this speaks to the people that have been involved in the effort in Yakima was a willingness to, kind of, to set aside narrow, self interests and look to the broader good of the Basin and kind of, the recognition that—because you're not going to get that. Any individual interest in the Integrated Plan is not going to get everything they want, but they're going to get a lot of what they want. And at the same time others will get a lot of what they need or want.

And it was, sort of, this quest for a win/win sort of relationship in the Basin and achieving harmony rather than going to court and spending decades fighting in court. I think that was an important element of the success in putting this together.

The CHAIRMAN. Good. Others? Mr. Garrity?

Mr. GARRITY. Well I'd add that I think the combination of state and Federal investment and readiness to help this process forward was really helpful. That the state has started the Office of Columbia River in 2006 which allowed some seed funding and room for creativity and collaboration on the state side. As Mr. Iseman mentioned, the Secure Water Act and the Basin study program was critical in basically matching some state investment early on that helped move the process forward.

The CHAIRMAN. I do not have any further questions for the panel, but I know that Senator Cantwell wants to continue.

So thank you.

Senator CANTWELL. Thank you, Madam Chair.

Just to that point, we obviously all, on a West-wide basis see those regions, California, Oregon, others, struggling with this. Do you think that our previous efforts on management within the region taught us a lot because obviously we have had many people here on other water settlements that have been through extensive legal battles? So is it the fact that we are able to take things off the table because we knew they did not work that brought people to the table or do you think there is something so unique about Washington? Which I am happy to believe. [Laughter.]

We are very collaborative; I mean, the Klamath Basin comes to mind. Why isn't the Klamath Basin pursuing a similar approach?

Mr. SANDISON. Because we are unique in Washington.

Senator CANTWELL. Okay. [Laughter.]

Mr. SANDISON. Yeah. Again, I think this was, in many respects, just a matter of maturity that, as you indicated, that many previous attempts had failed in terms of trying to come up with support for individual projects. And it was the recognition that, again, it's a broader set of problems that we're trying to resolve than just simply adding water to the stream or to the river.

That broader sense, but also the notion that the time was right, that decades had gone by, study after study and no substantive action. And that it really, we were at a point where the—in fact this was discussed in the first meeting when the workgroup was pulling together. There was a large mural or a poster with a stack or a picture of all the studies that have been done in the Yakima Basin prior to the workgroup being formed.

It was a mountain of documents, yet no, again, very low substantive action. And I think that the folks in the room, the stakeholders, the Yakama Nation, the state, Bureau of Reclamation, others, just realized that we have to do something to change the status quo to make these improvements. And there was just this overall commitment to say, yeah, I'm willing to set aside my individual, specific interests right now and again, work for the greater good.

So I guess it was a, no pun intended, it was a watershed moment, I think, back in 2009 when the group formed and came to this, sort of, realization that it was time to put something on the ground.

Senator CANTWELL. Well, I think having a seat at the table for everyone certainly conveyed that. I remember a meeting that we had with Secretary Salazar and Doc Hastings.

Mr. SANDISON. Exactly.

Senator CANTWELL. With the Bureau of Reclamation and I don't know how many, 30 people.

Mr. SANDISON. Yup.

Senator CANTWELL. On a Sunday morning.

Mr. SANDISON. Yes.

Senator CANTWELL. Because that is when the Secretary's schedule would allow. The fact that everybody was there meant that it was going to be a serious approach, that it was not going to be torpedoed later by somebody who was not at the table.

Mr. SANDISON. Right.

Senator CANTWELL. So I think the fact that it became a real process led people to then decide what are the most fundamentally important things to get done, as you have outlined in this phase of the project.

Mr. Eberhart, I cannot remember, but somebody's testimony, municipal water issues were really at risk here, right? I mean, when you look at how this is going to be. If we did not come up with a plan, pretty soon some of the challenges were going to be right within the municipal system, right?

Mr. EBERHART. Yes. And in the Integrated Plan, in this process, we have covered the supply that the municipalities will need to grow as we move forward. So we did improve that too.

I think one of the other things that wasn't touched on in the whole discussion of how we got together or why we are where we are and one key point is pure survival. None of the interests will be able to, would have been able to survive if we would have continued on the same road that we were on.

So it was time, as it's been mentioned by the other panel members, it was time to move forward and come up with a way that we could solve the problems and that we could do it. We knew we could do it cooperatively, together. We also knew that we couldn't do it individually. So it was just a realization that the things would be so bad if we didn't do this.

Senator CANTWELL. To that point, Mr. Iseman, we appreciate the Administration's support. You have outlined in your testimony how do we work together with other agencies that will be involved in this? You will be the point person for that?

Mr. ISEMAN. Yeah. We'll actually have something called the DC Leadership team that includes all the Federal agencies that have an interest in the Yakima Integrated Plan.

We're going to meet with this group and some of those agencies later today to talk more about these issues and how to move forward.

We know that legislation provides a good road map for where we need to go, but there's going to be a lot of work between now and then in terms of how we execute it. So we will continue to work with the other agencies and the Administration as well as the local stakeholders to advance these projects.

Senator CANTWELL. Well, again I want to thank the region for being here today and the witnesses. I cannot say how impressed I am and excited by the Plan that you have put forth that is now incorporated in this legislation and how much I appreciate being able to represent those interests in the context of it's great to have such innovation and bring it back here to Washington. I hope that it does help us understand some of the challenges we do face with drought.

Mr. Iseman, I doubt this will be the last time you will be before this Committee talking about what we are going to do about that in the future. What I like about this Plan is that you can get agreement on the lowest hanging fruit. Implementing those solutions right away can help us mitigate some of the huge economic impacts that we are going to see from drought.

So, I think looking at this as, if nothing else, an example for how low hanging fruit can be something that we prioritize in our most stricken drought areas, I think, will be very, very helpful for us.

Again, thank you, Madam Chair for holding this important hearing. And again, congratulations to everybody for their hard work on this. I know you didn't used to hang out, but thanks for hanging out——

[Laughter.]

Senator CANTWELL. Together today, and thanks for your—I know you guys have built friendships, so thank you.

The CHAIRMAN. I want to join my colleague from Washington in thanking you, not only for this issue, but I do think that it gives others around the country in the West, a glimmer of hope that perhaps after decades of their own water wars they might be able to come to legislative solutions that will prevail for all stakeholders.

So, thank you for not only being before the Committee today, but for your years of engagement on very important issues. We appreciate you being here.

With that, the Committee stands adjourned.

[Whereupon, at 11:13 a.m. the hearing was adjourned.]

APPENDIX MATERIAL SUBMITTED

114TH CONGRESS
1ST SESSION

S. 1694

To amend Public Law 103–434 to authorize Phase III of the Yakima River Basin Water Enhancement Project for the purposes of improving water management in the Yakima River basin, and for other purposes.

IN THE SENATE OF THE UNITED STATES

Ms. CANTWELL (for herself and Mrs. MURRAY) introduced the following bill; which was read twice and referred to the Committee on _______________

A BILL

To amend Public Law 103–434 to authorize Phase III of the Yakima River Basin Water Enhancement Project for the purposes of improving water management in the Yakima River basin, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Yakima River Basin Water Enhancement Project Phase III Act of 2015".

SEC. 2. MODIFICATION OF TERMS, PURPOSES, AND DEFINITIONS.

(a) MODIFICATION OF TERMS.—

(1) IN GENERAL.—Title XII of Public Law 103–434 (108 Stat. 4550) is amended—

(A) by striking "Yakama Indian" each place it appears and inserting "Yakama"; and

(B) by striking "Superintendent" each place it appears and inserting "Manager".

(2) HEADING AMENDMENTS.—Section 1204 of Public Law 103–434 (108 Stat. 4555) is amended—

(A) in the section heading by striking "**INDIAN**"; and

(B) in subsection (g), in the subsection heading, by striking "YAKAMA INDIAN NATION" and inserting "YAKAMA NATION".

(b) MODIFICATION OF PURPOSES.—Section 1201 of Public Law 103–434 (108 Stat. 4550) is amended—

(1) by striking paragraph (1) and inserting the following:

"(1) to protect, mitigate, and enhance fish and wildlife and the recovery and maintenance of self-sustaining harvestable populations of fish and other aquatic life, both anadromous and resident species, throughout their historic distribution range in the Yakima Basin through—

"(A) improved water management and the constructions of fish passage at storage and diversion dams, as authorized under the Hoover Power Plant Act of 1984 (43 U.S.C. 619 et seq.);

"(B) improved instream flows and water supplies;

"(C) improved water quality, watershed, and ecosystem function;

"(D) protection, creation, and enhancement of wetlands; and

"(E) other appropriate means of habitat improvement;";

(2) in paragraph (2), by inserting ", municipal, industrial, and domestic water supply and use purposes, especially during drought years, including reducing the frequency and severity of water supply shortages for pro-ratable irrigation entities" before the semicolon at the end;

(3) by striking paragraph (4);

(4) by redesignating paragraph (3) as paragraph (4);

(5) by inserting after paragraph (2) the following:

"(3) to authorize the Secretary to make water available for purchase or lease for meeting municipal, industrial, and domestic water supply purposes;";

(6) in paragraph (5), by striking "and" at the end;

(7) in paragraph (6), by striking the period at the end and inserting a semicolon; and

(8) by adding at the end the following:

"(7) to improve the resilience of the ecosystems, economies, and communities in the Basin as they faced drought, climate variability, and climate change, for the benefit of both the people and the fish and wildlife of the region; and

"(8) to authorize and implement the Yakima River Basin Integrated Water Resources Management Plan as Phase III of the Yakima River Basin Water Enhancement Project, in a balanced approach to maximize benefits to the communities and environment in the Basin.".

(c) MODIFICATION OF DEFINITIONS.—Section 1202 of Public Law 103–434 (108 Stat. 4550) is amended—

(1) by redesignating paragraphs (6), (7), (8), (9), (10), (11), (12), (13), and (14) as paragraphs (7), (10), (11), (12), (13), (14), (15), (17), and (19), respectively;

(2) by inserting after paragraph (5) the following:

"(6) DESIGNATED FEDERAL OFFICIAL.—The term 'designated Federal official' means the Commissioner of Reclamation (or a designee), acting pursuant to the charter of the Conservation Advisory Group.";

(3) by inserting after paragraph (7) (as redesignated by paragraph (1)) the following:

"(8) MANAGEMENT PLAN.—The term 'Management Plan' means the plan described in the document entitled 'Final Programmatic Environmental Impact Statement and Integrated Water Resource Management Plan, Yakima River Basin, Water Enhancement Project, Benton, Kittitas, Klickitat, and Yakima Counties, WA' (77 Fed. Reg. 12076 (February 28, 2012)).

"(9) MUNICIPAL, INDUSTRIAL, AND DOMESTIC WATER SUPPLY AND USE.—The term 'municipal, industrial, and domestic water supply and use' means the supply and use of water for—

"(A) domestic consumption (whether urban or rural);

"(B) maintenance and protection of public health and safety;

"(C) manufacture, fabrication, processing, assembly, or other production of a good or commodity;

"(D) production of energy;

"(E) fish hatcheries; or

"(F) any conservation activity relating to a use described in any of subparagraphs (A) through (E).";

(4) by inserting after paragraph (15) (as redesignated by paragraph (1)) the following:

"(16) WORK GROUP.—The term 'Work Group' means the work group that—

"(A) is identified in section 90.38.010(2) of the Revised Code of Washington as responsible for development of the Management Plan;

"(B) includes representatives of—

"(i) the Yakama Nation;

"(ii) Federal and State governments;

"(iii) participating county and city governments;

"(iv) environmental organizations; and

"(v) irrigation districts; and

"(C) is not subject to the Federal Advisory Committee Act (5 U.S.C. App.)."; and

(5) by inserting after paragraph (17) (as redesignated by paragraph (1)) the following:

"(18) YAKIMA ENHANCEMENT PROJECT; YAKIMA RIVER BASIN WATER ENHANCEMENT PROJECT.—The terms 'Yakima Enhancement Project' and 'Yakima River Basin Water Enhancement Project' mean the Yakima River basin water enhancement project authorized by Congress pursuant to this Act and other Acts (including Public Law 96–162 (93 Stat. 1241), section 109 of Public Law 98–381 (16 U.S.C. 839b note; 98 Stat. 1340), Public Law 105–62 (111 Stat. 1320), and Public Law 106–372 (114 Stat. 1425)) to promote water conservation, water supply, habitat, and stream enhancement improvements in the Yakima River basin.".

SEC. 3. YAKIMA RIVER BASIN WATER CONSERVATION PROGRAM.

Section 1203 of Public Law 103–434 (108 Stat. 4551) is amended—

(1) in subsection (a)—

(A) in paragraph (1), by striking "title" and inserting "section"; and

(B) in paragraph (2), by striking "irrigation" and inserting "the number of irrigated acres";

(2) in subsection (c)—

(A) in paragraph (2)—

(i) in each of subparagraphs (A) through (D), by striking the comma at the end and inserting a semicolon;

(ii) in subparagraph (E), by striking the comma at the end and inserting "; and";

(iii) in subparagraph (F), by striking "Department of Wildlife of the State of Washington, and" and inserting "Department of Fish and Wildlife of the State of Washington."; and

(iv) by striking subparagraph (G);

(B) in paragraph (3)—

(i) in each of subparagraphs (A) through (C), by striking the comma at the end and inserting a semicolon;

(ii) in subparagraph (D), by striking ", and" and inserting a semicolon;

(iii) in subparagraph (E), by striking the period at the end and inserting "; and"; and

(iv) by adding at the end the following:

"(F) provide recommendations to advance the purposes and programs of the Yakima Enhancement Project."; and

(C) by striking paragraph (4) and inserting the following:

"(4) DESIGNATED FEDERAL OFFICIAL.—The designated Federal official—

"(A) shall arrange and provide logistical support for meetings of the Conservation Advisory Group;

"(B) may use a facilitator to serve as a moderator for meetings of the Conservation Advisory Group or provide additional logistical support; and

"(C) shall grant any request for a facilitator by any member of the Conservation Advisory Group.";

(3) in subsection (d), by adding at the end the following:

"(4) PAYMENT OF LOCAL SHARE BY STATE OR FEDERAL GOVERNMENT.—The State or the Federal Government may fund not more than the 17.5 percent local share of the costs of the Basin Conservation Program in exchange for the long-term use of conserved water.";

(4) in subsection (e), by striking the first sentence and inserting the following: "To participate in the Basin Conservation Program, as described in subsection (b), an entity shall submit to the Secretary a proposed water conservation plan.";

(5) in subsection (i)(3)—

(A) by striking "purchase or lease" each place it appears and inserting "purchase, lease, or management"; and

(B) in the third sentence, by striking "made immediately upon availability" and all that follows through "Committee" and inserting "continued as needed to provide water to be used by the Yakima Project Manager as recommended by the System Operations Advisory Committee and the Conservation Advisory Group"; and

(6) in subsection (j)(4), in the first sentence, by striking "initial acquisition" and all that follows

through "flushing flows" and inserting "acquisition of water from willing sellers or lessors specifically to provide improved instream flows for anadromous and resident fish and other aquatic life, including pulse flows to facilitate outward migration of anadromous fish".

SEC. 4. YAKIMA BASIN WATER PROJECTS, OPERATIONS, AND AUTHORIZATIONS.

(a) YAKIMA NATION PROJECTS.—Section 1204(a)(2) of Public Law 103–434 (108 Stat. 4556) is amended in the first sentence by striking "not more than $23,000,000" and inserting "not more than $49,000,000, at September 2000 prices, plus or minus such amounts as may be justified by reason of ordinary fluctuations of applicable cost indexes,".

(b) OPERATION OF YAKIMA BASIN PROJECTS.—Section 1205 of Public Law 103–434 (108 Stat. 4557) is amended—

(1) in subsection (a)—

(A) in paragraph (4)—

(i) in subparagraph (A)—

(I) in clause (i)—

(aa) by inserting "additional" after "secure";

(bb) by striking "flushing" and inserting "pulse"; and

(cc) by striking "uses" and inserting "uses, in addition to the quantity of water provided under the treaty between the Yakama Nation and the United States";

(II) by striking clause (ii);

(III) by redesignating clause (iii) as clause (ii); and

(IV) in clause (ii) (as so redesignated) by inserting "and water rights mandated" after "goals";

(ii) in subparagraph (B)—

(I) in clause (i), in the first sentence, by inserting "in proportion to the funding received" after "Program"; and

(II) by adding at the end the following:

"(iii) CALCULATIONS AND DETERMINATIONS.—The Yakima Project Manager shall—

"(I) calculate the total amount of water conserved and acquired;

"(II) determine the amount of water available each year for the purpose of delivering or storing Project water for instream flows at variable rates (shaping), considering Yakima Project operational constraints; and

"(III) in consultation with the System Operations Advisory Committee, determine how and when the available water will be delivered or stored.

"(iv) USE OF CERTAIN PORTION.—The Yakima Project Manager, in consultation with the Systems Operations Advisory Committee, irrigation districts, and the Conservation Advisory Group, may acquire, manage, and use all or a portion of the irrigation district's ⅓ portion of the saved water resulting from conservation measures taken under this title to increase target flows or otherwise deliver Yakima Project water for instream flows. The right to use that water must be acquired by the Bureau of Reclamation or the State of Washington, in partnership with the Bureau of Reclamation, from any willing irrigation district seller through purchase, donation, or lease. During drought years, when the Yakima Project proration level is set at 70 percent or less of full entitlement, the ⅓ portion of the saved water acquired under this title may be used to supplement the irrigation districts' and other entities' water supply under the total water supply available only if the saved water is in priority during that time, unless provisions are made to the contrary as a condition of purchase."; and

(iii) by striking subparagraph (D); and

(B) by striking paragraph (6);

(2) in subsection (b) (as amended by section 2(a)(1)(B)), in the second sentence, by striking "instream flows for use by the Yakima Project Manager as flushing flows or as otherwise" and inserting "fishery purposes, as"; and

(3) in subsection (e), by striking paragraph (1) and inserting the following:

"(1) IN GENERAL.—Additional purposes of the Yakima Project shall be any of the following:

"(A) To recover and maintain self-sustaining harvestable populations of native fish, both anadromous and resident species, throughout their historic distribution range in the Yakima Basin.

"(B) To protect, mitigate, and enhance aquatic life and wildlife.

"(C) Recreation.

"(D) Municipal, industrial, and domestic use.".

(c) LAKE CLE ELUM AUTHORIZATION OF APPROPRIATIONS.—Section 1206(a) of Public Law 103–434 (108 Stat. 4560) is amended—

(1) in paragraph (1)—

(A) in the matter preceding subparagraph (A), by striking "at September" through "to—" and inserting "such sums as are necessary to—";

(B) by redesignating subparagraphs (A) through (C) as clauses (i) through (iii), respectively, and indenting the clauses appropriately; and

(C) by striking clause (iii) (as so redesignated) and inserting the following:

"(iii) to conduct feasibility studies and to design, construct, operate, and maintain fish passage facilities, in addition to any fish passage facilities authorized by section 109 of the Hoover Power Plant Act of 1984 (16 U.S.C. 839b note; Public Law 98–381), as determined to be feasible and appropriate within the Yakima River basin; plus";

(2) by redesignating paragraphs (1) and (2) as subparagraphs (A) and (B), respectively, and indenting the subparagraphs appropriately;

(3) in the matter preceding subparagraph (A) (as so redesignated), by striking "There is hereby" and inserting the following:

"(1) IN GENERAL.—There is"; and

(4) by adding at the end the following:

"(2) COST SHARING.—

"(A) IN GENERAL.—The Secretary may accept as part of the non-Federal cost-share, and expend as if appropriated, any contribution by the State of Washington or others, including in-kind services, that the Secretary determines will contribute toward the conduct and completion of the work.

"(B) FEDERAL SHARE.—The Federal cost-share for the project shall not exceed 50 percent of the total cost of the projects described in paragraph (1).".

(d) ENHANCEMENT OF WATER SUPPLIES FOR YAKIMA BASIN TRIBUTARIES.—Section 1207 of Public Law 103–434 (108 Stat. 4560) is amended—

(1) in subsection (a)—

(A) in the matter preceding paragraph (1), by striking "supplies" and inserting "management";

(B) in paragraph (1), by inserting "and water supply entities" after "owners"; and

(C) in paragraph (2)—

(i) in subparagraph (A), by inserting "that choose not to participate or opt out of tributary enhancement projects pursuant to this section" after "water right owners"; and

(ii) in subparagraph (B), by inserting "nonparticipating" before "tributary water users";

(2) in subsection (b)—

(A) in paragraph (1)—

(i) by striking the paragraph designation and all that follows through "(but not limited to)—" and inserting the following:

"(1) IN GENERAL.—The Secretary, following consultation with the State of Washington, the Yakama Nation, and on agreement of appropriate water supply entities, is authorized to conduct studies to evaluate measures to further Yakima Project purposes on tributaries to the Yakima River. Enhancement programs that use measures authorized by this section may be investigated and implemented by the Secretary in tributaries, including Taneum Creek, other areas, or tributary basins that currently or could potentially be provided supplemental or transfer water by entities, such as the Kittitas Reclamation District or the Yakima-Tieton Irrigation District. Measures to evaluate include—";

(ii) by indenting subparagraphs (A) through (F) appropriately;

(iii) in subparagraph (A), by inserting before the semicolon at the end the following: ", including irrigation efficiency improvements (in coordination with programs of the Department of Agriculture), consolidation of diversions or administration, and diversion scheduling or coordination";

(iv) by redesignating subparagraphs (C) through (F) as subparagraphs (E) through (H), respectively;

(v) by inserting after subparagraph (B) the following:

"(C) improvements in irrigation system management or delivery facilities within the Yakima River basin when those improvements allow for increased irrigation system conveyance and corresponding reduction in diversion from tributaries or flow enhancements to tributaries through direct flow supplementation or groundwater recharge;

"(D) improvements of irrigation system management or delivery facilities to reduce or eliminate excessively high flows caused by the use of natural streams for conveyance or irrigation water or return water;";

(vi) in subparagraph (E) (as redesignated by clause (iv)), by striking "ground water" and inserting "groundwater recharge and";

(vii) in subparagraph (G) (as redesignated by clause (iv)), by inserting "or transfer" after "purchase"; and

(viii) in subparagraph (H) (as redesignated by clause (iv)), by inserting "stream processes and" before "stream habitats";

(B) in paragraph (2)—

(i) in the matter preceding subparagraph (A), by striking "the Taneum Creek study" and inserting "studies under this subsection";

(ii) in subparagraph (B)—

(I) by striking "and economic" and inserting ", infrastructure, economic, and land use"; and

(II) by striking "and" at the end;

(iii) in subparagraph (C), by striking the period at the end and inserting "; and"; and

(iv) by adding at the end the following:

"(D) any related studies already underway or undertaken."; and

(C) in paragraph (3), in the first sentence, by inserting "of each tributary or group of tributaries" after "study";

(3) in subsection (c), in the matter preceding paragraph (1), by inserting "nonsurface storage and" after "implement";

(4) by striking subsection (d);

(5) by redesignating subsection (e) as subsection (d); and

(6) in paragraph (2) of subsection (d) (as so redesignated)—

(A) in the first sentence—

(i) by inserting "and implementation" after "investigation";

(ii) by striking "other" before "Yakima River"; and

(iii) by inserting "and other water supply entities" after "owners"; and

(B) by striking the second sentence.

(e) CHANDLER PUMPING PLANT AND POWERPLANT-OPERATIONS AT PROSSER DIVERSION DAM.—Section 1208(d) of Public Law 103–434 (108 Stat. 4562; 114 Stat. 1425) is amended by inserting "negatively" before "affected".

(f) INTERIM COMPREHENSIVE BASIN OPERATING PLAN.—Section 1210(c) of Public Law 103–434 (108 Stat. 4564) is amended by striking "$100,000" and inserting "$200,000, at September 2014 prices,".

(g) ENVIRONMENTAL COMPLIANCE.—Section 1211 of Public Law 103–434 (108 Stat. 4564) is amended by inserting ", at September 2014 prices," after "$2,000,000".

SEC. 5. AUTHORIZATION OF PHASE III OF YAKIMA RIVER BASIN WATER ENHANCEMENT PROJECT.

Title XII of Public Law 103–434 (108 Stat. 4550) is amended by adding at the end the following:

"SEC. 1213. PHASE III GRANTS AND COOPERATIVE AGREEMENTS.

"The Secretary may make grants or enter into cooperative agreements with the Yakama Nation, the State of Washington, Yakima River basin irrigation districts, water districts, conservation districts, other local governmental entities, nonprofit organizations, and land owners to carry out this title under such terms and conditions as the Secretary may require, including the following purposes:

"(1) Land and water transfers, leases, and acquisitions from willing participants, so long as the acquiring entity shall hold title and be responsible for any and all required operations, maintenance, and management of that land and water.

"(2) Operation and maintenance or management of Federal land acquired under this title, in partnership with the Secretary.

"(3) To combine or relocate diversion points, remove fish barriers, or for other activities that increase flows or improve habitat in the Yakima River and its tributaries in furtherance of this title.

"(4) To implement, in partnership with Federal and non-Federal entities, projects to enhance the health and resilience of the watershed, subject to the condition that if such a grant or cooperative agreement results in a direct benefit to a project beneficiary, the Secretary may determine that the costs are reimbursable.

"SEC. 1214. AUTHORIZATION OF PHASE III OF YAKIMA RIVER BASIN WATER ENHANCEMENT PROJECT.

"(a) MANAGEMENT PLAN IMPLEMENTATION.—

"(1) IN GENERAL.—It is the intent of Congress that the Management Plan shall be implemented in its entirety, in accordance with applicable laws.

"(2) INITIAL DEVELOPMENT PHASE.—

"(A) IN GENERAL.—During the Initial Development Phase of the Management Plan, the Secretary, in conjunction with the State of Washington and in consultation with the Work Group, shall—

"(i) complete the planning, design, and construction or development of upstream and downstream fish passage facilities at a Yakima Project reservoir, in addition to the Cle Elum Reservoir project described in section 1206, pursuant to the Hoover Power Plant Act of 1984 (43 U.S.C. 619 et seq.), to be identified by the Work Group and consistent with the Management Plan, as set forth in the applicable feasibility study or report;

"(ii) negotiate long-term agreements with participating proratable irrigation entities in the Yakima Basin for the non-Federal financing, construction, operation, and maintenance of—

"(I) new facilities needed to access and deliver inactive storage in Lake Kachess for the purpose of providing drought relief for irrigation (known as the 'Kachess Drought Relief Pumping Plant'), as set forth in the applicable feasibility study or report; and

"(II) a conveyance system to allow transfer of water between Keechelus Reservoir to Kachess Reservoir for purposes of improving operational flexibility for the benefit of both fish and irrigation (known as the 'K to K Pipeline'), as set forth in the applicable feasibility study or report; and

"(iii) participate in, provide funding for, and accept non-Federal financing for—

"(I) water conservation projects, not subject to the provisions of the Basin Conservation Program described in section 1203, that are intended to partially implement the Management Plan by providing 85,000 acre-feet of conserved water to improve tributary and mainstem stream flow; and

"(II) aquifer storage and recovery projects benefitting all beneficial uses.

"(B) COMMENCEMENT DATE.—The Initial Development Phase under this paragraph shall commence on the date of enactment of this section.

"(3) INTERMEDIATE AND FINAL PHASES.—

"(A) IN GENERAL.—During the Intermediate and Final Development Phases of the Management Plan, any project that is determined by Secretary, in consultation with the State of Washington and Work Group, to be appropriate to meet the objectives of the Management Plan shall be designed and constructed, subject to authorization and appropriation.

"(B) INTERMEDIATE PHASE.—It is the intent of Congress that the Intermediate Development Phase of the Management Plan shall commence not later than 10 years after the date of enactment of this section.

"(C) FINAL PHASE.—It is the intent of Congress that the Final Development Phase of the Management Plan shall commence not later than 20 years after the date of enactment of this section.

"(D) FEASIBILITY CONTINGENCY.—The Intermediate and Final Development Phases of the Management Plan shall be contingent on feasibility, as determined by the Secretary, in consultation with the Work Group, and in compliance with applicable laws.

"(4) PROGRESS REPORT.—

"(A) IN GENERAL.—Not later than 5 years after the date of enactment of this section, the Secretary, in conjunction with the State of Washington and in consultation with the Work Group, shall submit to the Committee on Energy and Natural Resources of the Senate and the Committee on Natural Resources of the House of Representatives a progress report that shall serve as a supplement to the Management Plan.

"(B) REQUIREMENTS.—The progress report under this paragraph shall—

"(i) provide a review and reassessment, if needed, of the objectives of the Management Plan, as applied to all elements of the Management Plan;

"(ii) assess, through performance metrics measured throughout implementation of the Management Plan, the degree to which the Initial Phase addresses the objectives and all elements of the Management Plan;

"(iii) identify additional projects and activities proposed for inclusion in any future phase of the Management Plan to address the objectives of the Management Plan, as applied to all elements of the Management Plan; and

"(iv) for water supply projects—

"(I) provide a preliminary discussion of the means by which—

"(aa) water and costs associated with each recommended project would be allocated among authorized uses; and

"(bb) those allocations would be consistent with the objectives of the Management Plan; and

"(II) establish a plan for soliciting and formalizing subscriptions among individuals and entities for participation in any of the recommended water supply projects that will establish the terms for participation, including fiscal obligations associated with subscription.

"(b) Operation and Maintenance of Kachess Drought Relief Pumping Plant and K to K Pipeline.—

"(1) Use of lake kachess stored water.—The additional stored water made available by the construction of facilities to access and deliver inactive storage in Lake Kachess under subsection (a)(2)(A)(ii)(I) shall—

"(A) be considered to be Yakima Project water;

"(B) not be part of the total water supply available, as that term is defined in various court rulings; and

"(C) be used exclusively by the Secretary—

"(i) to enhance the water supply in years when the total water supply available is not sufficient to provide 70 percent of proratable entitlements in order to make that additional water available up to 70 percent of proratable entitlements to the Kittitas Reclamation District, the Roza Irrigation District, or other proratable irrigation entities participating in the construction, operation, and maintenance costs of the facilities under this title under such terms and conditions to which the districts may agree, subject to the conditions that—

"(I) the Bureau of Indian Affairs, the Wapato Irrigation Project, and the Yakama Nation, on an election to participate, may also obtain water from Lake Kachess inactive storage to enhance applicable existing irrigation water supply in accordance with such terms and conditions to which the Bureau of Indian Affairs and the Yakama Nation may agree; and

"(II) the additional supply made available under this subparagraph shall be available to participating individuals and entities in proportion to the proratable entitlements of the participating individuals and entities; and

"(ii) to facilitate reservoir operations in the reach of the Yakima River between Keechelus Dam and Easton Dam for the propagation of anadromous fish.

"(2) ELECTRICAL POWER ASSOCIATED WITH KACHESS DROUGHT RELIEF PUMPING PLANT.—The Administrator of the Bonneville Power Administration, pursuant to the Pacific Northwest Electric Power Planning and Conservation Act (16 U.S.C. 839 et seq.), shall provide to the Secretary project power to operate the Kachess Pumping Plant constructed under this title whenever inactive storage in Lake Kachess is needed to provide drought relief for irrigation. The Administrator shall provide the power at the then-applicable lowest Bonneville Power Administration rate for public body, cooperative, and Federal agency customers firm obligations, which as of the date of enactment of this section is the priority firm Tier 1 rate, and shall not include any irrigation discount. At all other times, power needed to operate the Kachess Pumping Plant shall be obtained by the Secretary from a local provider. The cost of power for such pumping, station service power, and all costs of transmitting power from the Federal Columbia River Power System to the Yakima Enhancement Project pumping facilities shall be borne by irrigation districts receiving the benefits of that water. The Commissioner of Reclamation shall be responsible for arranging transmission for deliveries of Federal power over the Bonneville system through applicable tariff and business practice processes of the Bonneville system and for arranging transmission for deliveries of power obtained from a local provider. The cost of the power shall be credited to fishery restoration goals of the Columbia River fish and wildlife program.

"(c) DESIGN AND USE OF GROUNDWATER RECHARGE PROJECTS.—

"(1) IN GENERAL.—Any water supply that results from an aquifer storage and recovery project shall not be considered to be a part of the total water supply available if—

"(A) the water for the aquifer storage and recovery project would not be available for use, but instead for the development of the project;

"(B) the aquifer storage and recovery project will not otherwise impair any water supply available for any individual or entity entitled to use the total water supply available;

"(C) the development of the aquifer storage and recovery project will not impair fish or other aquatic life in any localized stream reach; and

"(D) the aquifer storage and recovery project is approved by the Work Group.

"(2) PROJECT TYPES.—The Secretary may design, implement, and otherwise participate in groundwater recharge projects of any of the following 3 types:

"(A) Aquifer recharge projects designed to redistribute Yakima Project water within a water year for the purposes of supplementing stream flow during the irrigation season, particularly during storage control, subject to the condition that if such a project is designed to supplement a mainstem reach, the water supply that results from the project shall be credited to instream flow targets, in lieu of using the total water supply available to meet those targets.

"(B) Aquifer storage and recovery projects that are designed, within a given water year or over multiple water years—

"(i) to supplement or mitigate for municipal uses;

"(ii) to supplement municipal supply in a subsurface aquifer; or

"(iii) to mitigate the effect of groundwater use on instream flow or senior water rights.

"(C) Aquifer storage and recovery projects designed to supplement existing irrigation water supply, or to store water in subsurface aquifers, for use by the Kittitas Reclamation District, the Roza Irrigation District, or any other proratable irrigation entity participating in the repayment of the construction, operation, and maintenance costs of the facilities under this section during years in which the total water supply available is insufficient to provide to those proratable irrigation entities all water to which the entities are entitled, subject to the conditions that—

"(i) the Bureau of Indian Affairs, the Wapato Irrigation Project, and the Yakama Nation, on an election to participate, may also obtain water from aquifer storage to enhance applicable existing irrigation water supply in accordance with such terms and conditions to which the Bureau of Indian Affairs and the Yakama Nation may agree; and

"(ii) nothing in this subparagraph affects any existing contract, law (including regulations) relating to repayment costs, or water rights.

"(d) FEDERAL COST-SHARE.—

"(1) IN GENERAL.—The Federal cost-share of a project carried out under this section shall be determined in accordance with the applicable laws (including regulations) and policies of the Bureau of Reclamation.

"(2) INITIAL PHASE.—The Federal cost-share for the Initial Development Phase of the Management Plan under subsection (a)(2), including the reimbursable share to be repaid by non-Federal project contractors, shall not exceed 50 percent of the total cost of the initial development phase.

"(3) STATE AND OTHER CONTRIBUTIONS.—The Secretary may accept as part of the non-Federal cost-share of a project carried out under this section, and expend as if appropriated, any contribution (including in-kind services) by the State of Washington or any other individual or entity that the Secretary determines will enhance the conduct and completion of the project.

"(e) SAVINGS AND CONTINGENCIES.—Nothing in this section shall—

"(1) be a new or supplemental benefit for purposes of the Reclamation Reform Act of 1982 (43 U.S.C. 390aa et seq.);

"(2) affect any contract in existence on the date of enactment of the Yakima River Basin Water Enhancement Project Phase III Act of 2015 that was executed pursuant to the reclamation laws;

"(3) affect any contract or agreement between the Bureau of Indian Affairs and the Bureau of Reclamation; or

"(4) affect, waive, abrogate, diminish, define, or interpret the treaty between the Yakama Nation and the United States.

"SEC. 1215. OPERATIONAL CONTROL OF WATER SUPPLIES.

"The Secretary shall retain authority and discretion over the management of project supplies to obtain maximum operational use and flexibility to meet all appropriated and adjudicated water rights. That authority and discretion includes the ability of the United States to store, deliver, conserve, and reuse water supplies deriving from projects authorized under this title.”.

July 6, 2015

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015.

Senator Murkowski (Chair) and members of the Committee:

The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Rob & Tina Aigner
60 Brookside Court
Easton WA 98925

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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Sincerely,

Michael Aiken

6809 Crestview Ave SE

Snoqualmie Wa, 98065

From: Michael Aiken <poco.aiken@gmail.com>
Sent: Monday, July 06, 2015 1:12 PM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office

304 Dirksen Senate Building

Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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Sincerely,

Michael and Madeline Aiken

North Bend, Washington

Senate Energy and Natural Resources Committee;

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S. 1694 is bad national water policy and bad national environmental policy. Please do not pass S. 1694, as introduced.

Before draining a pristine lake nearly dry, please review all options of creating a reservoir North of Lake Kachess or pulling water from the Columbia River, to name a few. Draining Lake Kachess an additional 80 feet below natural levels would devastate the environment and safety of the surrounding areas. Reasonable more cost efficient options have not been considered, please do not pass 1694

Sincerely,

Shanonn Aiken

2360 Via Kachess

Easton, Wa 98925

Energy and Natural Resources Committee Office

304 Dirksen Senate Building

Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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Sincerely,

Lucretia and Mihai Albulet

9709 173 CT NE

Redmond, WA 98052

ALPINE LAKES protection society

NORTH CASCADES CONSERVATION COUNCIL

EL SENDERO BACKCOUNTRY SKI & SNOWSHOE CLUB

TESTIMONY OF
ALPINE LAKES PROTECTION SOCIETY; EL SENDERO BACKCOUNTRY SKI & SNOWSHOE CLUB; AND NORTH CASCADES CONSERVATION COUNCIL
to the Energy and Natural Resources Committee
U.S. Senate
Washington D.C.

July 7, 2015

on S. 1694

Sen. Murkowski (Chair) and members of the Committee, thank you for the opportunity to provide comments on S. 1694.

As introduced, S. 1694, proposed Section 1214 (a)(1) states, "It is the intent of Congress that the Management Plan shall be implemented in its entirety." Amended Section 1202 new subsection (8) defines the "Management Plan" as the plan described in the 2012 Final Programmatic EIS and Integrated Water Resource Management Plan for the Yakima River Basin (Benton, Kittitas, Klickitat, and Yakima Counties, WA). This 2012 Plan is also known as the Yakima River Basin Integrated Plan, or the Yakima Plan.

The 2012 Yakima Plan is:

Bad national water policy

A 2014 analysis by the Water Resource Center found that "When implemented together as part of the Integrated Plan, the major water storage projects as a group do not pass a B-C [benefit-cost] test." The 2012 Yakima Plan violates both past water projects principles and standards and recently adopted CEQ principles, standards and regulations.

The 2012 Yakima Plan is a prototype of the BuRec's Watersmart Program to support the BuRec's goal of constructing over 100 new water storage projects throughout the west to respond to climate change.

The 2012 Yakima Plan includes studies to pump water from the Columbia River to the Yakima River Basin.

Bad National Forest policy

The 2012 Yakima Plan would flood 1,000 acres of ancient forest roadless area that should be added to the adjacent William O. Douglas Wilderness area.

Bad national recreation policy

The 2012 Yakima Plan would designate two new National Recreation Areas within the Okanogan-Wenatchee National Forest with 41,000 acres dedicated to off-road vehicle use.

Bad national Endangered Species Act (ESA) policy

The 2012 Yakima Plan would flood critical habitat for ESA-listed bull trout and Northern spotted owls, as well as sage-steppe habitat for greater sage grouse.

Bad National Environmental Policy Act (NEPA) policy

The Yakima Plan's 2012 Final Programmatic EIS included only the BuRec's preferred alternative and the required no-action alternative. The BuRec failed to consider a range of alternatives as required by NEPA.

Bad public participation policy

The 2012 Yakima Plan was developed by a Yakima Workgroup, handpicked by the BuRec and the Washington State Department of Ecology. Meetings of the Implementation Committee of the Workgroup remain closed to the public.

Although the Yakima River Basin Conservation Advisory Group was authorized in 1994 by Congress and established under the Federal Advisory Committee Act (FACA), the Yakima Workgroup is specifically exempted from FACA under this bill (modified section 1202, new subsection (16)(C)).

For more information, please see the attached article from the February 13, 2103 issue of *The Water Report.*

ALPS
P.O. Box 27646
Seattle, WA 98165

El Sendero Backcountry Ski and Snowshoe Club
301 Yakima St #5622
Wenatchee, WA 98807

NCCC
P.O. Box 95980
Seattle, WA 98145-2980

Yakima Plan Another View

YAKIMA WATER PLAN

THE OTHER SIDE OF THE STORY

by Brock Evans, President, Endangered Species Coalition;
Karl Forsgaard, President, North Cascades Conservation Council;
Chris Maykut, President, Friends of Bumping Lake;
& Elaine Packard, Chair, Sierra Club, Washington Chapter, Water and Salmon Committee

Editor's Note: This article is a response to "*Yakima River Basin Integrated Water Plan*" — an article published in *The Water Report* #106. This response article presents its authors' views as submitted and is published with only minimal editing conducted to better match our usual layout.
The authors of the original TWR #106 article provided a short reply (see following article).

Introduction

Previous Article

The recent article "*Yakima River Basin Integrated Water Plan*" (*The Water Report*, Dec. 15, 2012) touts the Yakima Plan as a "model…for the West," but the article tells only part of the story, omits key facts, and paints a misleading picture. The Yakima Plan proposes activities with serious adverse environmental impacts relating to water (e.g., new dams inundating ancient forests and endangered species habitat) and land (dedicating national forest lands to off-road vehicles). The actual cost of the Plan is disguised in incomplete economic reports. The Plan is also deeply flawed for its deliberate exclusion of public review and participation in the planning and study process. These problems will set precedent for other projects throughout the western U.S.

Plan Criticisms

For example, that article fails to mention the Yakima Plan's controversial proposal for two new National Recreation Areas (NRAs) on National Forest lands that would promote use of off-road vehicles (ORVs) — motorcycles, ATVs, 4x4s, and snowmobiles. This undermines the land protection strategies of many nonprofits in the Washington State conservation community, who were blindsided by the NRA proposal. It generated so much mistrust that the federal Bureau of Reclamation (BuRec) and State Department of Ecology (Ecology) are now paying for a facilitated series of conservation community meetings to deal with it; the "sponsors" of the meetings include the authors of *The Water Report's* prior article. Adding the NRAs to the Yakima Plan without conducting due diligence created lots of new problems for Yakima Plan proponents, which can serve as lessons to water practitioners throughout the country.

Off-Road Vehicles

Ecology is lobbying Congress and the Washington State Legislature for millions of dollars as a down payment on the controversial Yakima Plan developed with BuRec that would ultimately cost billions of dollars, paid by taxpayers rather than the project beneficiaries. This is not just a local plan. It has national implications for National Forest land use planning, endangered species, the National Environmental Policy Act, and federal water policy.

Taxpayer Costs

On February 7, 2012, the U.S. House Natural Resources Subcommittee on Water and Power held an oversight hearing on "Water for Our Future and Job Creation: Examining Regulatory and Bureaucratic Barriers to New Surface Storage Infrastructure." The one-sided hearing highlighted regulatory burdens that hinder new dams and water storage projects and attacked "cumbersome environmental regulation" and "environmental litigation." The hearing press release highlighted a recent BuRec study that "found nearly one hundred potential sites for new surface storage, yet due to environmental regulations and other factors it has been over a generation since BOR built multiple large scale water storage facilities." *See* http://naturalresources.house.gov/news/documentsingle.aspx?DocumentID=278395.

Storage Projects

One hundred new large dams across the West are a lot of dams. The new BuRec looks a lot like the old "BuWreck," and it has a new program, WaterSMART, authorized by the SECURE Water Act in Public Law 111-11 to seal the deal. *See* www.doi.gov/ocl/hearings/112/WaterSurfaceStorage_020712.cfm.

WaterSMART

In Fiscal Year 2009, BuRec began WaterSMART by funding three basin studies, one on the Colorado River Basin, one on the St. Mary and Milk River Basins in Montana and Canada, and the third being the Yakima River Basin Study in south-central Washington State. *See* www.usbr.gov/WaterSMART/bsp/studies.html#fy2009.

Basin Studies

Under the WaterSMART program, BuRec currently has 12 studies of major river basins underway in the west. All of these major Basin Studies will consider structural (i.e., dams) and non-structural options to supply adequate water in the future. This will include consideration of potential new surface storage needs, as directed in the Act at Section 9503(b)(4)(e). *See* www.doi.gov/ocl/hearings/112/WaterSurfaceStorage_020712.cfm.

Yakima Plan Another View

Ecology Dam Studies

Meanwhile Ecology, a State agency unable to manage its existing water, air and toxics regulatory programs, successfully lobbied the Washington State Legislature in 2006 to become a State dam building agency. aggressively seek out new water supplies for both instream and out-of-stream uses. The same legislation set up the Columbia River Basin Development Account and authorized $200 million to fund it. In effect, Ecology seeks to be a mini-BuRec and has been spending tens of millions of state taxpayer dollars on new dam studies, including the technically infeasible Black Rock dam project. *See* www.ecy.wa.gov/programs/wr/cwp/crwmp.html.

Climate Change Cloak

How do BuRec and Ecology possibly hope to start up the bulldozers and cement mixers to wreak havoc on endangered species habitat, ancient forests, and public lands across the West? By cloaking themselves in "climate change."

BuRec and Ecology do not even need to do the heavy lifting themselves. As the recent article in *The Water Report* demonstrates, American Rivers and the National Wildlife Federation are now engaged in a full scale lobbying effort to promote controversial new dams in the Yakima Basin.

It is very important to pay attention to what is happening in the Yakima Basin. As one of the first WaterSMART programs, the Yakima plan demonstrates just how controversial BuRec remains, and how far the Washington Department of Ecology has strayed from its environmental mission.

Procedural Flaws

In an August 2012 op-ed in the Ellensburg (WA) Daily Record, Charlie de la Chappelle, vice-chair of the Yakima Basin Storage Alliance in Yakima (YBSA is a Yakima Workgroup member) and Marlin Rechterman, vice president of the Kittitas Audubon Society, detailed the procedural flaws in the Yakima Water Plan process. These flaws include:

- limited Workgroup membership;
- closure of the Workgroup implementation subcommittee meetings to the public and other Workgroup members, such as the YBSA;
- preparation of a $20 million "Early Action Implementation Request" prior to release of the Draft Programmatic Environmental Impact Statement (DPEIS);
- lack of a range of alternatives in the DPEIS;
- BuRec and Ecology's denial of a request from 11 local, state, and national organizations for a DPEIS comment-period extension;
- after the close of comments on the DPEIS, the inclusion in the Final Programmatic EIS (FPEIS) of the new proposal for National Recreation Areas within the Okanogan-Wenatchee National Forest, based on a Workgroup plan for more than 40,000 acres dedicated to off-road vehicle (ORV) use; and
- failure to respond to 15 local, state and national organizations' March 2012 comment letter on the FPEIS.

Critical Comments

In addition, BuRec and Ecology received more than 1,500 comments on the DPEIS from citizens around the country objecting to the Yakima integrated plan. *See* www.washington.sierraclub.org/uppercol/ucr/yakima/media/Entries/2012/8/9_Guest_column__Yakima_plan_flawed_from_the_start.html .

Any one of these procedural missteps under the National and State Environmental Policy Acts should raise alarms. In addition, BuRec refused to constitute the Yakima Workgroup under the Federal Advisory Committee Act and failed to consult with the federal wildlife agencies under the Endangered Species Act.

Benefit/Cost Analysis

Under current water policy (Principles and Guidelines) BuRec is required to prepare a benefit/cost analysis on water projects proposed for Congressional funding. In 2008, BuRec prepared a benefit/cost analysis for the proposed Wymer Dam project, which is part of the Yakima Plan. This analysis showed a money-losing benefit/cost ratio of 0.31. Because the Wymer project (and likely a new Bumping Lake Dam) would be a colossal waste of federal taxpayer funds, BuRec has prepared a separate analysis on the entire Yakima Plan, counting benefits that have nothing to do with the two new dams.

Taken together this is an ominous start to BuRec's WaterSMART program. It certainly does not deserve the support of elected officials, state and federal resource agencies, or any conservation organization connected with the Yakima Workgroup.

Realities

Hundreds of thousands of taxpayer dollars are being poured into persuading the public to support the Yakima Plan. Contrary to what has been presented to *The Water Report* readers in the prior article, and before Congress and the Washington State Legislature spend money we can't afford, discussed below are a few realities.

Taxpayers Pay

Yakima irrigators are not entitled to more water at taxpayer expense.

Welcome to Western Water Law: first in time is first in right. During drought years, senior Yakima irrigation districts get 100 percent of their water allotment. Junior irrigation districts get whatever is left over. The junior irrigation districts have always known that in drought years their water would be curtailed. The Yakima Plan intends, in part, for taxpayers to pay for and provide insurance water to junior irrigation districts during water-short years by building two new irrigation dams.

Yakima Plan Another View

Voluntary Conservation

Yakima irrigators have not conserved as much as possible.

As far back as the 1970s, Yakima Basin irrigators were told that they needed to improve water conservation. After more than 30 years, the irrigation districts have installed some measures. But the Yakima Plan still identifies up to 170,000 acre-feet (AF) of water conservation savings yet to be attained. In 2009, Ecology identified 223,596 AF of potential conserved water savings from Yakima River water users and an additional 20,003 AF of potential conserved water savings from Naches River water users. But under the Yakima Plan, any future water conservation would be VOLUNTARY.

Junior districts now claim that they can get by with 70% of their allotment during a drought. It would help if the senior districts would match that. One way is through water marketing. According to a presentation made to the Workgroup in 2010, up to 110,000 AF of water may be available for inter-district water trades and up to 230,000 AF of water may be available for intra-district trades. Under the Yakima Plan this eminently sensible approach is virtually a non-starter.

Two new multi-billion dollar Bureau of Reclamation dams are not needed in the Yakima Basin.

Expensive Insurance

In normal snowpack years such as 2012, both senior and junior districts receive adequate water supplies. The two proposed dams (Bumping Lake and Wymer) would be used to provide additional water to junior districts during drought years. This means they are really "insurance" dams. That is a very expensive insurance policy! Especially when a 2008 BuRec study showed that Wymer dam would provide only 31 cents of benefits for every dollar spent. The Green Scissors Campaign, a national coalition, identified both the proposed Bumping and Wymer dams in its 2012 report as wasteful government projects that should not be funded in the Federal Budget. *See* http://greenscissors.com/wp-content/uploads/2012/06/GS2012-v7E.pdf. A new Bumping Lake Dam would flood roadless ancient forests and endangered species habitat within the Okanogan-Wenatchee National Forest. This spectacular remnant of what once was nearly everywhere in the Cascades still stands along the shores of Bumping Lake — a pretty, natural lake expanded when a small (60') dam was built at its natural outlet some decades ago. All of us have hiked National Forest Trail #971, an accessible hiking trail with little elevation gain along the northern shore of the existing Bumping Lake. The National Forest trail, the ancient forest, as well as historic cabins, a marina, and a campground at the existing dam site would all be flooded. This is no "ordinary" forest: a great many of its individual trees are huge, some enormous (8-10' diameter) by today's standards. Without the threat of a new dam, this magnificent ancient forest as well as other uncut forest along the southern boundary of the lake could be added to the William O. Douglas Wilderness in honor of Justice Douglas, who helped fight a successful battle against a new Bumping Lake dam in the 1970s. Many of the other unprotected ancient forests of the Cascades in our state have vanished. The Yakima Plan would guarantee the loss of even more irreplaceable ancient forests.

Ancient Forest

Protection and enhancement of other Yakima Basin lands will not "mitigate" for endangered species habitat and ancient forests destroyed by new Bumping and Wymer dams.

Acquisition Questions

This is no way to "mitigate" for the loss of ancient forests, roadless area, and endangered species habitat from these new dams. There is no guaranteed protection and little enhancement in the Yakima Plan. The original proposed watershed lands protection element of the Integrated Plan, which has nothing to do with Yakima Basin water supplies, has been significantly weakened and remains voluntary and ill-defined. The Yakima Workgroup's Watersheds Land Subcommittee is scheduled to meet in 2013 to try to correct obvious flaws. There are no guarantees that acquisition of 46,000-acres of private timberlands owned by American Forest Land Co. (AFLC) in the Teanaway watershed would take place. No appraisal has been completed. Other options include acquiring only development rights where the land would continue as "working forest." At the March 2012 Workgroup meeting, Ecology admitted that acquiring the AFLC property may not happen at all. If so, the entire rationale for supporting new irrigation dams to protect the Teanaway goes away.

While the Yakima Plan proposes minimal Wilderness designations within the Okanogan-Wenatchee National Forest, The Wilderness Society is on record saying that Wilderness designation is not necessary for the Yakima Plan. Because of these and other flaws, over 1,500 DPEIS comments opposed the Yakima Plan.

More off-road vehicle use in the Okanogan-Wenatchee National Forest is not integral to the Yakima Integrated Plan.

Off-Road Use Dedicated

On January 4, 2012, the day after the DPEIS public comment period closed, a Workgroup subcommittee presented a new, controversial, and damaging recommendation for new National Recreation Areas (NRAs) with over 40,000 acres dedicated to off-road vehicle use (ORV) within the Okanogan-Wenatchee National Forest — dancing over even the cosmetics of open public process. In March 2012, 26 local, state, and national conservation organizations submitted a letter to BuRec and Ecology opposing NRAs as part of the Yakima Plan. Included in that group are the Alpine Lakes Protection Society; Aqua

Yakima Plan Another View

Permanente; Center for Biological Diversity; CELP; El Sendero; Endangered Species Coalition; Federation of Western Outdoor Clubs; Friends of Bumping Lake; Friends of the Earth; Friends of the Teanaway; Friends of Wild Sky; Issaquah Alps Trails Club; Kittitas Audubon Society; Kittitas County Conservation Coalition; Mazamas; MidFORC; North Cascades Conservation Council; Olympic Forest Coalition; Seattle Audubon Society; Sierra Club; Washington Native Plant Society; Wenatchee Mountains Coalition; Western Lands Project; Western Watersheds Project; Wilderness Watch; and Wildlands CPR.

Last Minute Addition

The FPEIS says that the purpose of the "National Recreation" designation is to "attract more users" onto these National Forest lands. However, putting more ORVs into the headwaters is bad for fish, bad for watershed values, and bad for wildlife habitat. It is also bad for all kinds of non-motorized recreationists. The NRA proposal was published without consulting those who know the most about ORV problems, including the National Forest District Ranger who manages the land in question. The last-minute addition of NRAs to the Yakima Plan makes no sense, and would set a horrible precedent in Washington State and nationally.

Conclusion

As the Yakima Basin Storage Alliance and Kittitas Audubon pointed out in their August 9, 2012 Op-Ed, "These flaws and the $4 billion to $6 billion price tag are evidence that this plan will be viewed with skepticism in Olympia, and in Washington D.C., where legislators are looking at major budget deficits, not opportunities to earmark billions of dollars."

Fish Passage

We agree with YBSA and Kittitas Audubon that the local tribe, the Yakama Nation, is entitled to Yakima Basin fishery restoration, but that fish passage at existing irrigation dams, even if feasible, is not dependent on new irrigation dams. Indeed fish passage is already required by the Endangered Species Act and should not be a "quid pro quo" for building new dams. We agree that the Yakima Plan does not address low flows in the lower Yakima River, where upstream anadromous fish have to pass. Nor does it adequately address the Wapato Irrigation Project on the Yakama Nation, which is managed by the Bureau of Indian Affairs and is one of the largest, most water-wasteful irrigation districts in the country.

We agree that Yakima River Basin improvements can take place with a steady eye on water conservation, water banking, streamside and fish restoration, and aquifer water storage. But not with a controversial, fatally flawed integrated plan.

For Additional Information:
Chris Maykut, 206/ 378-0114
Friends of Bumping Lake, 4000 Aurora Avenue North, Suite 224, Seattle, WA 98103

Brock Evans was the Northwest Representative of the Sierra Club and Federation of Western Outdoor Clubs in the 1960s & early 70s. Exploring nearly all of the wilderness places in the Cascades in those years, he was especially moved by the unusual magnificence and huge size of the ancient trees around Bumping Lake. Now President of the National Endangered Species Coalition, he is also very concerned that the destruction of these forests and grasslands by the proposed dams will lead to irreversible losses of prime habitats for such endangered species as bull trout, sage grouse, and spotted owl.

Karl Forsgaard is President of the North Cascades Conservation Council. He is an attorney who has represented conservation and recreation groups seeking to protect public lands from adverse impacts of off-road vehicle use.

Chris Maykut is President of Friends of Bumping Lake. He is an native Seattlite who owns the Chaco Canyon Organic Cafe, a vegetarian establishment which is dependent on year-round produce from the Yakima Basin. Chris is an avid outdoorsman and environmentalist who cherishes the pristine, untouched nature around Bumping Lake.

Elaine Packard is Chair of the Sierra Club, Washington Chapter, Water and Salmon Committee. She has monitored the Yakima Workgroup process for the last three years. Upon her retirement as high school principal and mathematics teacher, she is devoting time to the protection of water quality and quantity in Washington State.

From: David Andrew <dmandrew@msn.com>
Sent: Thursday, July 02, 2015 8:53 PM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Re: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced

Sincerely,

David Andrew
安大卫
dmandrew@msn.com
(+86) 158 1124 9429

From: Robert Angrisano <rangrisano@gmail.com>
Sent: Thursday, July 02, 2015 9:50 AM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

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Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Best regards,
Robert Angrisano, President
Kachess Community Association

Email: rangrisano@gmail.com
Phone: 425-443-5421
PO Box 1089
Fall City, WA 99024

From: dianaaresu@comcast.net
Sent: Monday, July 06, 2015 1:38 AM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694
Attachments: S 1694 Yakima III.PDF

Energy and Natural Resources Committee Office

304 Dirksen Senate Building

Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. ***I urge you to review the FACTS by accessing the following link - the Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council***
http://swwrc.wsu.edu/2014ybip/

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Anthony Aresu, Adult Voter

Diana Aresu, Adult Voter

Avery Aresu, Adult Voter

Kendall Aresu, Adult Voter

20207 Island Parkway E.

Lake Tapps, WA 98391

and

90 Tranquility Lane

Easton, WA 98925

From: Hailly Bailey <haillyscomet@gmail.com>
Sent: Saturday, July 04, 2015 2:40 PM
To: Ripchensky, Darla (Energy)

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Hailly Bailey
621 E Hyak Dr
Snoqualmie Pass, WA 98068
==

From: Hailly Bailey <haillyscomet@gmail.com>
Sent: Saturday, July 04, 2015 3:12 PM
To: Ripchensky, Daria (Energy)
Subject: And another thought

Hello, I recently drove from Yellowstone National Park back home, through the Yakima Valley on I-82 from Tri Cities to Snoqualmie Pass. I was born in Richland Washington, moved to the Seattle area when I was 7yrs, and have been driving back and forth to visit my grandmother up until 2001 when she passed. I haven't been on I-82 since and let me tell you, it has changed. The little farms and towns with at least a 30 mile stretch of desert in between is no more. The landscape is one big sprawl of green vineyards, and houses with the greenest of lawns. The ponds and rivers are slugged with thick algae where once the locals, my family used to cool off in summers. Driving through a temp of 105 degree up over the hills, turning off the AC as to not over heat our tow vehicle, I was describing to my husband and kids where when I was a kid, I would drive to, where my grandparents are buried, what tree I use to play under, what house I always thought was a mansion, but the whole seen of the valley put me off.

Just coming back from a vacation in a National Park and seeing how important it is to leave our landscape at natural state is. That whole Yakima valley is a desert, and we must respect it for what it is and try not making it into something it's not. We should learn from the California drought, and not place a green space on top of a desert. There has to be a more sustainable way to grow crops somewhere else, limit the growth because like we all learned from the Rangers, one person's bad choice can have a long lasting effect anywhere on the chain. Please don't take any more water from lake keechelus and Kachess. Since climate change is proven to be here to stay, we must conserve our water now.

Thanks for taking the time,

Hailly Bailey

From: Richard Blacker <richmared@aol.com>
Sent: Thursday, July 02, 2015 11:24 PM
To: Ripchensky, Darla (Energy)
Subject: S 1694 Yakima Water Enhancement Project

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is BAD national water policy and BAD national ENVIRONMENTAL policy....and hugely expensive!!!. Please do not pass S. 1695, as introduced.

Sincerely,

Margot Blacker
200 99th Ave NE #24,
Bellevue WA
98004
==

July 3, 2015

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee:
The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Thomas M. Bocek
15025 16th Ave. S.W.
Burien, WA 98166

From: M Burke <burkepostoffice@gmail.com>
Sent: Monday, July 06, 2015 8:10 AM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,
Mark Burke

From: Craig Burt <bronco2663@gmail.com>
Sent: Thursday, July 02, 2015 7:06 PM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I own property in Yakima, but rent a house and work in Auburn, WA. I love both sides of the mountains. But I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/[swwrc.wsu.edu] .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Craig Burt
11857 SE 321st PL
Auburn, WA 98092

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. Please consider the following comments in opposition to S. 1694. I ask that these comments be included in the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1694, as introduced. As an advocate of sound environmental policy and a vibrant agricultural economy (with deep family roots in irrigated agriculture) you and your constituents should be alarmed at the contents of this bill. The Yakima Plan has been developed in secrecy, has carefully excluded citizens and interests who are damaged by its effects, and has consistently rejected state-of-the-art science that shows the plan wastes enormous amounts of money and has devastating impacts on the environment. Perhaps most importantly, independent scientists and economists have shown this plan cannot deliver what it promises. The proponents of this plan are known as the Working Group and have carefully excluded or rejected independent, peer-reviewed science that documents the flaws in the plan (see the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/). I fear the July 7 Hearing of this Committee will be more of the same, dominated by deceptive, inaccurate, and frankly dishonest representations by a group of advocates who have consistently refused to disclose conflicts of interest and opposing points of view.

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation, which will return far greater benefits at a fraction of the cost.

S. 1694 is bad national water policy, bad national environmental policy, and bad economic policy. Please do not pass S. 1694, as introduced.

Sincerely,

William H. Campbell
P.O. Box 6123
Easton, WA 98925

Energy and Natural Resources Committee Office

304 Dirksen Senate Building

Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Murray Chapman

428 289th Place NE
Carnation, WA 98014

July 6, 2015

Senate Energy and Natural Resources Committee
Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Re: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I urge you to more closely consider the negative impact of S. 1695 and to vote against authorizing the next Phase of the Yakima River Basin Water Enhancement Project. The current plan represents outdated views on how to address water shortage issues. As with other failed efforts to address these issues in the past, the plan wrongly focuses on the supply of water rather than demand for water. It ignores the urgent need for conservation to address the reality of global warming and drought in the Western US. It is the problem, not the solution.

The Yakima Plan also includes environmentally damaging water storage projects that are not cost-effective, as demonstrated in the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ . This report and other criticism has led to negative PR in Washington State and heated debate among environmental and conservation experts. (See, e.g., http://swwrc.wsu.edu/2014ybip/). S. 1695 is an attempt to bypass that public debate in favor of certain special interests and to push authorization of a project that does not make fiscal or environmental sense.

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Timothy W. Cranton, Esq.
5222 17th Ave NE
Seattle, WA 98105
206 973-7928
tcranton@hotmail.com

From: MELISSA <robmiscurtis@comcast.net>
Sent: Sunday, July 05, 2015 11:04 PM
To: Ripchensky, Darla (Energy)
Subject: Please do not pass S. 1695, as introduced.

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are our comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

We are opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Robert & Melissa Curtis

16023 SE 125th St
Renton, WA

2861 Via Kachess Rd
Easton, WA

From: Eric Cyzner <ecyzner@gmail.com>
Sent: Monday, July 06, 2015 11:39 AM
Cc: Ripchensky, Darla (Energy)
Subject: Re: S. 1694 - DO NOT PASS

FROM:
Eric Cyzner
233 26th Ave East, Seattle WA 98112

TO:
Senate Energy and Natural Resources

RE:
Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project.
July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1694, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective. Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1694 is bad national water policy and bad national environmental policy. Please do not pass S. 1694, as introduced.

Thank you,
Eric Cyzner

From: N M Fountain <kachess386@gmail.com>
Sent: Monday, July 06, 2015 1:15 AM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694 in the Subject Line of the email

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerley,

Nikki Delarosa-Fountain
17528 150th CT SE L-1
Renton, Wa. 98058

From: Kay Duncanson <kayd@duncansonco.com>
Sent: Tuesday, July 07, 2015 1:04 PM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694 in the Subject Line of the email
Attachments: IMG_0271.JPG

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

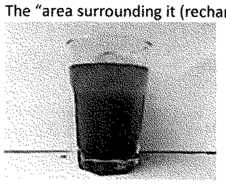
Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1694, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs and most importantly pulling water 65 feet below the natural level of Lake Kachess (a natural lake) a is NOT the right approach to remedy irrigation concerns. In fact, I believe it is so damaging that it should be illegal. It is not a man-made reservoir. It's a natural lake providing recreation, homes and fire protection buffer to thousands of residents and visitors.

Below is a water sample taken yesterday 7/6/15 from a well in the Lake Kachess area. The dry weather has severely impacted wells in the Lake Kachess area. The effect of dropping the lake water level further than ever before has not been quantified. Pulling additional water as proposed will likely result in unstainable water usage.
"It all depends on how fast the aquifer that the well uses is resaturated with water from the surface or from the area surrounding it (recharge). This from a US government website: http://water.usgs.gov/edu/qa-measure-wlevel.html

The "area surrounding it (recharge)" would be Lake Kachess.



S. 1694 is bad national water policy and bad national environmental policy. Please do not pass S. 1694, as introduced.

Sincerely,

Kay Duncanson

19625 Marine View Drive SW
Normandy Park, WA 98166

From: ericafisette@yahoo.com
Sent: Friday, July 03, 2015 10:40 AM
To: Ripchensky, Darla (Energy)
Subject: Please do not pass S. 1695, as introduced

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Erica Fisette
240 Chamonix Place
Snoqualmie Pass, WA 98068

==

Sent from my iPad

July 03, 2015
Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510
Via E-Mail

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

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Building new water storage projects and withdrawing more water from existing reservoirs and alpine lakes is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation. I do not want to see my tax dollars wasted on a project that is fiscally imprudent and does not address any conservation method by the various water districts which can be just as effective and more cost efficient.

Additionally the DEIS does not, in my opinion, effectively articulate the mitigation of the environmental disaster that may befall federally protected species in the watershed area. I do not want to see my tax dollars allocated to a project that has the potential to create further stress in an environmentally sensitive area.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Avery Foster
12215 201st Ct NE
Woodinville WA 98077

July 03, 2015
Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510
Via E-Mail

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs and alpine lakes is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation. I do not want to see my tax dollars wasted on a project that is fiscally imprudent and does not address any conservation method by the various water districts which can be just as effective and more cost efficient.

Additionally the DEIS does not, in my opinion, effectively articulate the mitigation of the environmental disaster that may befall federally protected species in the watershed area. I do not want to see my tax dollars allocated to a project that has the potential to create further stress in an environmentally sensitive area.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Kelsey C. Foster
12215 201st Ct NE
Woodinville WA 98077

July 02, 2015
Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510
Via E-Mail

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

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Building new water storage projects and withdrawing more water from existing reservoirs and alpine lakes is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation. I do not want to see my tax dollars wasted on a project that is fiscally imprudent and does not address any conservation method by the various water districts which can be just as effective and more cost efficient.

Additionally the DEIS does not, in my opinion, effectively articulate the mitigation of the environmental disaster that may befall federally protected species in the watershed area. I do not want to see my tax dollars allocated to a project that has the potential to create further stress in an environmentally sensitive area.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Roger A. Foster
12215 201st Ct NE
Woodinville WA 98077

From: Jean/Tim Fountain <kachess385@gmail.com>
Sent: Sunday, July 05, 2015 5:56 PM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694 in the Subject Line of the email.

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely.

Tim & Jean Fountain
4725A NE 18th Pl
Renton, Wa 98059

FRIENDS OF BUMPING LAKE

June 30, 2015

Friends of Bumping Lake
4000 Aurora Avenue North
Suite 224
Seattle, WA 98103

Date of Hearing : July 7, 2015
Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project.

Senator Murkowski (Chair) and members of the Committee. The following comments on S. 1694 are submitted in opposition to this version of the bill on behalf of Friends of Bumping Lake. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

We have been monitoring the Yakima Integrated Plan and Workgroup for some time now. There are many good people in that room dedicated to accomplishing goals that will benefit their constituencies and their communities. There are also elements of the Workgroup that, as it was constructed, make it impossible for them to change course at all.

This is disappointing, because our expectation of public policy and government is that they should be able to consider change when given new data to work with. In December, 2014 the Workgroup was given unbiased data to consider in the Water Research Center cost-benefit analysis of the Yakima Plan, but the only outcome of that has been outright denial and a commitment to the analysis that they and the Bureau of Reclamation produced for their own uses.

The WRC report, which you be viewed at http://swwrc.wsu.edu/2014ybip/ , clearly states that none of the water storage projects pencil out economically, and return far less than half of the initial investments on them over a 100-year span. Bumping Lake, a storage project that promises to drown out 1000 acres of ancient forest, destroy habitat critical to endangered species, and wipe out a beloved campground and cabin community just to provide water that would only be used in severe, single-year droughts returns 18 cents on the dollar.

Ultimately, the Workgroup will not change course because there are organizations in that room who want to build storage projects, no matter if they return 42 cents, 18 cents, or 9 cents for every dollar that is committed from our precious State and National budgets. While it seems ludicrous that these projects could ever happen, this draft legislation would provide Congressional approval to authorize and implement **the entire Yakima Plan**.

Please do not pass this current version of the plan until the Workgroup and the proponents make a commitment to solving our water issues in an economic way that benefits the many and not the few.

Thank you,

Chris Maykut
President
Friends of Bumping Lake
(206)818-9778
chris@friendsofbumpinglake.org

"Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it is the only thing that ever has." --Margaret Mead

www.friendsofbumpinglake.org

July 24, 2015

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Madam Chair and Members of the Committee:

Thank you for the opportunity to provide comments on S. 1694. This bill concerns the Yakima River Basin Integrated Plan (Yakima Plan) in Washington State.

"Friends of Lake Kachess" is an organization of private citizens, homeowners associations, fire departments, businesses and other groups who have been denied an opportunity to provide comments to the Yakima Workgroup since the formation of the Yakima Workgroup in 2009. Despite repeated efforts to bring transparency to the process and contribute an objective public perspective, we have been denied the most basic opportunity for citizen input. We are opposed to Phase One of the Yakima Plan, which is known as the Kachess Drought Relief Pumping Plant and Keechelus Reservoir-to-Kachess Reservoir Conveyance projects. Contrary to Senator Cantwell's representations to the Committee, there is substantial opposition within Washington State to the Yakima Basin Plan based upon economic, environmental, and procedural grounds.

These projects contain fatal substantive and procedural flaws which are detailed in the attached comment letters submitted during the DEIS comment period.

We are also opposed to passage of S. 1694, as written, as it is premature and based on a flawed and incomplete DEIS. Furthermore, S. 1694 and the DEIS rely upon outdated cost estimates. The most recent feasibility study conducted by the BOR, put the total cost at nearly 4 times the estimates used in the benefit cost analysis. In addition to the exponentially increasing costs, the mathematical errors in the benefit cost analysis are also so egregious as to call validity of the entire analysis into question (see Water Research Center independent analysis and attached economic audit by Jay Schwartz).

We understand that Senator Cantwell is attempting to attach S. 1694 to the Energy Modernization Act of 2015. We strongly object to this, as we believe S. 1694 need rewrite, discussion, and debate before it is ready to be voted on by the committee.

Specifically, our objections can be categorized into the following five areas with relevant concerns noted. We have also drafted recommended changes to the bill that address these concerns:

1. Yakima Plan and National Environmental Policy Act (NEPA) Final Programmatic Environmental Impact Statement

The bill defines the "Management Plan" as the plan described in the document entitled "Final Programmatic Environmental Impact Statement and Integrated Water Resource

Management Plan, Yakima River Basin, Water Enhancement Project, Benton, Kittitas, Klickitat, and Yakima Counties, WA." (2012 FPEIS). The bill should not reference or incorporate the 2012 FPEIS because the 2012 FPEIS did not include a range of alternatives as required by NEPA. *40 CFR Sec. 1502.14.* Instead the bill should reference the 2011 Workgroup Yakima Plan document.

http://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/plan/integratedplan.pdf

http://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/2012meetings/201201-04/wtrlandssubfinal.pdf

The Yakima Plan, as defined in the 2012 FPEIS, includes projects which are environmentally damaging and not cost effective such as a proposed Kachess Drought Relief Pumping Plant and Keechelus Reservoir-to-Kachess Reservoir Conveyance which are not cost effective and viable alternatives have not been considered.

It is requested that Congress require these projects be "cost effective measures" rather than "maximizing benefits." In 2013, the Washington State Legislature was so skeptical of the 2012 Yakima Plan that they required an independent analysis of the benefits and costs by the Congressionally-established State of Washington Water Resource Center (WRC). The WRC's benefit-cost analysis of the Yakima Integrated Plan Project, released in 2014, found that "When implemented together as part of the IP, the major water storage projects as a group do not pass a B-C [benefit-cost] test."
(http://swwrc.wsu.edu/documents/2014/12/ybip_bca_swwrc_dec2014.pdf)

We suggest these revisions to the bill which address the problems mentioned above:

1.1 Authorization of the full Yakima Plan:

Page 4 (8) Lines 13-18 state:

"(8) to authorize and implement the Yakima River Basin Integrated Water Resources Management Plan as Phase III of the Yakima River Basin Water Enhancement Project, in a balanced approach to maximize benefits to the communities and environment in the Basin."

Amend to:

Page 4 (8) Lines 13-18:

"(8) to authorize projects listed in new Section 1214(a)(2)(A) that are cost effective to provide benefits to the communities and environment in the Basin."

1.2 Adoption of a flawed NEPA 2012 FPEIS:

Page 5 (3) Lines 10-17 state:

"(8) Management Plan – The term 'Management Plan' means the plan described in the document entitled, 'Final Programmatic Environmental Impact Statement and

Integrated Water Resource Management Plan, Yakima River Basin, Water Enhancement Project, Benton, Kittitas, Klickitat, and Yakima Counties, WA' (77 Fed. Reg. 12076 (February 28, 2012)).

Amend to:

Page 5 (3) Lines 10-17:

"(8) Management Plan – The term 'Management Plan' means the Yakima River Basin Study (Yakima Plan) (08CA10677A ID/IQ) (April 2011), as amended by the Watershed Land Conservation Proposal (January 2012).

1.3 Authorization of Phase III as part of the Yakima Plan:

Page 7 (3) Lines 3-16 state:

"(18) Yakima Enhancement Project, Yakima River Basin Water Enhancement Project

– The Terms 'Yakima Enhancement Project' and Yakima River Basin Water Enhancement Project' mean the Yakima River basin water enhancement project authorized by Congress pursuant to this Act and other Acts. . . . . "

Amend to:

Page 7 (3) Lines 3-16:

"(18) Yakima Enhancement Project, Yakima River Basin Water Enhancement Project – The Terms 'Yakima Enhancement Project' and Yakima River Basin Water Enhancement Project' mean the Yakima River Basin Water Enhancement Project authorized by Congress listed in new Section 1214(a)(2)(A) that are cost effective pursuant to this Act and other Acts. . ."

1.4 Implementation of the full Yakima Plan in its entirety:

Page 23 Sec. 1214(a)(1) Lines 21-23 state:

"(1) In General – It is the intent of Congress that the Management Plan shall be implemented in its entirety, in accordance with applicable laws."

Strikeout:

Page 23 Sec. 1214(a)(1) Lines 21-23

~~*"(1) In General – It is the intent of Congress that the Management Plan shall be implemented in its entirety, in accordance with applicable laws."*~~

2. New National Recreation Areas on National Forest lands

The process used to include National Recreation Areas (NRAs) called out in the 2012 FPEIS was deeply flawed. The Yakima Workgroup added a new proposal for two NRAs within the Okanogan-Wenatchee National Forest after the close of the public period on the Draft Programmatic Environmental Impact Statement (DPEIS). As proposed, the Yakima NRAs are highly deficient because 41,000 acres are dedicated damaging off-road vehicle (ORV) per the FPEIS. Additionally, an NRA boundary included in the FPEIS overlays part of the existing Alpine Lakes Wilderness.

Because this element of the Yakima Plan was adopted after the close of public comment period of the DPEIS, we request this element be deleted from the Yakima Plan.

Decisions on establishing new NRAs in the Okanogan-Wenatchee National Forest are best made after the Okanogan-Wenatchee National Forest completes its forest planning processes. These processes are now in work.

We suggest this bill revision to address the problems mentioned above:

2.1 Delete the Okanogan-Wenatchee National Forest NRAs from the Yakima Plan: **Add a new (E) on Page 27, after line 8:**

"The Yakima Plan's designations for new National Recreation Areas (NRAs) within the Okanogan-Wenatchee National Forest with 41,000 acres of dedicated off-road vehicle use shall be deleted from the Yakima Plan. Any new NRA proposals shall be evaluated as part of the Okanogan-Wenatchee National Forest Plan revision process and Travel Management process."

3. Federal Advisory Committee Act and Public Participation

The Bureau of Reclamation (Bureau) has skirted the Federal Advisory Committee Act (FACA) by establishing the Yakima Workgroup as an advisory group without a FACA charter and now asks Congress to continue to insulate the Yakima Workgroup from FACA. The Yakima Workgroup does not have any members from adversely affected parties and the Workgroup has not allowed negatively affected parties access to meetings or documents. By contrast, the Workgroup is comprised of members who all benefit from the implementation of the Integrated Plan, many of whom are irrigators who will benefit in the form of increased profits. Furthermore, the Workgroup has provided policy and implementation recommendations which the Bureau has relied upon exclusively. Each of these actions is in direct contravention of FACA requirements. In the interests of good open government, as well as facilitating communication with Yakima Valley residents, we believe the Workgroup and all subcommittees of the Workgroup should be subject to FACA. In addition, the Secretary should not be able to add any projects to the Intermediate and Final Development Phases without public participation and comment and such decisions should not be delegated to private and conflicted parties.

We suggest these bill revisions to address the problems mentioned above:

3.1 FACA

Page 6 (4) Lines 23-24 state the Workgroup:

"(C) is not subject to the Federal Advisory Committee Act (5 U.S.C. App.)";

Amend to:

Page 6 (4) Lines 23-24 state the Workgroup:

"(C) is subject to the Federal Advisory Committee Act (5 U.S.C. App.)";

3.2 Intermediate and Final Phases **Page 26 (3), lines 8-16 state:**

"(A) In general. – During the Intermediate and Final Development Phases of the Management Plan, any project that is determined by the Secretary, in consultation with the State of Washington and Work Group, to be appropriate to meet the obligations of the Management Plan shall be designed and constructed, subject to authorization and appropriation."

Amend to:

Page 26 (3), lines 8-16:

"(A) In general. - Any project proposed by the Yakima Workgroup for Federal funding beyond the Initial Development Phase shall be subject to a 90-day public comment prior to a review by the Bureau. No additional project beyond the Initial Development Phase shall be authorized or funds appropriated, without National Environmental Policy Act compliance.

4. Kachess Drought Relief Pumping Plant Project and Keechelus to Kachess Conveyance Project

The Bureau is asking this Committee to authorize the Secretary to negotiate long-term agreements with participating proratable irrigation entities for the non-Federal financing, construction, operation, and maintenance of the Kachess Drought Relief Pumping Plant Project and Keechelus to Kachess Conveyance Projects. However, these sections do not prohibit continued Federal funding of design or feasibility studies of these projects. In addition, the Bureau has not completed reviewing comments on the Draft Environmental Impact Statement for the Kachess Drought Relief Pumping Plant or Keechelus to Kachess Conveyance projects or issued a Final Environmental Impact Statement.

We suggest this bill revision to address the problems mentioned above:

4.1 Proratable irrigation entities Amend to:

Add a New (C) on page 26, beginning Line 8 as follows:

"(C) Other than NEPA compliance, no Federal funds shall be spent on the design or feasibility studies of inactive storage in Lake Kachess and a conveyance system to allow transfer of water between Lake Keechelus to Lake Kachess as set out in Sec. 2014 (a)(2)(A) (ii)(I) and (II). If non-Federal financing, construction, operation, and maintenance of these projects are carried out, the participating proratable irrigation entities in the Yakima Basin shall reimburse the Federal government for all Federal planning and study funds expended on these projects. Nothing in this Act shall circumvent the National Environmental Policy Act."

5. Yakima Plan Discretion

S. 1694 contains sections with ambiguous language and discretion. For example, Sec.

1213 authorizes the Secretary to make grants to irrigation districts to carry out this title. Section 1215 appears to reinforce a long-term bias of putting water supply for other purposes rather than benefiting fish. Since the purpose of the Yakima Plan is to benefit both fish and downstream uses, this section is a step back from that approach.

We suggest these bill revisions to address the problems mentioned above:

5.1 Phase III Grants

Page 22 Sec. 1213 Lines 15-21 state:

"The Secretary may make grants or enter into cooperative agreements with the Yakama Nation, the State of Washington, Yakima River basin irrigation districts, water districts, conservation districts, other local governmental entities, nonprofit organizations, and

land owners to carry out this title under such terms and conditions as the Secretary may require including the following purposes:

Amend to:

Page 22 Sec. 1213 Lines 15-21:

"The Secretary may make grants or enter into cooperative agreements with the Yakama Nation, the State of Washington, Yakima River basin irrigation districts, water districts, conservation districts, other local governmental entities, nonprofit organizations, and land owners under such terms and conditions as the Secretary may require for the following purposes:"

5.2 Feasibility Contingency **Page 27 (D), lines 3-5 state:**

"*(D) Feasibility contingency – The Intermediate and Final Development Phases of the Management Plan shall be contingent on feasibility, as determined by the Secretary, in consultation with the Workgroup and in compliance with applicable laws.*"

Amend to:

Page 27(D), lines 3-5:

"(D) Feasibility contingency – The Intermediate and Final Development Phases of the Management Plan shall be contingent on feasibility, cost-effectiveness, and a positive benefit-cost ratio."

5.3 Operational Control of Water Supplies

Page 36, lines 19 -24 and page 37, lines 1-2 state:

"Section 1215. Operational Control of Water Supplies

The Secretary shall retain authority and discretion over the management of project supplies to obtain maximum operational use and flexibility to meet all appropriated and adjudicated water rights. That authority and discretion includes the ability of the United States to store, deliver, conserve and reuse water supplies deriving from projects authorized under this title."

Strikeout:

Page 36, lines 19-24 and page 37, lines 1-2:

~~"Section 1215. Operational Control of Water Supplies~~

~~The Secretary shall retain authority and discretion over the management of project supplies to obtain maximum operational use and flexibility to meet all appropriated and adjudicated water rights. That authority and discretion includes the ability of the United States to store, deliver, conserve and reuse water supplies deriving from projects authorized under this title."~~

Summary

In conclusion, we remain very concerned that:

- S. 1694 sets out the intent of Congress "that the Management Plan shall be implemented in its entirety";"
- That it seeks to create NRAs that were added after closure of the public comment period with a boundary that overlays part of existing Alpine Lake Wilderness;
- That it exempts the Yakima Workgroup from the Federal Advisory Committee Act;
- That it accepts a flawed 2012 Yakima Plan Final Programmatic EIS that failed to consider a range of alternatives;
- That it seeks to proceed with the Kachess Drought Relief Pumping Plant and Keechelus-to-Kachess Conveyance projects prior to a final EIS and with a fatally flawed DEIS;
- And that has not incorporated benefit-cost analysis that would protect the Federal taxpayer

We have provided comments to the Yakima Workgroup and have a lengthy record of correspondence with the Workgroup, the Bureau of Reclamation, and various elected officials concerning this project. A copy of the key letters are attached.

We request that the attached letters, along with this letter, be included in the hearing record.

Respectfully submitted by Robert Angrisano, on behalf of the Friends of Lake Kachess.

Sincerely,

Robert Angrisano
PO Box 1089
Fall City, WA 98024
Phone: 425-443-5421
Email: rangrisano@gmail.com

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Carll and Robyn Frye
100 Alpine Lane
Easton, WA

425-890-2820

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,
Albert W Hazard
40 Brookside ct
Easton Wa.

Heart of America Northwest

The Public's Voice for Hanford Cleanup

444 NE Ravenna Blvd. Suite 406 · Seattle, WA 98115 · phone: (206)382-1014 · web: www.hanfordcleanup.org

TESTIMONY OF
HEART OF AMERICA NORTHWEST
to the Energy and Natural Resources Committee
U.S. Senate
Washington D.C.
On S. 1694
[redacted]

Sen. Murkowski (Chair) and members of the Committee, thank you for the opportunity for Heart of America Northwest to comments on S. 1694. Heart of America Northwest is the leading citizens' watchdog organization working for the clean-up of the federal Energy Department's Hanford Nuclear Reservation, which is the most contaminated area in North America. The Columbia River runs through Hanford for over fifty miles, and there is a massive amount of deep soil contamination above the current groundwater level which would be re-wetted, mobilized and transported to the River if Black Rock Reservoir were constructed just upgradient of Hanford.

The Black Rock reservoir proposal was investigated in the early 2000s by the Bureau of Reclamation and the State of Washington. This multi-billion dollar dam project would have been constructed southeast of Yakima, WA, and filled with pumped water from the Columbia River for transfer to the Yakima River Basin. Heart of American Northwest opposed this project because studies showed that groundwater seepage from a Black Rock reservoir would have migrated under the Hanford Nuclear Reservation carrying radioactive contamination toward the Columbia River. http://columbia-institute.org/blackrock/backrock/Home.html Our review was conducted by experts, including board member geohydrologist Floyd Hodges, Ph.D., retired senior scientist for Pacific NW National Lab.

This threat is back in the form of the Bureau of Reclamation's Yakima Plan, which is the subject of S. 1694. We were concerned to learn that at the June 3, 2015, Yakima Workgroup meeting the Bureau of Reclamation reported that they had begun "appraisal of potential projects to transfer water from the Columbia River to the Yakima Basin."
http://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/2015meetings/2015-06-03/ppt.pdf
(Slide 13)
In addition, the Yakima Basin Storage Alliance, a member of the Yakima Workgroup has announced that "It is Time to Revive the Black Rock Reservoir Plan."
http://ybsa.org/2015/07/ybsa-monthly-report-june-2015/

S. 1694 appears to provide Congressional support and endorsement for the entire Yakima Plan, including projects to transfer water from the Columbia River to the Yakima Basin, which could include projects such as Black Rock. Therefore, Heart of American Northwest is opposed to S. 1694, as proposed. Please include this testimony in the hearing record for S. 1694. Thank you.

Gerry Pollet

Representative Gerry Pollet, J.D.,
Executive Director,
Gerry@hoanw.org (206)382-1014

From: Ann Hurley <hurleyann@me.com>
Sent: Friday, July 03, 2015 12:07 AM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Ann Hurley

From: Traci Jones <tjloves2fish@gmail.com>
Sent: Sunday, July 05, 2015 2:41 PM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Senate Energy and Natural Resources
Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project.
July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1694, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective. Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1694 is bad national water policy and bad national environmental policy. Please do not pass S. 1694, as introduced.

Sincerely,

Traci Jones
P. O. Box 195
Easton, WA 98925

Energy and Natural Resources Committee Office

304 Dirksen Senate Building

Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am emphatically opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced. I also disagree with the process beign carried out. Of the THOUSANDS of people on Lake Kachess this past holiday weekend, few even know the lake may be drained below its natural lake level under this plan.

Sincerely,

Nancy Judd

Nancy Judd

Homeowner in Lake Kachess Community

From: Christa June <christasana@gmail.com>
Sent: Thursday, July 02, 2015 1:47 PM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Senate Energy and Natural Resources
Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project.
July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective. Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Christa
June

13777 Wayne Pl N
Seattle WA 98133

From: Carol Jung <jungcf@comcast.net>
Sent: Tuesday, July 07, 2015 2:59 AM
To: Ripchensky, Darla (Energy)
Subject: Senate Bill 1694

Senate Energy and Natural Resources
Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project.
July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are our comments on S. 1694 . We oppose this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

We are completely opposed to authorizing S. 1694, as introduced by Senator Cantwell . I sympathize with the suffering farmers of Eastern Washington - AND_ The Yakima Plan includes environmentally damaging, incompletely thought out water storage projects that are not cost-effective. Reflexively creating new and costly water storage projects and withdrawing more water from existing lakes and reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation. This represents another moral hazard when one groups benefits from public spending and is not responsible for the consequences .

S. 1694 is bad national water policy and bad national environmental policy. Please do not pass S. 1694, as introduced. We cannot afford to foolishly spend public monies when the beneficiaries are not responsible fully implementing conservation measures. The environment of the Cascade crest watershed lakes and reservoirs will be irretrievably affected, and to waste such precious assets is not in the public interest .

Charles and Carol Jung
6745 W Mercer Way
Mercer Island, WA 98040

To: (via e-mail) June 15, 2015

Ms. Candace McKinley
Environmental Program Manager
Bureau of Reclamation
Columbia-Cascades Area Office
191 7 Marsh Road
Yakima, WA 98901-2058
Phone: 509-575-5848, ext. 603
Fax: 509-454-5650
Email: kkbt@usbr.gov

RE: Comments Kachess Drought Relief Pumping Plant and Keechelus Lake-to-Kachess Lake Conveyance, DRAFT Environmental Impact Statement

Dear Ms. McKinley:

Per my previous letter, dated February 28, 2015, providing comments to the previous open comment period, I am submitting this letter with additional comments.

In my previously letter, I stated the following concern, in reference to the risk to fire fighting and the community's public water system.

Section 3.5.2.1 acknowledges the many wells within 2 miles of Lake Kachess, however, it fails to recognize the Public Group "A" Water System, located several hundred feet from the lake shoreline. This water system provides water to 162 homes in our community, to our fire hydrants, for use in firefighting of structures and wildfire within the boundaries of Kittitas County Fire District #8, and for firefighting via tanker and transport apparatus in contiguous districts where mutual aid and collaborative agreements exist. It fails to describe or quantify the potential effect, dropping the lake level an additional 80+ feet below its natural lowest level, will have on our Public water system or the wells in the area, or on the ability to conduct effect fire suppression activities.

We know that when the level of the lake drops to its lowest possible level in drought years, the input water to our system decreases, but neither we nor you have any idea what would happen if the level was dropped an additional 80+ feet and remained below the full level for many years after a drought, as the DEIS projects it will do. As part of the DEIS, you must determine and quantify the effect the lake level drop will have on our Public water system and provide a mitigation plan to protect our water source.

We have senior water rights dating back to pre-May 10, 1905. As such, if this project proceeds without a full study and satisfactory mitigation, we will be forced to seek *injunctive relief to stop the project and protect our water rights and the water supply to the Kachess Community.*

On April 4, 2015, the Kittitas County Commissioners held an open public meeting, which was attended by several members of the Yakima River Basin Water Enhancement Project (YRBWEP) working committee. At that meeting, I again expressed my concern and threat of the diminished water supply to the Kachess Community Association's public water system and requested that this threat be properly examined and understood. The Kittitas County Commissioner and the working group members stated that they would take steps to better understand issues facing our public water system as well as the other private wells in the area.

As of the writing of this letter, no one has contacted me to understand our water system or the possible effects of this proposal on our water source for the community water system.

Also, as previously stated, Lake Kachess provides a vital source of water needed to fight fires in our community. The fire insurance policies of all members in the Kachess Community Association are based on an independent fire rating. The Washington Surveying and Rating Bureau is in the process of reexamining the firefighting capability in our community and updating it's rating of our community. As part of the evaluation and rating process, we include access to the water in Lake Kachess as the secondary source of water for firefighting purposes.

If the level of the lake is below the maximum drop of 65 vertical feet possible today, the water would no longer be accessible for firefighting purposes and would substantially affect our firefighting ability and lower the fire rating of our community. This would have a direct negative impact on the cost of fire insurance policies that our community members have to pay to insure their property as well as the property values in our community.

This proposal needs to include a viable method for the Kittitas County Fire District #8 to access water from the lake when it drops below the 65 vertical foot level to include a pipeline and pumping capability that would provide a flow of at least 750 gallons per minutes with an end-point pressure of at least 70psi to maintain a secondary source of water for firefighting purposes.

Although the BOR and Ecology extended the comment period for the DEIS they did not supplement it in anyway. Despite this the BOR stated the following in their website:

The new comment period will end June 15, 2015. A Final EIS will be prepared after all comments have been addressed. Then, a decision will be made regarding which alternative will be selected. Before any project can be implemented, Congress would still need to provide authorization and funding.

WE HEARD YOUR CONCERNS!

Groundwater – You told us you are concerned that additional drawdowns could affect your wells. Water levels at Kachess already undergo annual fluctuation without any known impacts to existing wells or aquifers. During drought years, the proposed pumping plant would draw the reservoir down further. Reclamation and Ecology are reexamining any potential impacts of the drawdown on wells.

Property Values – Many of you expressed concern over potential decline in long-term property values resulting from the operational changes at Kachess Reservoir. Reclamation and Ecology are reevaluating potential impacts on property.

Once again, the BOR and Ecology have ignored the concerns of the public directly affected by this proposal and failed to respond to the commitments made to the public to mitigate the negative impact of this plan.

As President of the Kachess Community Association, I formally request, on behalf of our members, that you rewrite the Kachess Drought Relief Pumping Plant and Keechelus Lake-to-Kachess Lake Conveyance plan and address, to the satisfaction of our members, all of the points outlined in my previous letter, dated February 28, 2015, as well as the specific points outlined in this letter.

Sincerely,

Robert Angrisano
President, Kachess Community Association
PO Box 1089
Fall City, WA 98024

February 28, 2015

Ms. Candace McKinley or Email: kkbt@usbr.gov
Environmental Program Manager
Bureau of Reclamation
Columbia-Cascades Area Office
1917 Marsh Road
Yakima, WA 98901-2058

Please accept these comments, on behalf of the Kachess Community Association, in response to the Draft Environmental Impact Statement (DEIS) for the proposed Kachess Drought Relief Pumping Plant (KDRPP) and Keechelus Reservoir-to-Kachess Reservoir Conveyance (KKC) Projects.

The KDRPP and KKC Projects pose serious threats to the economic and environmental status of the Okanogan-Wenatchee National Forest and to the several communities in the watershed of Keechelus Reservoir and Kachess Reservoir. The numerous adverse environmental impacts documented in the DEIS include habitat destruction of bull trout and Northern Spotted Owl, negative impacts on private property values, reduction in aquifer in Northern Kittitas County with the possibility of well failures, shoreline destruction, increased hazard from wildfires, reduction in recreational opportunities, increased mortality of fish and game, destruction of scenic vistas, risk to wildlife and people attributable to construction activities, damage to commercial activities and deterioration of emergency medical, fire and other public services.

Signed into law, on January 1, 1970, the National Environmental Policy Act (NEPA) established to implement protection of our public lands, managed by the Forest Service. NEPA instructs agencies (Forest Service) to assess the environmental effects of proposed actions before making decisions.

I have read the NATIONAL ENVIRONMENTAL POLICY ACT HANDBOOK - CATEGORICAL EXCLUSION FROM DOCUMENTATION (chapter 30) and cannot find any wording that would exclude the Forest Service from doing the required detailed NEPA study to determine the full impact of this project. In fact, the handbook makes it very clear that a NEPA is mandated, due to the wide spread impact these proposals will have on the environment, wildlife, plants, and fauna. The DEIS states "This DEIS was prepared in compliance with the National Environmental Policy Act (NEPA) 42 USC 4371 et seq. and the State of Washington Environmental Policy Act (SEPA), Chapter 43.21C RCW, and the SEPA Rules (Chapter 197-11 WAC)." Where is the required NEPA study? This DEIS does not meet the requirements mandated by the NEPA process.

The previously stated negative impacts are acknowledged in the DEIS, however in most cases the Bureau simply states negative impacts "will be monitored and mitigated." The substantial negative impacts on private and public property are inadequately described and never quantified. This does not meet the letter or spirit of a valid Environmental Impact Statement. When a well has gone dry, when bull trout have been unable to spawn or have died due to low water levels, when property values have declined, and in a multitude of similar negative impacts it is either impossible or too late to "mitigate" the negative impact. Indeed the DEIS fails to provide substantive and clear information about what monitoring will occur, or what mitigation strategies would even be considered, and in all those instances must be rejected as nonresponsive.

Among our many concerns, a major one is the potential threat the KDRPP and KKC projects represent to the Kachess Community, located on the west shore of Lake Kachess. In addition to significantly decreasing our property values and stopping our ability to recreate on or in the vicinity of the lake for periods of several consecutive years every time the lake level is dropped below its natural level, you are threating our community's water source.

Section 3.5.2.1 acknowledges the many wells within 2 miles of Lake Kachess, however, it fails to recognize the Public Group "A" Water System, located several hundred feet from the lake shoreline. This water system provides water to 162 homes in our community, to our fire hydrants, for use in firefighting of structures and wildfire within the boundaries of Kittitas County Fire District #8, and for firefighting via tanker and transport apparatus in contiguous districts where mutual aid and collaborative agreements exist. It fails to describe or quantify the **EXACT** effect, dropping the lake level an additional 80+ feet below its natural lowest level, will have on our Public water system or the wells in the area, or on the ability to conduct effect fire suppression activities.

We know that when the level of the lake drops to its lowest possible level in drought years, the input water to our system decreases, but neither we nor you have any idea what would happen if the level was dropped an additional 80+ feet and remained below the full level for many years after a drought, as the DEIS projects it will do. As part of the DEIS, you must determine and quantify the effect the lake level drop will have on our Public water system and provide a mitigation plan to protect our water source.

We have senior water rights dating back to pre-May 10, 1905. As such, if this project proceeds without a full study and satisfactory mitigation, we will be forced to seek injunctive relief to stop the project and protect our water rights and the water supply to the Kachess Community.

Because the DEIS fails to adequately describe and quantify **all** the negative impacts of KDRPP and KKC, because it misrepresents and undervalues the true economic and environmental risks, and because it overvalues benefits to a select group of individuals it fails to meet the minimum criteria of a valid Environmental Impact Statement as set forth in the National Environmental Protection Act (NEPA). The DEIS must therefore be rejected in its current form, it must be substantially revised, and it must be resubmitted as a DEIS and with an appropriate comment period.

A more detailed analysis and comment has been prepared by the organization "Friends of Lake Kachess" citing specific examples of the above-stated concerns. I support in entirety the comments submitted by that organization (see attached). I ask that you acknowledge receipt of these comments at the earliest opportunity.

Sincerely,

Robert Angrisano
President, Kachess Community Association
PO Box 1089
Fall City, WA 98024

Comments on Draft Environmental Impact Statement (DEIS)
For
Yakima River Basin Water Enhancement Project (YRBWEP)

Prepared by "Friends of Lake Kachess"

1. The following statement is repeated at various points: "Reclamation would use the pumping plant during drought years and could possibly use it in following years..." [emphasis added]. *(ES-viii)* It appears this statement is at variance with the authorized purpose of the KDRPP/KKC projects, which is to initiate pumping only when portable water supplies fall below 70%. What authority exists for using the pumping plant outside the 70% criteria, and please cite the statutory and/or regulatory authority for such an action. If such action is contemplated, what is the maximum frequency and amount of such pumping?

2. One purported goal of the KDRPP/KKC projects is to allow Reclamation to "reduce flows in the upper Yakima River, thereby improving rearing habitat for steelhead and spring Chinook." *(ES-xii)* However the DEIS does not provide any data on mortality or survivability of current runs (if any exist) or projected mortality/survivability of future runs. Please provide quantitative estimates of mortality and survivability gains in fish passage and cite the references for such estimates.

3. Kittitas County Fire District #8 (KCFD8) is responsible for providing emergency medical and fire service within the proposed boundaries of the proposed KDRPP/KKC project area. There will be significant vehicle, heavy equipment, and trucking equipment used on the project, by personnel. There is also the possibility of round the clock working hours for the project during non-winter months. This will require significant staffing and the possible purchase of specialized equipment rescue equipment, by KCFD8, to be able to respond in an appropriate and timely manner to life threatening emergencies. There are no provisions in the DEIS for funding this ramped up effort or mitigating these essential services during the build-out period. What funding or mitigation options are available to assure continued and unimpeded emergency services for the Kachess Reservoir community? What assurance can Reclamation give that these options will be available? What are the levels of effectiveness of any mitigation efforts?

4. The DEIS acknowledges "major construction impacts including dust, vehicle emissions, noise, and traffic." Truck traffic along Kachess Lake Road may be as high as 1 truck per minute (59 per hour) at peak levels and average 1 truck per 5 minutes.(ES xviii; Table 4-75) The claim is this will not significantly impact local traffic, emergency responders, recreationists and others, however this appears to be an overly optimistic speculation. We request that you confirm these conclusions by consulting with Kachess Fire Department No. 8, with DOT, and other affected parties. We further ask that you report the results of such consultations and cite any evidence

for any conclusion(s) by Reclamation that are counter to the conclusions of Kachess Fire Department No. 8 and/or DOT.

5. Wildland fire risk is a significant hazard in the KDRPP and KKC areas, evidenced by recent Kittitas County fires: South Cle Elum Ridge Fire, Taylor Bridge Fire, Table Mountain Fire, and others. These fires are frequently caused by sparks, construction work (e.g., welding), brake and bearing fires, and other causes related to vehicular traffic, especially heavy vehicles, and construction apparatus. (4-281) Given the large increase in traffic on Lake Kachess Road we ask for a thorough assessment of the additional risks of wildland fire imposed by construction work for KDRPP and KKC, the costs associated with suppressing or managing typical fires in the area, and the responsibility for mitigation (including financial reimbursement to private interests). If these costs are not to be borne by Reclamation we ask the affected parties (public and private) be contacted and they acknowledge their acceptance of financial and other risks in case of fire caused by KDRPP and KKC construction.

6. In numerous locations the statement is made that Kachess Reservoir will "...take 2 to 5 years following a drought year to refill" using the KKC gravity mechanism. Please provide information on the frequency with which drought refill will require 2, 3, 4, and 5 years to refill, and the evidence for such projections.(ES-xix and other locations)

7. According to the DEIS, "Bull trout will be adversely affected [in Keechelus tributaries] for approximately 115 days in 81 percent of years." Enhancement efforts in Keechelus Reservoir tributaries are described but in order for Environmental Species Act criteria to be met there must be no net loss of population. Please provide quantitative information to indicate, with certainty, that there will be no net loss of Bull Trout population in the Keechelus Reservoir based upon the enhancement efforts under consideration.(ES-xix)

8. "Food based prey in both reservoirs will be reduced in both reservoirs" but the extent of reduction is not quantified. Also, both reservoirs provide food for the threatened Osprey (Pandion haliaetus) protected by the Migratory Bird Treaty Act (federal) and Washington State Fish and Wildlife Department and this is not acknowledged in the DEIS. Please provide quantitative estimates of the reduction in food prey, including type of food (including fresh water mussels/clams in Little Kachess), with citation of evidence, and conduct an analysis of the effect of habitat degradation on the Osprey. (4-113 to 4-116)

9. DEIS acknowledges the drawdowns of Kachess Reservoir will have significant impacts due to changes in overall landscape character and desirability from a recreational perspective. (4-155, 4-256) For example the operation of KDRPP and KKC will likely "reduce the camping season at Lake Kachess Campgrounds by an average of 25 days." This will remove approximately one month...1/3rd of the camping season...for people who use Lake Kachess Campground. The DEIS cites Cle Elum Forest District that this is the most used Forest Service Campground in Kittitas County. Obviously this will have a large impact on citizens who are not residents of Kittitas

County. We ask that a full accounting of the loss of use of Lake Kachess Campground (LKC) by conducted and that numbers of peoples, days of recreation, types of recreation (fishing, water sports, camping, etc.) by tabulated. We further ask that this information be provided to the population who have used or will likely use LKC. We ask that this information be provided via public media, U.S;. Forest Service communications and other appropriate means, so these affected persons will have an opportunity to provide comment on the KDRPP and KKC projects.

10. Moreover the DEIS indicates water level is a factor that significantly and adversely affects property values. However despite the clear hazard to private citizens' property values, and the claim that some unidentified mitigation effort will occur if damage occurs, there is no estimate of damage or how it will be calculated. Please provide specific, quantitative analyses of adverse impacts on property values, the evidence for such analyses, the mitigation efforts that will be used, the terms and conditions (including time frame) of such mitigation efforts, and the responsible parties for mitigation.

11. Drawdown of Kachess Reservoir will expose areas with steep slopes and the DEIS indicates landslides may occur on slopes of 15% or less *(3-9)*. Slopes along Kachess Reservoir will be exposed at grades of 20 – 60% with unknown vulnerability to slides *(3-7)*. No information is provided on the extent, severity, specific locations, or outcomes of instability likely to occur in Kachess Reservoir. Please provide this information including the reference evidence for such estimates. DEIS indicates that slide likelihood is unknown, however that could also be said for the deadly slide that occurred this year in Oso, WA. It is unacceptable to drastically change the geologic environment to provoke possibly deadly instability and dismiss the outcomes as "unknown." Please provide more detailed information on slide risk due to KDRPP/KKC, both from historical data derived from similar geologic conditions, or from scientifically valid predictions.

12. The "cumulative effects of traffic will create a nuisance for people traveling on I-90." *(ES-xxix)* This corridor is the most heavily traveled mountain pass in the U.S. with annual traffic in the millions of vehicles. It is cavalier, at best, to label heavy construction caused by KDRPP/KKC projects as merely a "nuisance." Given the extremely heavy traffic and sometimes severe weather conditions, we ask for a comprehensive estimate of projected injuries, accidents, and other incidents attributable to the construction projects, and the evidence for such estimates. This will also affect Kachess Fire Department No. 8 which has primary responsibility for fire and rescue calls in the I-90 Corridor from Snoqualmie Pass to Easton, and shares coverage for dispatches East of Easton and West of Snoqualmie Pass. We ask that the added impact of aid and fire calls in the area be estimated and the financial and manpower burden on Dist. 8 be quantified, and that mitigation (including financial relief) be provided.

13. The DEIS accurately states the Kachess Reservoir aquifer will be depleted and private wells may be compromised or fail entirely (1-19). The only accommodation will be for "...Reclamation to develop appropriate mitigation strategies" if water levels and wells are adversely impacted. It is

hard to imagine any mitigation strategy that could be sufficient to ameliorate the loss of water for private residences and the DEIS does not provide any indication of what mitigations efforts would be considered or appropriate. It is essential that these mitigation efforts be identified in advance, the likelihood of their need to be implemented also identified in advance, and that these estimates be quantitative and based upon scientific evidence. We respectfully request this information immediately and further request that no action take place that would affect Kachess Reservoir aquifer until monitoring and mitigation strategies have been thoroughly identified and vetted.

14. The DEIS acknowledges Bull Trout passage between Box Canyon Creek and Kachess Reservoir will be impeded due to habitat destruction (reduction of water flow) with resultant decline in population. (ES xix) DEIS further quotes the Endangered Species Act as stating that federal agencies must "ensure that their actions do not jeopardize the continued existence of ESA-listed species, or destroy or adversely modify their critical habitat." It appears from the clear meaning of the words in DEIS, coupled with the ESA language, that the KDRPP/KKC projects are a violation of the Act. As documented by the DEIS, Bull Trout continued existence IS JEOPARDIZED by the KDRPP and KKC Projects and some unstated number of Bull Trout will not survive. It further appears that the DEIS is attempting a "sleight of hand" with regard to the Bull Trout Enhancement measures. In other words, while habitat and actual fish counts will be reduced in Kachess Reservoir, there will be an attempt to increase Bull Trout habitat in Gold Creek and other areas. However these areas do not connect in any way to the Bull Trout population in Kachess Reservoir and will do nothing to reduce their destruction or loss of habitat. There are vague statements about "mitigation efforts" and "studies" that will be conducted but this abstract promise fails to meet the language or intent of the ESA. Please indicate by what authority this "sleight of hand" (where a population of an endangered species in one location will be adversely affected while a population in another---noncontiguous---area is enhanced) can fulfill the obligations imposed on federal agencies by the ESA.

15. It is claimed Reclamation will "implement a public communication strategy to prepare recreation users for the significant impacts on recreation at Kachess Reservoir" (*ES-xxx*). With all due respect, the YRBWEP and KDRPP/KKC initiatives have been characterized by their LACK of communication efforts to citizens in the affected areas. Please provide any evidence that Reclamation is capable of a public communication strategy to the affected areas, any evidence of effective past efforts, and specific examples of methods and timing to prepare recreation areas for the significant impacts acknowledged in the DEIS.

16. Based upon the DEIS it appears the two projects, KDRPP and KKC, have never been authorized in federal statute. If that is not correct please indicate the federal authorization for the two projects. If it is correct, please indicate the minimum Benefit/Cost thresholds, and criteria, for these projects to receive federal authorization, and the evidentiary basis for such thresholds.

17. Additional steps in implementation include "Reclamation's Planning Report feasibility analysis, including benefit-cost analysis and other environmental analysis." *(1-12).* The Washington Water Research Center benefit-cost analysis of the Yakima Plan's individual water storage projects, required by the Washington State Legislature and prepared by a team of experts from the University of Washington and Washington State University, documents that KDRPP has a negative 0.46 (benefit/cost) and KKC has a negative 0.20 (benefit/cost) ratio. Please indicate the criteria that will be used to determine an acceptable vs. unacceptable benefit/cost outcome for KDRPP and KKC, and provide the basis for any criteria that could cause Reclamation to conclude the projects meet federal requirements for benefit-cost outcome.

18. We further contend (with regard to item #15 above) that the appropriate benefit/cost analysis has already been conducted and is the one required by the Washington State Legislature and prepared by a team of experts from the University of Washington and Washington State University. We ask that this study be entered into the record as a definitive analysis of Benefit/Cost analysis for YRBWEP and specifically for the KDRPP and KKC projects. If a separate analysis is conducted by Reclamation (as noted in 1-12) we ask that its authors consult with Dr. Yoder and the WSUWRC, and that Dr. Yoder and his group be allowed to review the study referred to in 1-12 and that all comments from WSUWRC be included fully and without editing in the final report.

19. Executive Order 12898: Environmental Justice states (DEIS *1-21*) that "no person or group of people shoulders a disproportionate share of negative environmental impacts resulting from the execution of environmental programs." This criteria is clearly violated by the KDRPP and KKC projects based as documented in the DEIS. Adverse impacts of these projects include water pollution, air pollution, noise pollution, traffic risk, wetlands damage, aquifer depletion, decline in property values, loss of recreation opportunities, possible shoreline instability, and many other "negative environmental impacts" resulting from KDRPP and KKC construction and operation. The DEIS fails to acknowledge (Section 4.22) these impacts and the fact they are disproportionately shouldered by approximately 500 citizens in close proximity to Kachess Reservoir. The KDRPP and KKC projects represent a transfer of private assets (wealth) from citizens of Kachess Reservoir who bear all of the negative impacts, to the citizens of Yakima Basin who receive all of the benefits and shoulder none of the negative impacts. We assert the DEIS fails on two counts, to acknowledge the disproportionate distribution of negative impacts and their explication, and to acknowledge this is a violation of Executive Order 128989: Environmental Justice. If this assertion is incorrect on either count we ask Reclamation to provide clarification and the basis for Reclamation's position.

20. Adding to the discussion about Executive Order 12898: Environmental Justice, while the negative impacts disproportionately fall on citizens in the area of Kachess Reservoir, almost none of the benefits accrue to that population. There is no fish passage proposed or planned for the reservoir and there is no irrigation in the area. Of the 200,000 ac. ft. of water that will be drained during drought years from Kachess Reservoir, only 14.7 % will even stay in Kittitas

County (Based on equal proration, which is the law, Kittitas Reclamation District would receive only 29,400 ac. ft. *[p. 3-19]* and none of that would irrigate land near Kachess Reservoir. We assert this reinforces our position that KDRPP and KKC represent a violation of Executive Order 12898, and ask that Reclamation state the basis for any disagreement with our assertion. The DEIS concludes that the absence of significant minority or low-income populations in the Kachess Reservoir vicinity means that Executive Order 12898 has not been violated (*4-329*). However Order 12898 speaks to "disproportionate impacts" on populations and does not restrict such impacts to low income or minority.

21. Page *4-331* indicates members of the Yakama Nation and other Tribes "would be expected to use Kachess Reservoir disproportionately" to other populations. As described in Section 4.6.2 impacts to fish in Kachess Reservoir are largely negative. Therefore, "implementation of [KDRPP and KKC] could decrease the potential for subsistence use of these resources and the impact could be substantial." This appears to be a clear statement of disproportionate impact on a minority population caused by a federal agency project, and therefore a violation of Executive Order 12898. Please explain how Reclamation can continue with a project that violates Executive Order 12898.

22. During construction the DEIS states "approximately 1,200 feet of Kachess Lake Road would be temporarily realigned around the Kachess Lake Road portal area" (*2-41*). However in reviewing the construction schedule it appears the definition of "temporary" is a minimum of three years. In view of the delays experienced by the Seattle tunnel project it is reasonable to expect the KKC tunnel (nearly 5 miles in length) may experience similar delays. A three year delay is hardly "temporary" to residents facing traffic congestion of 1 truck every 5 minutes (1 per minute at peak operation). In the likely event the project completion date is extended, a 5 year or greater horizon is quite possible. Please provide the rationale for considering a 3-5 year realignment as temporary, and refrain from using the term "temporary" when the clear intent is 3-5 years. In addition, please consult with affected emergency service agencies (EMS and Fire & Rescue) at Kachess Reservoir to confirm the DEIS finding that traffic problems will not be significant during construction. When information is available from affected local agencies please provide that information to all affected parties. The staging zone at Exit 62 is a particularly critical area to include in re-analysis, with traffic from the I-90 DOT Project, the quarry providing rock and other materials, two Sno-Parks, private residences, and a Landing Zone for EMS operations.

23. The frequency and amount of drawdown of Kachess Reservoir is unknown, only climate conditions in the future will provide the answer. Based upon recent history, however, prorationing occurred about once every 4 years in the last 20 years (*3-20*). In 5 of those years, prorationing fell below the 70% threshold and met the criteria for KCRPP to be activated. YRBWEP would allow a drawdown of 82.75 additional feet below the current lowest allowable level due to gravity flow over Kachess Dam spillway. The DEIS does not state the legal authority for establishing 82.75 feet as the maximum drawdown of Kachess Reservoir, which raises the question of whether drawdowns could occur below 82.75 ft. Is it possible that drawdown of

Kachess Reservoir could exceed 82.75 ft.? If so, under what conditions could that occur? If not, what authority (legal or otherwise) exists to assure that drawdown greater than 82.75 ft. will not occur? If drawdown greater than 82.75 ft. could occur, how much greater drawdown could occur and under what conditions? If drawdown greater than 82.75 ft. could occur what modifications of the current (and all other YRBWEP) DEIS's would be required?

24. The Table 3-39 "Characteristics of Properties Surrounding Kachess Reservoir" is inaccurate in its representation of the population affected by KDRPP and KKC. The DEIS apparently claims that only those individuals/parcels with 0.1 mile of Kachess Reservoir will be affected by changes in water level, recreation opportunities, property values, and other critical impacts. To be very clear, this statement is false. Three homeowners associations (HOA's) surround Kachess Reservoir (Lake Kachess Village HOA, Kachess Ridge HOA, and East Kachess HOA) plus individual residents located on private parcels throughout the area. We ask that a more realistic assessment of affected areas surrounding Kachess Reservoir be conducted, with a criteria of 5 miles distance to Kachess Reservoir shore. The shoreline is public access property available to anyone who travels Kachess Lake Road, Via Kachess, and/or East Lake Kachess shore road. A 0.1 mile criteria for definition of "affected persons/parcels" is unacceptable and cannot be defended by Reclamation. By the DEIS's own assertions, the area is a popular area for recreationist from the major population centers of Olympia, Seattle, and Everett. Lake Kachess Village HOA alone has 166 parcels (lots) and so the estimate of 197 "private parcels" for the total population shown in the table is significantly understated. We ask for an accurate survey and/or analysis that will correct the table to represent the true population affected by KDRPP and KKC.

25. The areas of Snoqualmie Pass, with communities of Hyak, Snoqualmie Pass, and Alpental are significantly affected by the drainage of water from Kachess Reservoir and Keechelus Reservoir. The population of persons/parcels in this area likely exceed 1,000 and have not been notified of environmental, economic, and other impacts resulting from KDRPP and KKC. We ask that these communities be included environmental impact assessment, with public notification and opportunity for involvement, before any Final EIS is issued.

26. As noted in DEIS (*4-286*) the Easton State Airport is approximately 3,000 ft. southeast of the proposed discharge facilities and is used by a variety of private and public aircraft. A critical use of the airport is for large tanker and other airborne firefighting equipment, which require longer takeoff and landing space. The DEIS indicates a power transmission line will be required and may be located with 3,000 feet from the airport and exceed 60 ft. in height. The DEIS intends to use FAA minimum standards (50-1 height/length ratio) for placing transmission lines. It is further indicated FAA will be notified <u>after</u> the transmission line is established. In a word, this is irrational. The critical use of heavy firefighting airborne craft requires more than minimum safety standards for runway and landing, and notification <u>after</u> putting the line in place is irresponsible. We request that the minimum height/length standard be revisited and revised to assure safer fire suppression efforts, and that FAA be engaged immediately in this matter.

27. Drawdown of Kachess Reservoir will *(4-348)* "cause significant impacts on recreation...reduce aesthetic quality of the reservoir...cause recreationists to seek similar opportunities [elsewhere...cause increased use and crowding in other areas...prevent use of boat launches, decrease fishing opportunities" and other adverse impacts. These all have negative economic impacts on property values in area residences and we ask that such impacts be quantified. Absence such an analysis, any representations that future mitigation efforts will be implemented ring hollow.

28. The Spotted Owl is an endangered species. The Spotted Owl is native to forested areas surrounding Kachess Reservoir. The Spotted Owl habitat is adversely affected by KDRPP and KKC construction and operation. Therefore KDRPP and KKC cannot be implemented without violating conditions of the Endangered Species Act. If Reclamation disagrees, please explain how the KDRPP and KKC Projects can comply with ESA with regard to the Spotted Owl.

29. Environmental Commitments (shown on page 4-353) purport to indicate how "mitigation" efforts will be conducted in case of environmental damage. For example, wells will be monitored and "appropriate mitigation strategies" put in place. In all cases the mitigation occurs after the damage takes place, and in all cases the mitigation is unspecified or too vague to evaluate. As one example, after Bull Trout passage is impeded in Little Kachess basin it is too late to mitigate the damage. The Bull Trout are either dead or prevented from spawning. Please identify those mitigation efforts that take place after the damage occurs, and in each prepare a detailed analysis of what mitigation will occur and what proportion of damage will be mitigated.

30. In the building of a pipeline between Lake Keechelus and Lake Kachess, there would be a significant requirement for the storage, staging and parking of the construction equipment needed to build the pipeline. All available DOT owned space is currently leased to the contractor engaged in the multi-year I90 expansion project and we challenge the assertion by Reclamation that Exit 62 DOT facility will be adequate for KDRPP and KKC staging purposes. Please state exactly that Exit 62 DOT and no other area will be used for staging purposes. If other staging areas will be used or are contemplated, indicate those areas in sufficient detail for third-party verification. The DEIS indicates spoils from the digging of the pipeline may be disposed of in the Stampede Pass Quarry but there is no commitment to do so. If spoils will be transported and disposed of in a different location, specify the location(s). We ask that the EIS study to allow for storage and disposal of materials be conducted before a Final EIS is issued for KDRPP and KKC. (see 2.7.2.5 p. 2-50).

31. We note that DEIS indicates acquisition of Right of Way of private property may be required for completion and operation of the Kachess Reservoir Portal. (2-41 to 2-51). We ask that any and all private properties that may be considered for acquisition be identified. We further ask that

these private owners be immediately notified of this possibility, the legal basis for acquisition, the reimbursement and/or mitigation to be available, and the timing of such events.

32. DEIS states (3-42) Keechelus Reservoir has high levels of chlorite pesticides, PCB's, Dioxins, and other pollutants that result in fish (according to a study in 2007) "exceeding the human health criteria for PCB's." It is obvious the KKC will spill this contaminated water into Kachess Reservoir and create higher levels of toxins to humans, fish and wildlife in and around Kachess Reservoir. Despite the clear hazard this represents, the DEIS does not acknowledge this risk nor does it quantify the risks. We ask that appropriate environmental toxicology studies be conducted to quantitatively estimate the increased levels of all toxicants being added to Kachess Reservoir, and by extension to Yakima River, by KKC. We acknowledge that Keechelus Reservoir is currently spilling pollutants into the Yakima River and exposing downstream people and wildlife to poisons. We reject any response from Reclamation that attempts to minimize the additional exposure as minimal or just "more of the same." Toxicologic science recognizes the principle of a "dose-response relationship" meaning there is a physiologic response to every dose (i.e., exposure) and must be measured property. Increased volume of the solvent vehicle (in this case 200,000 acre feet of water), possibly time of exposure, 100% bioavailability, possibly increased consumption, increased tissue levels in fish, and a host of other factors all contribute to increasing the dose of, and exposure to, toxicants attributable to KKC.

    We further ask that the increased levels in fish species of such toxicants be estimated in Kachess Reservoir and that the potential increased in incidence and prevalence of morbidity and mortality to human and other wildlife be assessed using state-of-the art scientific methods. We ask that this study be conducted by a reputable third-party selected by the University of Washington Environmental Law program. We ask that the results of this environmental toxicology analysis be fully communicated to all persons and populations facing additional exposure and we ask that no final EIS be issued until this critical risk to human and animal health can be determined.

33. DEIS indicates the staging area for KKC and KDRPP will be Exit 62 of I-90 currently under the management of Washington State Department of Transportation. DEIS claims space is available at Exit 62 to accommodate the construction activities, however it is our understanding this area is committed to private contractor(s) and other DOT uses at least until the completion of the I-90 widening project. In other words, Reclamation does not have assured use of this space. If this is true, the DEIS substantially misrepresents the construction logistics for KKC and KDRPP, and this means either additional and/or separate staging space will be necessary. We ask that legally enforceable documentation be provided that Exit 62 staging area is committed to KKC KDRPP. If this documentation cannot be provided, we ask that optional staging locations and logistics be provided, and an opportunity to comment on said locations, be provided before issuing a Final EIS.

Ms. Candace McKinley
Environmental Program Manager
Bureau of Reclamation
Columbia-Cascades Area Office
1917 Marsh Road
Yakima, WA 98901-2058

Via email to kkbt@usbr.gov and USPS certified

Please accept the attached comments on behalf of the Kachess Ridge Maintenance Association in response to the Draft Environmental Impact Statement (DEIS) for the proposed Kachess Drought Relief Pumping Plant (KDRPP) and Keechelus Reservoir-to-Kachess Reservoir Conveyance (KKC) Projects. The residents and landowners of the Kachess community are likely to suffer "significant impacts" which have "a reasonable likelihood of more than a moderate adverse impact on environmental quality." WAC 197-11-794(1). These probable significant adverse impacts are not adequately disclosed, quantified or analyzed and vague assurances of mitigation without any description or quantification or authority are insufficient to meet the most basic regulatory requirements.

The DEIS is required to consider direct effects including air, water, groundwater, noise pollution, wildlife and land as well as comprehensive socioeconomic effects on the human environment including the natural and physical environment and the relationship of people with that environment. William H Rodgers, Jr. *Environment Law*, 943, 944 (2d ed. 1994). The DEIS fails to consider significant direct and socioeconomic effects and therefore does not meet the threshold for sufficiency and must be rejected in its entirety. In the absence of wholesale rejection, the DEIS should be re-drafted with appropriate research and documentation and the public should then be allow a reasonable comment period. In addition to violation of the SEPA/NEPA requirements, failure to provide adequate analysis and data would constitute a violation of procedural due process.

The DEIS contains too many uncertainties and lacks sufficient analysis to be considered adequate. The DEIS does not comply with either the letter or spirit of the regulations. The DEIS purports to be "prepared in compliance with ... the State Environmental Policy Act (SEPA), Chapter 43.21C RCW." However, the statute explicitly states, "(t)he legislature... directs that, *to the fullest extent possible*... all branches of government of this state... shall: (a) Utilize a *systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences* and the environmental design arts in planning and in decision making which may have an impact on the environment;" 43.21C.030 RCW (emphasis added). The purpose of these requirements is to provide both the public and decision makers with sufficient information to evaluate impacts of the proposal. The DEIS is vague, misleading and fails to identify significant impacts or evaluate the effect of identified issues. It ignores existing known scientific data and fails to provide any scientific data to support conclusions that there are no significant impacts, but rather broadly asserts, without authority or data, there will be no significant impact to the environment. Therefore it fails to meet the minimum standard of sufficiency and should be rejected in its entirety. By failing to provide sufficient data the DEIS is effectively usurping the essential legal requirement that impacted parties are provided with notice and opportunity to be heard.

Section 3.5 broadly refers to the hydrological impacts of the alternatives. It states "hydraulic conductivity values indicate the glacial and alluvial sediments in the study area would likely yield significant quantities of water during dewatering or other groundwater control efforts for project construction" (3.5.4.1). Yet the DEIS fails to identify the impact of dewatering and hydraulic conductivity on the surrounding land. In addition to the negative impacts to wells, loss of hydrologic pressure is likely to result in soil instability and settling with expected harm to structures, underground utilities and significant increases in the likelihood of land slides. "Increased risk of slope stability on the reservoir rim. Long-term erosion not significant. " Table 2-17. There is no data to support this conclusion. Much of the area of construction and land surrounding Lake Kachess is glacial till. Loss of hydrological pressure, vibration propagation and increased slope exposure are all likely to contribute to slope instability and erosion. The DEIS fails to consider the effects of hydrological changes created by the tunneling project and associated water level reduction on the surrounding land post construction. The DEIS should be rejected in it's entirety as such information is essential for impacted parties to have an opportunity to provide input through comments and for decision makers to evaluate alternatives. Failure to address these reasonably foreseeable harms, which are neither remote nor speculative, violates the requirements of the DEIS and denies the impacted parties the opportunity to evaluate and comment. The purpose of the DEIS is to provide sufficient information to decision makers and impacted parties such that economical and reasoned decisions which minimize harm can be made. Failure to identify and disclose likely harms or failure to analyze and quantify them DEIS disenfranchises the impacted parties and undermines the purpose of a DRAFT environmental impact statement and the subsequent comment period. Failure to identify and analyze significant foreseeable harms should invalidate the DEIS. At a minimum, it should be redrafted with analysis of all significant impacts with associated credible analysis.

The DEIS fails to consider the cumulative effects of the project which is an identified part of the broader Yakima River Basin Water Enhancement Project Integrated Plan (the "IP"). SEPA requires "closely related" actions to be disclosed and analyzed for their cumulative impact in a single EIS. WAC 197-11-060(3). The KKC and KDRPP projects are interdependent parts of the larger IP proposal and therefore the cumulative effects must be analyzed in a single document. Gebbers v. Okanagan PUD. 144 Wn.App 371 (Wash.App. Div 3 2008). The DEIS should be rejected for failure to consider cumulative effects and should be redrafted incorporating cumulative effects and allowing for public comment on those disclosed and analyzed effects.

The DEIS repeatedly refers to Lake Kachess as a reservoir. This is a patently false statement which demonstrates the misleading manner in which the DEIS has been drafted and the shocking lack of analysis. Lake Kachess is a natural alpine lake that has existed for thousands of years. The name "Kachess," meaning "many fish," was given to it by Native Americans long before Europeans ever reached the continent. Furthermore, it has been a popular recreation destination for well over 125 years (please see attached photo archives circa 1890 of vacation destination brochures for Lake Kachess which list recreational activities and have images of enthusiasts boating, hunting and fishing at the lake). Lake Kachess has remained a very popular destination. Reserve America, which provides recreation area reviews and reservations describes the area as follows, "Kachess Campground is considered one of the most beautiful sites in the Cle Elum Ranger District." The US Forest Service describes the Kachess Lake Campground as follows:

> Set in dense old-growth evergreens and surrounded by high mountains, Kachess Campground has over 100 campsites and one group campsite (by reservation only). It is an excellent location for family camping. There are two boat launches and a picnic area. These water accesses accommodate cartoppers and trailer boats and there is parking for vehicles & trailers. The south boat launch is paved; and the north boat launch is maintained gravel. On busy summer weekends, the boat launch and day use parking areas fill up fast.

It is simply a false statement to claim that constructing a dam to raise the water level changed history and converted the entire body of water into an irrigation reservoir. Construction of Kachess dam did not begin until 1910 according to the Bureau of Reclamation. The construction of the dam only raised the lake 65 vertical feet above its natural level, increasing the overall depth from 400' to 465'. This is only a 15% increase in depth and does not change the essential nature of the entire body of water that pre-existed as a natural alpine lake. Lake Kachess has a long history of use for recreation and species habitat. Simply adding 15% more to the lake does not change the entire body of water into a reservoir primarily for the purpose of providing water to junior water rights irrigators. The DEIS would lower the lake 82.75 vertical feet below its natural level and below the level authorized upon construction of the dam (hence the need to add a pumping station in the middle of the lake because the BOTTOM of the dam is 82' above the proposed new low water mark). In addition to destroying the essential nature of the natural alpine lake and associated habitat, the soil that would be exposed upon lowering the water level 82 vertical feet below the natural lake level has likely been under water since the ice age. It is misleading and non-compliant with SEPA regulations to simply semantically change the name from "lake" to "reservoir," thus ignoring history and facts, in order to advance the initiative. It is also irresponsible to simply assert there will be "no significant harm" without investigation and analysis.

Misrepresentations in the DEIS create deceptions about key premises of the DEIS, specifically that Lake Kachess is nothing but a reservoir and the proposal simply plans to access reservoir water that has always been stored for irrigators, but which was not being utilized. The DEIS is biased and misrepresentative. The DEIS should be rejected in its entirety as the biased and misrepresentative drafting undermines any ability to reach confidence in the analysis. At a minimum, it should be redrafted and resubmitted without misrepresentations, in compliance with NEPA and SEPA regulations and with sufficient analysis, data and authority such that interested parties and decision makers will have the opportunity to evaluate the alternatives and provide feedback in the DEIS comment period.

Proposed plan will result in the permanent lowering of the surface water elevation of Lake Kachess to an elevation at 80-82 feet below the current outlet level (2,192.75 ft, mean sea level) and will upset the ecological equilibrium of the lake in-place for over a century following the construction of the Kachess Dam in 1912. The reduction in the surface water level elevation will likely eliminate the existing Bull Trout population (a Federally Endangered Species), principally as a result of increased turbidity from wave action on newly emergent shorelines, increases in water temperature due to an overall decrease in lake depth and the loss of spawning tributary areas.

As a part of the Yakima Plan, the K-K Tunnel Project is an attempt to mitigate the impact of the Kachess Pumping Plant Project through a transfer of surface water from Lake Keechelus into Lake Kachess as a means of augmenting the average annual natural inflow into Lake Kachess. This attempt may be insufficient to offset an average refill ratio (the ratio of average annual natural flow into the reservoir to reservoir capacity) for Lake Kachess of 0.9:1, which is the lowest refill ratio of the five main storage reservoirs of the Yakima Basin (USBR, *Progress Report: Limnological Surveys of Fives Reservoirs in the Upper Yakima River Basin, Washington*, 1998 [Draft]). A ratio of less than 1:1 indicates that a reservoir will not fill even in an average year if it starts the year empty; in contrast, the remaining four reservoirs have average refill ratios ranging from 1.5:1 to 5.9:1 (USBR, 1998).The reduction of the water level in Lake Kachess to an elevation of approximately 2110 ft above mean sea level could result in the division of the existing Lake Kachess (approximately 9.1 miles in length) into two separate surface water bodies in the vicinity of the Lake Kachess Narrows. Potentially a narrower northern lake (approximately 3.5 miles in length) might be connected by a small channel to wider southern lake (approximately 5.6 miles in length). Such a scenario would result in decreased recreational opportunities when compared to the existing configuration of Lake Kachess. The DEIS should be rejected for failure to consider these effects or should be redrafted, analyzing and incorporating the effects and allowing for public comment on those disclosed and analyzed impacts.

The KDRPP and KKC Projects pose serious threats to the economic and environmental status of the Okanogan-Wenatchee National Forest and to the several communities in the watershed of Keechelus Reservoir and Kachess Reservoir. In addition to the overlooked or misrepresented impacts in the DEIS, there are numerous adverse environmental impacts which are documented in the DEIS, but discarded as insignificant. They include habitat destruction of bull trout and Northern Spotted Owl, negative impacts on private property values, reduction in aquifer in Northern Kittitas County with the possibility of well failures, shoreline destruction, increased hazard from wildfires, reduction in recreational opportunities, increased mortality of fish and game, destruction of scenic vistas, risk to wildlife and people attributable to construction activities, damage to commercial activities and deterioration of emergency medical, fire and other public services.

The previously stated negative impacts are acknowledged in the DEIS, however in most cases the Bureau simply states negative impacts "will be monitored and mitigated." The substantial negative impacts on private and public property are inadequately described and never quantified. This does not meet the letter or spirit of a valid Environmental Impact Statement. Many of these impacts simply cannot be addressed after the fact. When a well has gone dry, when bull trout have been unable to spawn or have died due to low water levels, when property values have declined, and in a multitude of similar negative impacts it is either impossible or too late to "mitigate" the negative impact. Indeed the DEIS fails to provide substantive and clear information about what monitoring will occur, or what mitigation strategies would even be considered, and in all those instances the DEIS must be rejected as nonresponsive.

Section 3.5.2.1 acknowledges the many wells within 2 miles of Lake Kachess, however, it fails to recognize that many of these wells have senior water rights that pre-date the 1905 date of the junior water rights holders who will be the beneficiaries of this water transfer. The report identifies that the aquifer will be depleted and private wells may be compromised or destroyed as well as decreasing or eliminating water supply to streams, springs and ponds. Yet despite these identifiable and potentially devastating impacts to property and the environment, the DEIS simply asserts "Reclamation (will) develop appropriate mitigation strategies." These impacts cannot simply be mitigated after the fact. An entire community as well as a large area of land, which includes portions of the Alpine Lakes Wilderness, will likely lose significant portions of groundwater with no estimate for how much will be lost, where it will be lost or how it could possibly be mitigated after the fact. We assert that the DEIS is insufficient on its face to meet the basic criteria of reasonably assessing impacts to the various environments. We further request that no action be taken until a reasonable assessment has been performed based upon scientific analysis and a mitigation plan has been proposed which has a reasonable likelihood of effectiveness such that affected parties can review the proposals and provide the feedback which the Draft Environmental Impact Statement process is designed to allow. The DEIS in its current form is simply too vague to allow for the opportunity for the public to provide comments and should be rejected or redrafted with appropriate analysis and an opportunity for public comment.

The DEIS fails to consider the impact on human safety and environment associated with the implementation of the proposal. The plan fails to recognize the dramatic increase in risk associated with fire safety. The streams, creeks, ponds and wells, which have been used for fire suppression will no longer be available. Furthermore, the lake level will be drawn down to a point which will not allow withdrawal for fire suppression. This threatens lives, property wildlife, habitat and national forests. Vague representations of mitigation of such serious and readily identifiable consequences, without data and analysis, is insufficient to meet the requirements of SEPA and NEPA. The DEIS should be rejected in its entirety or redrafted with appropriate analysis and opportunity for public comment.

The DEIS cites cost estimates for KDRPP that are more than twice the previous estimates used in Four Accounts Analysis and/or the Water Research Center ("WRC") Benefit-Cost analysis (e.g. table 4-8 in the DEIS, and see table 7 in the WRC report). Table 4-91 for Alternative 2B shows $350m. Needless to say this has implications for the B/C ratios. This effect of this increase in proposed cost is to roughly cut in half the already abysmal benefit to cost ratios as previously analyzed. It would result in the B/C ratio for intermediate climate and market outcomes at around 0.25 (in other words losing 75 cents of every dollar invested). This is further amplified by the fact that the financial damage to all properties within the vicinity of Kachess (and likely Keechelus) should be included in the financial analysis for in economic impact assessment. It should be noted that the DEIS identifies that the groundwater impact is being considered within a two mile radius of Kachess, but damage to properties are not included in the analysis. Worse yet, the DEIS states on page 4-300: "(r)eclamation evaluated potential effects to property values because numerous factors combine to affect property values, and it is difficult to quantify the potential impact. As such, potential impacts on property values are discussed generally, and an impact indicator was not established." Thus the DEIS acknowledges property values will be negatively harmed and yet fails to perform any quantitative analysis because it's "difficult." This is an absurd statement and flies in the face of the intent of a DEIS. The quantitative analysis is actually not that difficult and most financial consulting firms perform this analysis on a regular basis. It is no different than the analysis that goes in to any proposed development. Regardless of the difficulty, it is unquestionably a significant impact which requires analysis. Failure to include ANY analysis (despite identifying it as a significant factor) is clearly not in compliance with SEPA and NEPA requirements. Simply presenting analysis in the Final EIS would also not be sufficient as it would serve to prevent the impacted parties from evaluating the analysis and having an opportunity for public comment. Therefore the DEIS MUST be rejected and redrafted with this analysis performed and an appropriate opportunity for impacted parties to review the analysis and provide input.

The DEIS makes false and misrepresentative statements about the contents and methods of the WRC Benefit-Cost analysis. The DEIS states at 4-302: "This agriculture model allowed identification of the agricultural activity that could occur with increased water supply reliability relative to the baseline." The DEIS fails to explain the model and the drought frequency distribution that was used. This is essential because higher drought frequency would in principle lead to (1) higher positive agricultural impacts and (2) higher negative property value impacts. It also depends on climate and whether (and in this case when) the other storage projects and proposed instream flow changes are implemented. Additionally, the technical economic reports cited on page 4-302 are not in the reference list and not otherwise available. Property impacts must be assessed based on the full range of climate outcomes that are used for assessing other impacts (such as agricultural impacts). It is misrepresentative to cite the benefits but not the associated costs.

Furthermore, economic impact assessment is not equivalent to a B-C analysis, and does not provide any measure of the economic efficacy or economic tradeoffs of K project implementation. The source of the funds becomes essential as in a world with limited resources (such as our state budget). Dollars spent on this project are NOT available for uses in other places within the state budget. Therefore, it is a zero sum game analysis in which relative B-C analysis must be weighed against priority of funding. In this case, the proposal loses at least 75% of all money spent. A proposal that loses a little more on a percentage basis might actually be preferred depending on the priority of the initiative (such as education or emergency firefighting).

The DEIS claims the WRC benefit-cost analysis reviews each project "in isolation." This is a misrepresentation of the analysis which considers the impacts of implementing a project (or not) *conditional* on the implementation status of the other projects to the extent that our data allow. In other words, the WRC report recognizes the physical and economic interdependencies and accounts for them whenever our data and models allow. This is evident throughout the report and misrepresentative of the facts to claim otherwise. The DEIS claims the WRC reports "assume that markets can do too much." This is clearly a misrepresentation as the report estimates the full range of possible market outcomes, from a very restrictive assumption of proportional curtailment (which is the "irrigators are dumb" scenario) to a full trade scenario. We do not "assume" any one of them and analyzes them across the entire spectrum of effectiveness. Further, the report goes to great lengths to explain the costs and frictions that can limit market development. The DEIS further claims the WRC B-C analysis "assume(s) a benign future climate." This is patently false. The report provides results for four different climate scenarios. We chose to focus on one as a primary example because it provided baseline curtailment results most similar to those used in the Four Acounts analysis. The DEIS is biased in what little analysis it has conducted. It attempts to discredit independent scientific and economic analysis by making false and misleading statements about the contents of the report. This should be ample evidence to discard the DEIS in its entirety and require an unbiased and thorough analysis which considers information and input which may not be to the liking of the proponents of the plan.

The questions raised in the DEIS comments are reasonably foreseeable and supporting data should have been provided in the DEIS in order to allow for evaluation and comment on that data. "(A)n environmental impact statement should not be an ex post facto justification of official action" WAC 197-11-070. Failure to comply with these requirements in the preparation, content and use is unlawful. Richard L. Settle, The Washington State Environmental Policy Act: A Legal and Policy Analysis § 14.01(4^{th} ed. 1993). An EIS must identify environemental impacts, reasonable alternatives and mitigation measures, which must be sufficiently disclosed, discussed and substantiated by opinion and data. E.g. *Barrie v. Kitsap Cy.* 93 Wash. 2d 843, 854, 613 P. 2d 1148 (1980). Therefore, the DEIS fails to comply with the legislative mandate of providing "integrated us of natural and social sciences" "to the fullest extent possible" (43.21C.030 RCW).

The DEIS fails to adequately disclose, discuss and substantiate the probable and significant adverse impacts to identified parties. The DEIS fails to adequately describe and quantify negative impacts of KDRPP and KKC proposals. It misrepresents and undervalues the true economic and environmental risks. It overvalues benefits to a select group of individuals. It fails to consider reasonable alternatives and fails to evaluate why previously identified and less expensive/harmful alternatives (such as conservation) have not been considered or implemented. It fails to meet the minimum criteria of a valid Environmental Impact Statement as set forth in both the State Environmental Protection Act (SEPA) and the National Environmental Protection Act (NEPA). The DEIS must therefore be rejected in its current form, it must be substantially revised, and it must be resubmitted as a DEIS and with an appropriate comment period.

In addition to all other factors, we believe that the both current proposals are unconstitutional state action resulting in the taking of private property for private use and without compensation. This factor alone should be sufficient to reject the DEIS in its entirety without need of redrafting with additional analysis as the stated objectives of the plan cannot be met without an unconstitutional taking.

A more detailed analysis and comment has been prepared by the organization "Friends of Lake Kachess" citing specific examples of the above-stated concerns. I support in entirety the comments submitted by that organization (see attached). I ask that you acknowledge receipt of these comments at the earliest opportunity.

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Grant Learned, Jr.
On behalf of Kachess Ridge Maintenance Association
PO Box 642
Easton, WA 98925

Comments on Draft Environmental Impact Statement (DEIS) For Yakima River Basin Water Enhancement Project (YRBWEP)

Prepared by "Friends of Lake Kachess"

1. The following statement is repeated at various points: "Reclamation would use the pumping plant during drought years and could possibly use it in following years..." [emphasis added]. *(ES-viii)* It appears this statement is at variance with the authorized purpose of the KDRPP/KKC projects, which is to initiate pumping only when portable water supplies fall below 70%. What authority exists for using the pumping plant outside the 70% criteria, and please cite the statutory and/or regulatory authority for such an action. If such action is contemplated, what is the maximum frequency and amount of such pumping?

2. One purported goal of the KDRPP/KKC projects is to allow Reclamation to "reduce flows in the upper Yakima River, thereby improving rearing habitat for steelhead and spring Chinook." *(ES-xii)* However the DEIS does not provide any data on mortality or survivability of current runs (if any exist) or projected mortality/survivability of future runs. Please provide quantitative estimates of mortality and survivability gains in fish passage and cite the references for such estimates.

3. Kittitas County Fire District #8 (KCFD8) is responsible for providing emergency medical and fire service within the proposed boundaries of the proposed KDRPP/KKC project area. There will be significant vehicle, heavy equipment, and trucking equipment used on the project, by personnel. There is also the possibility of round the clock working hours for the project during non-winter months. This will require significant staffing and the possible purchase of specialized equipment rescue equipment, by KCFD8, to be able to respond in an appropriate and timely manner to life threatening emergencies. There are no provisions in the DEIS for funding this ramped up effort or mitigating these essential services during the build-out period. What funding or mitigation options are available to assure continued and unimpeded emergency services for the Kachess Reservoir community? What assurance can Reclamation give that these options will be available? What are the levels of effectiveness of any mitigation efforts?

4. The DEIS acknowledges "major construction impacts including dust, vehicle emissions, noise, and traffic." Truck traffic along Kachess Lake Road may be as high as 1 truck per minute (59 per hour) at peak levels and average 1 truck per 5 minutes.(ES xviii; Table 4-75) The claim is this will not significantly impact local traffic, emergency responders, recreationists and others, however this appears to be an overly optimistic speculation. We request that you confirm these conclusions by consulting with Kachess Fire Department No. 8, with DOT, and other affected parties. We further ask that you report the results of such consultations and cite any evidence for any conclusion(s) by Reclamation that are counter to the conclusions of Kachess Fire Department No. 8 and/or DOT.

5. Wildland fire risk is a significant hazard in the KDRPP and KKC areas, evidenced by recent Kittitas County fires: South Cle Elum Ridge Fire, Taylor Bridge Fire, Table Mountain Fire, and others. These fires are frequently caused by sparks, construction work (e.g., welding), brake and bearing fires, and other causes related to vehicular traffic, especially heavy vehicles, and construction apparatus. (4-281) Given the large increase in traffic on Lake Kachess Road we ask for a thorough assessment of the additional risks of wildland fire imposed by construction work for KDRPP and KKC, the costs associated with suppressing or managing typical fires in the area, and the responsibility for mitigation (including financial reimbursement to private interests). If these costs are not to be borne by Reclamation we ask the affected parties (public and private) be contacted and they acknowledge their acceptance of financial and other risks in case of fire caused by KDRPP and KKC construction.

6. In numerous locations the statement is made that Kachess Reservoir will "...take 2 to 5 years following a drought year to refill" using the KKC gravity mechanism. Please provide information on the frequency with which drought refill will require 2, 3, 4, and 5 years to refill, and the evidence for such projections.(ES-xix and other locations)

7. According to the DEIS, "Bull trout will be adversely affected [in Keechelus tributaries] for approximately 115 days in 81 percent of years." Enhancement efforts in Keechelus Reservoir tributaries are described but in order for Environmental Species Act criteria to be met there must be no net loss of population. Please provide quantitative information to indicate, with certainty, that there will be no net loss of Bull Trout population in the Keechelus Reservoir based upon the enhancement efforts under consideration.(ES-xix)

8. "Food based prey in both reservoirs will be reduced in both reservoirs" but the extent of reduction is not quantified. Also, both reservoirs provide food for the threatened Osprey (Pandion haliaetus) protected by the Migratory Bird Treaty Act (federal) and Washington State Fish and Wildlife Department and this is not acknowledged in the DEIS. Please provide quantitative estimates of the reduction in food prey, including type of food (including fresh water mussels/clams in Little Kachess), with citation of evidence, and conduct an analysis of the effect of habitat degradation on the Osprey. (4-113 to 4-116)

9. DEIS acknowledges the drawdowns of Kachess Reservoir will have significant impacts due to changes in overall landscape character and desirability from a recreational perspective. (4-155, 4-256) For example the operation of KDRPP and KKC will likely "reduce the camping season at Lake Kachess Campgrounds by an average of 25 days." This will remove approximately one month...1/3rd of the camping season...for people who use Lake Kachess Campground. The DEIS cites Cle Elum Forest District that this is the most used Forest Service Campground in Kittitas County. Obviously this will have a large impact on citizens who are not residents of Kittitas County. We ask that a full accounting of the loss of use of Lake Kachess Campground (LKC) by conducted and that numbers of peoples, days of

recreation, types of recreation (fishing, water sports, camping, etc.) by tabulated. We further ask that this information be provided to the population who have used or will likely use LKC. We ask that this information be provided via public media, U.S;. Forest Service communications and other appropriate means, so these affected persons will have an opportunity to provide comment on the KDRPP and KKC projects.

10. Moreover the DEIS indicates water level is a factor that significantly and adversely affects property values. However despite the clear hazard to private citizens' property values, and the claim that some unidentified mitigation effort will occur if damage occurs, there is no estimate of damage or how it will be calculated. Please provide specific, quantitative analyses of adverse impacts on property values, the evidence for such analyses, the mitigation efforts that will be used, the terms and conditions (including time frame) of such mitigation efforts, and the responsible parties for mitigation.

11. Drawdown of Kachess Reservoir will expose areas with steep slopes and the DEIS indicates landslides may occur on slopes of 15% or less *(3-9)*. Slopes along Kachess Reservoir will be exposed at grades of 20 – 60% with unknown vulnerability to slides *(3-7)*. No information is provided on the extent, severity, specific locations, or outcomes of instability likely to occur in Kachess Reservoir. Please provide this information including the reference evidence for such estimates. DEIS indicates that slide likelihood is unknown, however that could also be said for the deadly slide that occurred this year in Oso, WA. It is unacceptable to drastically change the geologic environment to provoke possibly deadly instability and dismiss the outcomes as "unknown." Please provide more detailed information on slide risk due to KDRPP/KKC, both from historical data derived from similar geologic conditions, or from scientifically valid predictions.

12. The "cumulative effects of traffic will create a nuisance for people traveling on I-90." *(ES-xxix)* This corridor is the most heavily traveled mountain pass in the U.S. with annual traffic in the millions of vehicles. It is cavalier, at best, to label heavy construction caused by KDRPP/KKC projects as merely a "nuisance." Given the extremely heavy traffic and sometimes severe weather conditions, we ask for a comprehensive estimate of projected injuries, accidents, and other incidents attributable to the construction projects, and the evidence for such estimates. This will also affect Kachess Fire Department No. 8 which has primary responsibility for fire and rescue calls in the I-90 Corridor from Snoqualmie Pass to Easton, and shares coverage for dispatches East of Easton and West of Snoqualmie Pass. We ask that the added impact of aid and fire calls in the area be estimated and the financial and manpower burden on Dist. 8 be quantified, and that mitigation (including financial relief) be provided.

13. The DEIS accurately states the Kachess Reservoir aquifer will be depleted and private wells may be compromised or fail entirely (1-19). The only accommodation will be for "...Reclamation to develop appropriate mitigation strategies" if water levels and wells are adversely impacted. It is hard to imagine any mitigation strategy that could be sufficient to

ameliorate the loss of water for private residences and the DEIS does not provide any indication of what mitigations efforts would be considered or appropriate. It is essential that these mitigation efforts be identified in advance, the likelihood of their need to be implemented also identified in advance, and that these estimates be quantitative and based upon scientific evidence. We respectfully request this information immediately and further request that no action take place that would affect Kachess Reservoir aquifer until monitoring and mitigation strategies have been thoroughly identified and vetted.

14. The DEIS acknowledges Bull Trout passage between Box Canyon Creek and Kachess Reservoir will be impeded due to habitat destruction (reduction of water flow) with resultant decline in population. (ES xix) DEIS further quotes the Endangered Species Act as stating that federal agencies must "ensure that their actions do not jeopardize the continued existence of ESA-listed species, or destroy or adversely modify their critical habitat." It appears from the clear meaning of the words in DEIS, coupled with the ESA language, that the KDRPP/KKC projects are a violation of the Act. As documented by the DEIS, Bull Trout continued existence IS JEOPARDIZED by the KDRPP and KKC Projects and some unstated number of Bull Trout will not survive. It further appears that the DEIS is attempting a "sleight of hand" with regard to the Bull Trout Enhancement measures. In other words, while habitat and actual fish counts will be reduced in Kachess Reservoir, there will be an attempt to increase Bull Trout habitat in Gold Creek and other areas. However these areas do not connect in any way to the Bull Trout population in Kachess Reservoir and will do nothing to reduce their destruction or loss of habitat. There are vague statements about "mitigation efforts" and "studies" that will be conducted but this abstract promise fails to meet the language or intent of the ESA. Please indicate by what authority this "sleight of hand" (where a population of an endangered species in one location will be adversely affected while a population in another---noncontiguous---area is enhanced) can fulfill the obligations imposed on federal agencies by the ESA.

15. It is claimed Reclamation will "implement a public communication strategy to prepare recreation users for the significant impacts on recreation at Kachess Reservoir" (*ES-xxx).* With all due respect, the YRBWEP and KDRPP/KKC initiatives have been characterized by their LACK of communication efforts to citizens in the affected areas. Please provide any evidence that Reclamation is capable of a public communication strategy to the affected areas, any evidence of effective past efforts, and specific examples of methods and timing to prepare recreation areas for the significant impacts acknowledged in the DEIS.

16. Based upon the DEIS it appears the two projects, KDRPP and KKC, have never been authorized in federal statute. If that is not correct please indicate the federal authorization for the two projects. If it is correct, please indicate the minimum Benefit/Cost thresholds, and criteria, for these projects to receive federal authorization, and the evidentiary basis for such thresholds.

17. Additional steps in implementation include "Reclamation's Planning Report feasibility analysis, including benefit-cost analysis and other environmental analysis." *(1-12).* The Washington Water Research Center benefit-cost analysis of the Yakima Plan's individual water storage projects, required by the Washington State Legislature and prepared by a team of experts from the University of Washington and Washington State University, documents that KDRPP has a negative 0.46 (benefit/cost) and KKC has a negative 0.20 (benefit/cost) ratio. Please indicate the criteria that will be used to determine an acceptable vs. unacceptable benefit/cost outcome for KDRPP and KKC, and provide the basis for any criteria that could cause Reclamation to conclude the projects meet federal requirements for benefit-cost outcome.

18. We further contend (with regard to item #15 above) that the appropriate benefit/cost analysis has already been conducted and is the one required by the Washington State Legislature and prepared by a team of experts from the University of Washington and Washington State University. We ask that this study be entered into the record as a definitive analysis of Benefit/Cost analysis for YRBWEP and specifically for the KDRPP and KKC projects. If a separate analysis is conducted by Reclamation (as noted in 1-12) we ask that its authors consult with Dr. Yoder and the WSUWRC, and that Dr. Yoder and his group be allowed to review the study referred to in 1-12 and that all comments from WSUWRC be included fully and without editing in the final report.

19. Executive Order 12898: Environmental Justice states (DEIS *1-21*) that "no person or group of people shoulders a disproportionate share of negative environmental impacts resulting from the execution of environmental programs." This criteria is clearly violated by the KDRPP and KKC projects based as documented in the DEIS. Adverse impacts of these projects include water pollution, air pollution, noise pollution, traffic risk, wetlands damage, aquifer depletion, decline in property values, loss of recreation opportunities, possible shoreline instability, and many other "negative environmental impacts" resulting from KDRPP and KKC construction and operation. The DEIS fails to acknowledge (Section 4.22) these impacts and the fact they are disproportionately shouldered by approximately 500 citizens in close proximity to Kachess Reservoir. The KDRPP and KKC projects represent a transfer of private assets (wealth) from citizens of Kachess Reservoir who bear all of the negative impacts, to the citizens of Yakima Basin who receive all of the benefits and shoulder none of the negative impacts. We assert the DEIS fails on two counts, to acknowledge the disproportionate distribution of negative impacts and their explication, and to acknowledge this is a violation of Executive Order 128989: Environmental Justice. If this assertion is incorrect on either count we ask Reclamation to provide clarification and the basis for Reclamation's position.

20. Adding to the discussion about Executive Order 12898: Environmental Justice, while the negative impacts disproportionately fall on citizens in the area of Kachess Reservoir, almost none of the benefits accrue to that population. There is no fish passage proposed or planned for the reservoir and there is no irrigation in the area. Of the 200,000 ac. ft. of

water that will be drained during drought years from Kachess Reservoir, only 14.7 % will even stay in Kittitas County (Based on equal proration, which is the law, Kittitas Reclamation District would receive only 29,400 ac. ft. *[p. 3-19]* and none of that would irrigate land near Kachess Reservoir. We assert this reinforces our position that KDRPP and KKC represent a violation of Executive Order 12898, and ask that Reclamation state the basis for any disagreement with our assertion. The DEIS concludes that the absence of significant minority or low-income populations in the Kachess Reservoir vicinity means that Executive Order 12898 has not been violated (*4-329*). However Order 12898 speaks to "disproportionate impacts" on populations and does not restrict such impacts to low income or minority.

21. Page *4-331* indicates members of the Yakama Nation and other Tribes "would be expected to use Kachess Reservoir disproportionately" to other populations. As described in Section 4.6.2 impacts to fish in Kachess Reservoir are largely negative. Therefore, "implementation of [KDRPP and KKC] could decrease the potential for subsistence use of these resources and the impact could be substantial." This appears to be a clear statement of disproportionate impact on a minority population caused by a federal agency project, and therefore a violation of Executive Order 12898. Please explain how Reclamation can continue with a project that violates Executive Order 12898.

22. During construction the DEIS states "approximately 1,200 feet of Kachess Lake Road would be temporarily realigned around the Kachess Lake Road portal area" (*2-41*). However in reviewing the construction schedule it appears the definition of "temporary" is a minimum of three years. In view of the delays experienced by the Seattle tunnel project it is reasonable to expect the KKC tunnel (nearly 5 miles in length) may experience similar delays. A three year delay is hardly "temporary" to residents facing traffic congestion of 1 truck every 5 minutes (1 per minute at peak operation). In the likely event the project completion date is extended, a 5 year or greater horizon is quite possible. Please provide the rationale for considering a 3-5 year realignment as temporary, and refrain from using the term "temporary" when the clear intent is 3-5 years. In addition, please consult with affected emergency service agencies (EMS and Fire & Rescue) at Kachess Reservoir to confirm the DEIS finding that traffic problems will not be significant during construction. When information is available from affected local agencies please provide that information to all affected parties. The staging zone at Exit 62 is a particularly critical area to include in re-analysis, with traffic from the I-90 DOT Project, the quarry providing rock and other materials, two Sno-Parks, private residences, and a Landing Zone for EMS operations.

23. The frequency and amount of drawdown of Kachess Reservoir is unknown, only climate conditions in the future will provide the answer. Based upon recent history, however, prorationing occurred about once every 4 years in the last 20 years (*3-20*). In 5 of those years, prorationing fell below the 70% threshold and met the criteria for KCRPP to be activated. YRBWEP would allow a drawdown of 82.75 additional feet below the current lowest allowable level due to gravity flow over Kachess Dam spillway. The DEIS does not

state the legal authority for establishing 82.75 feet as the maximum drawdown of Kachess Reservoir, which raises the question of whether drawdowns could occur below 82.75 ft. Is it possible that drawdown of Kachess Reservoir could exceed 82.75 ft.? If so, under what conditions could that occur? If not, what authority (legal or otherwise) exists to assure that drawdown greater than 82.75 ft. will not occur? If drawdown greater than 82.75 ft. could occur, how much greater drawdown could occur and under what conditions? If drawdown greater than 82.75 ft. could occur what modifications of the current (and all other YRBWEP) DEIS's would be required?

24. The Table 3-39 "Characteristics of Properties Surrounding Kachess Reservoir" is inaccurate in its representation of the population affected by KDRPP and KKC. The DEIS apparently claims that only those individuals/parcels with 0.1 mile of Kachess Reservoir will be affected by changes in water level, recreation opportunities, property values, and other critical impacts. To be very clear, this statement is false. Three homeowners associations (HOA's) surround Kachess Reservoir (Lake Kachess Village HOA, Kachess Ridge HOA, and East Kachess HOA) plus individual residents located on private parcels throughout the area. We ask that a more realistic assessment of affected areas surrounding Kachess Reservoir be conducted, with a criteria of 5 miles distance to Kachess Reservoir shore. The shoreline is public access property available to anyone who travels Kachess Lake Road, Via Kachess, and/or East Lake Kachess shore road. A 0.1 mile criteria for definition of "affected persons/parcels" is unacceptable and cannot be defended by Reclamation. By the DEIS's own assertions, the area is a popular area for recreationist from the major population centers of Olympia, Seattle, and Everett. Lake Kachess Village HOA alone has 166 parcels (lots) and so the estimate of 197 "private parcels" for the total population shown in the table is significantly understated. We ask for an accurate survey and/or analysis that will correct the table to represent the true population affected by KDRPP and KKC.

25. The areas of Snoqualmie Pass, with communities of Hyak, Snoqualmie Pass, and Alpental are significantly affected by the drainage of water from Kachess Reservoir and Keechelus Reservoir. The population of persons/parcels in this area likely exceed 1,000 and have not been notified of environmental, economic, and other impacts resulting from KDRPP and KKC. We ask that these communities be included environmental impact assessment, with public notification and opportunity for involvement, before any Final EIS is issued.

26. As noted in DEIS (*4-286*) the Easton State Airport is approximately 3,000 ft. southeast of the proposed discharge facilities and is used by a variety of private and public aircraft. A critical use of the airport is for large tanker and other airborne firefighting equipment, which require longer takeoff and landing space. The DEIS indicates a power transmission line will be required and may be located with 3,000 feet from the airport and exceed 60 ft. in height. The DEIS intends to use FAA minimum standards (50-1 height/length ratio) for placing transmission lines. It is further indicated FAA will be notified after the transmission line is established. In a word, this is irrational. The critical use of heavy firefighting airborne craft requires more than minimum safety standards for runway and landing, and

notification after putting the line in place is irresponsible. We request that the minimum height/length standard be revisited and revised to assure safer fire suppression efforts, and that FAA be engaged immediately in this matter.

27. Drawdown of Kachess Reservoir will (*4-348*) "cause significant impacts on recreation...reduce aesthetic quality of the reservoir...cause recreationists to seek similar opportunities [elsewhere...cause increased use and crowding in other areas...prevent use of boat launches, decrease fishing opportunities" and other adverse impacts. These all have negative economic impacts on property values in area residences and we ask that such impacts be quantified. Absence such an analysis, any representations that future mitigation efforts will be implemented ring hollow.

28. The Spotted Owl is an endangered species. The Spotted Owl is native to forested areas surrounding Kachess Reservoir. The Spotted Owl habitat is adversely affected by KDRPP and KKC construction and operation. Therefore KDRPP and KKC cannot be implemented without violating conditions of the Endangered Species Act. If Reclamation disagrees, please explain how the KDRPP and KKC Projects can comply with ESA with regard to the Spotted Owl.

29. Environmental Commitments (shown on page 4-353) purport to indicate how "mitigation" efforts will be conducted in case of environmental damage. For example, wells will be monitored and "appropriate mitigation strategies" put in place. In all cases the mitigation occurs after the damage takes place, and in all cases the mitigation is unspecified or too vague to evaluate. As one example, after Bull Trout passage is impeded in Little Kachess basin it is too late to mitigate the damage. The Bull Trout are either dead or prevented from spawning. Please identify those mitigation efforts that take place after the damage occurs, and in each prepare a detailed analysis of what mitigation will occur and what proportion of damage will be mitigated.

30. In the building of a pipeline between Lake Keechelus and Lake Kachess, there would be a significant requirement for the storage, staging and parking of the construction equipment needed to build the pipeline. All available DOT owned space is currently leased to the contractor engaged in the multi-year I90 expansion project and we challenge the assertion by Reclamation that Exit 62 DOT facility will be adequate for KDRPP and KKC staging purposes. Please state exactly that Exit 62 DOT and no other area will be used for staging purposes. If other staging areas will be used or are contemplated, indicate those areas in sufficient detail for third-party verification. The DEIS indicates spoils from the digging of the pipeline may be disposed of in the Stampede Pass Quarry but there is no commitment to do so. If spoils will be transported and disposed of in a different location, specify the location(s). We ask that the EIS study to allow for storage and disposal of materials be conducted before a Final EIS is issued for KDRPP and KKC. (see 2.7.2.5 p. 2-50).

31. We note that DEIS indicates acquisition of Right of Way of private property may be required for completion and operation of the Kachess Reservoir Portal. (2-41 to 2-51). We ask that any and all private properties that may be considered for acquisition be identified. We further ask that these private owners be immediately notified of this possibility, the legal basis for acquisition, the reimbursement and/or mitigation to be available, and the timing of such events.

32. DEIS states (3-42) Keechelus Reservoir has high levels of chlorite pesticides, PCB's, Dioxins, and other pollutants that result in fish (according to a study in 2007) "exceeding the human health criteria for PCB's." It is obvious the KKC will spill this contaminated water into Kachess Reservoir and create higher levels of toxins to humans, fish and wildlife in and around Kachess Reservoir. Despite the clear hazard this represents, the DEIS does not acknowledge this risk nor does it quantify the risks. We ask that appropriate environmental toxicology studies be conducted to quantitatively estimate the increased levels of all toxicants being added to Kachess Reservoir, and by extension to Yakima River, by KKC. We acknowledge that Keechelus Reservoir is currently spilling pollutants into the Yakima River and exposing downstream people and wildlife to poisons. We reject any response from Reclamation that attempts to minimize the additional exposure as minimal or just "more of the same." Toxicologic science recognizes the principle of a "dose-response relationship" meaning there is a physiologic response to every dose (i.e., exposure) and must be measured property. Increased volume of the solvent vehicle (in this case 200,000 acre feet of water), possibly time of exposure, 100% bioavailability, possibly increased consumption, increased tissue levels in fish, and a host of other factors all contribute to increasing the dose of, and exposure to, toxicants attributable to KKC.

    We further ask that the increased levels in fish species of such toxicants be estimated in Kachess Reservoir and that the potential increased in incidence and prevalence of morbidity and mortality to human and other wildlife be assessed using state-of-the art scientific methods. We ask that this study be conducted by a reputable third-party selected by the University of Washington Environmental Law program. We ask that the results of this environmental toxicology analysis be fully communicated to all persons and populations facing additional exposure and we ask that no final EIS be issued until this critical risk to human and animal health can be determined.

33. DEIS indicates the staging area for KKC and KDRPP will be Exit 62 of I-90 currently under the management of Washington State Department of Transportation. DEIS claims space is available at Exit 62 to accommodate the construction activities, however it is our understanding this area is committed to private contractor(s) and other DOT uses at least until the completion of the I-90 widening project. In other words, Reclamation does not have assured use of this space. If this is true, the DEIS substantially misrepresents the construction logistics for KKC and KDRPP, and this means either additional and/or separate staging space will be necessary. We ask that legally enforceable documentation be provided that Exit 62 staging area is committed to KKC KDRPP. If this documentation

cannot be provided, we ask that optional staging locations and logistics be provided, and an opportunity to comment on said locations, be provided before issuing a Final EIS.

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RE: Comments on Kachess Drought Relief Pumping Plant and Keechelus Reservoir-to-Kachess Reservoir Conveyance, Draft Environmental Impact Statement

Dear Ms. McKinley,

On behalf of the Kachess Ridge Maintenance Association, Kachess Community Association, Kittitas County Fire District # 8, and the East Kachess Homeowner's Association I respectfully submit the following public comments regarding the *Kachess Drought Relief Pumping Plant and Keechelus Reservoir-to-Kachess Reservoir Conveyance, Draft Environmental Impact Statement (DEIS).* These comments supplement and are in addition to the ones already submitted by each of these groups during the original comment period that ended in March of 2015.

Thank you for your attention to this important matter,

David Dicks – JD

Tatoosh Law and Policy Group
318 1st Ave S, Suite 310
Seattle, Washington 98104

On behalf of:

The Kachess Ridge Maintenance Association
The Kachess Community Association,
The Kittitas County Fire District # 8
The East Kachess Homeowner's Association

Introduction

Under National Environmental Policy Act (NEPA) agencies considering "major Federal actions significantly affecting the quality of the human environment" must prepare and issue an Environmental Impact Statement (EIS). 42 U.S.C. § 4332(2)(C); *Nw. Envtl. Advocates v. NMFS*, 460 F.3d 1125, 1133 (9th Cir.2006). The EIS:

> "shall provide full and fair discussion of significant environmental impacts and shall inform decision makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment." 40 C.F.R. § 1502.1; *Nw. Envtl. Advocates*, 460 F.3d at 1134.

Thus, the EIS is more than a mere "disclosure document." 40 C.F.R. § 1502.1. Agencies must take a 'hard look' at the potential environmental consequences of the proposed action." *Klamath-Siskiyou Wildlands Ctr. v. BLM*, 387 F.3d 989, 993 (9th Cir.2004) (citing *Churchill County v. Norton*, 276 F.3d 1060, 1072 (9th Cir.2001)). By focusing on the environmental effects of the proposed agency action, "NEPA ensures that the agency will not act on incomplete information, only to regret its decision after it is too late to correct." *Marsh*, 490 U.S. at 371, 109 S.Ct. 1851 (1989). Reclamation and Ecology fail to meet this burden in this DEIS.[1]

There are at least seven fatal flaws with the DEIS which render it insufficient under NEPA and SEPA. Because of this the Bureau of Reclamation and Ecology must either start over with a new DEIS, or select the no action alternative. This comment letter explains the flaws in the DEIS and poses a series of questions that should have been addressed in the DEIS. As required by both NEPA and SEPA, and their implementing regulations, we expect both Reclamation and Ecology to provide responses to each of the questions posed in this letter.

Fatal Flaw #1: It is unclear what Proposed Action the DEIS is actually evaluating

According to the DEIS:

> "Reclamation's Proposed Action is to construct, operate, and maintain one or both of two closely related water resource projects in the upper Yakima River basin pending congressional authorization. Reclamation and Ecology are considering how these two parts of the Proposed Action, alone or in combination, contribute to restoring ecological functions and providing more reliable and sustainable water resources for the health of the riverine environment and for

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[1] Washington State's Environmental Protection Act (SEPA) mirrors NEPA and places the same burden upon Washington State agency actions.

agricultural, municipal, and domestic needs. *The two projects are so closely related in overlapping geography, concurrent timing, interrelated operations, cumulative impacts, and interdependence through the Integrated Plan ROD to be considered interconnected parts of a single course of action that should be evaluated in a single EIS* (40 CFR 1502.4 and 40 CFR 1508.25). These relationships are detailed in Section 1.5 and Chapter 2 of this DEIS. (ES-iii)" (emphasis added).

According to the DEIS, the two projects being considered under the Proposed Action are: 1) the Kachess Drought Relief Pumping Plant (KDRPP), which is intended to deliver up to an additional 200,000 acre-feet of water from Lake Kachess during drought years by installing a new deeper outlet works and pumping system to access existing stored water that cannot currently be accessed and 2) Lake Keechelus -to- Lake Kachess Conveyance (KKC) designed to augment flows into Lake Kachess and reduce flows in the Yakima River downstream from Lake Keechelus to Lake Easton by transferring water from Keechelus Lake to Kachess Lake via a new tunnel. ⍰

The DEIS purports to analyze four alternatives (and two sub-alternatives). Alternative 1 is the No Action Alternative, Alternative 2A - KDRPP East Shore Pumping Plant, Alternative 2B - KDRPP South Pumping Plant, Alternative 3A - KKC North Tunnel Alignment, Alternative 3B - KKC South Tunnel Alignment, and, Alternative 4 - Combined KDRPP and KKC.

In reality the DEIS only considers Alternative 4 and the "no action" alternative. As the DEIS repeatedly states the KKC and KDRPP are so "closely related... to be considered interconnected parts of a *single course of action*." (emphasis added). Despite this, the DEIS purports to consider the Kachess pumping plant independently from the Kecheelus to Kachess Conveyance (tunnel). However, if the pumping plant is implemented without the tunnel, the data within the DEIS shows that Lake Kachess would likely not refill for up to 20 years. This would create a semi-permanent impact upon the environment, that is not evaluated in the DEIS. Similarly if the pumping plant is not built there would be no reason to construct KKC project.

If the projects were real alternatives, that could be implemented independently, an analysis of the impacts of independent implementation of each alternative would be required. The DEIS fails to analyze independent implementation. For this reason the actual "Proposed Action" the DEIS is really only Alternative 4 (the combined project) and the Alternative 1 - No Action. The distinction between the stated "Proposed Action" and the actual "Proposed Action" is the first major flaw in the DEIS.

Key Questions for Reclamation and Ecology

Please explain how the DEIS analysis would change if one of the closely related and interrelated projects is not authorized, is not funded, or does not happen for some other reason?

Is there really a possibility that the KDRPP would happen without the KKC and vice versa?

What would be the environmental impact of implementation of each project independent of the others?

Fatal Flaw #2 - Failure to Consider Reasonable Alternatives

Both NEPA and the Washington State Environmental Policy Act (SEPA) require consideration of all reasonable alternatives. Under both laws an EIS must include a detailed statement and analysis of all "reasonable alternatives" to the proposed action.

The alternatives analyzed in the DEIS are inadequate for three reasons: 1) the range of alternatives is far too limited to satisfy NEPA and SEPA; 2) the alternatives analyzed are not actually alternatives but are instead by Reclamation's own admission "interconnected parts of a single course of action;" (ES –iii) and, 3) the alternatives evaluated in the DEIS were improperly narrow because they stem from a compromise agreement reached by the Yakima River Basin Water Enhancement Project (YRBWEP) Workgroup.

1) Agencies conducting a DEIS are bound by NEPA's obligation to consider a full range of alternatives. In one case, for example, the Park Service was aware of studies documenting the adverse effects of trail grooming in winter on wildlife. The agency nevertheless failed to consider the elimination of trail grooming as an alternative when it considered whether to allow continued use of snowmobiles in Yellowstone and Grand Teton National Parks. The fact that the Park Service was unsure whether the beneficial effects of trail grooming would outweigh the negative effects did not justify the failure to even consider the alternative of elimination of trail grooming. Instead, that uncertainty "scream[ed] out for further study." The agency's failure to consider the no trail grooming alternative rendered the DEIS "flatly inadequate." *The Fund for Animals v. Norton*, 294 F. Supp. 2d 92 (D.D.C. 2003). Here Reclamation and Ecology are aware of numerous alternatives that are not evaluated in the DEIS.

2) The alternatives analyzed don't appear to be actual alternatives but are instead - by Reclamation's own admission "interconnected parts of a single course of action." As discussed earlier, it seems implausible that the KDRPP would happen without the KKC and vice versa. Assuming that the two projects must happen together or not at all, the DEIS really only analyzes two scenarios – Alternative 4

(the combined project) and the No Action Alternative. This range of alternatives is "flatly inadequate" under both NEPA and SEPA requirements.

3) Finally it should be noted that the severely restricted alternatives analysis in this DEIS stems from the fact that the proposed projects are part of a broader political compromise solution known as the Yakima Basin Integrated Plan (YBIP) developed by the YRBWEP Workgroup (Workgroup). Because of this, it is not surprising that the Reclamation and Ecology did not want to consider other ways to achieve the desired fish enhancements and increases in water storage and flows – those options were not part of the mandate of the YBIP.

Whatever one thinks of the YBIP it is clear that it includes the KKC and KDRPP and does not include other alternatives that could meet the same underlying objectives but were not agreed upon by the Workgroup in the YBIP. Reclamation and Ecology's inclusion of other public officials and stakeholders interested in and affected by Yakima Basin water shortage problems is perhaps laudable. It does not, however, relieve either agency from complying with the statutory requirements of state and federal law (SEPA and NEPA).

The advice provided to Reclamation and Ecology by the YRBWEP Workgroup does not supplant the requirement that Reclamation and Ecology themselves consider environmental alternatives when making decisions about major actions significantly affecting the quality of the environment. Reclamation and Ecology may not delegate that decision-making authority to others, or accept a workgroup recommendation without comparing that recommendation against other alternative courses of action. That delegation, however, is exactly what Reclamation and Ecology have done in this DEIS. This level of "predetermination" and failure to independently evaluate reasonable alternatives to the YBIP leads to a "black letter law" violation of NEPA and SEPA and is fatal to this DEIS.

Key Questions for Reclamation and Ecology

Why were more alternatives not considered?

Are the alternatives considered actually real alternatives or are Alternative 4 and the no action alternative really the only alternatives?

Why wasn't water conservation explicitly considered as an alternative?

Why was Kecheelus not evaluated for a drought relief pumping plant with a canal or pipeline diversion directly from Kecheelus to Easton? This alternative would accomplish the same objectives in a significantly less environmentally harmful and dramatically less costly manner.

Why were alternative storage locations not considered?

Why was the Columbia River Pump Exchange not considered as an alternative?

Why were water markets not considered as an alternative?

Fatal Flaw #3 - The DEIS repeatedly relies on vague and hypothetical mitigation measures

One essential ingredient of an EIS is to identify adverse environmental impacts and then discuss the steps that will be taken to mitigate unavoidable adverse environmental consequences. The projects evaluated in the DEIS have numerous environmental consequences that will require extensive mitigation. The requirement that an EIS contain a detailed discussion of possible mitigation measures flows both from the language of the NEPA and, more expressly, from CEQ's implementing regulations for NEPA.

Implicit in NEPA's demand that an agency prepare a detailed statement on "any adverse environmental effects which cannot be avoided should the proposal be implemented," 42 U.S.C. § 4332(C)(ii), is an understanding that the EIS will discuss the extent to which adverse effects can be avoided and mitigated for. See D. Mandelker, NEPA Law and Litigation § 10:38 (1984).

The Supreme Court considered the duty to mitigate under NEPA in *Robertson v. Methow Valley Citizens Council* (109 S.Ct. 1835). In that case the plaintiffs challenged a Forest Service permit for a ski resort in a national forest. The Court held that the requirement that an agency discuss mitigation measures is implicit in "NEPA's demand" and CEQ regulations. The omission of a "reasonably complete discussion" of mitigation measures would undermine NEPA's action-forcing functions. Without such a discussion, the Court added, neither the agency nor other interested groups or individuals, could properly evaluate the severity of the adverse effects of the action. That is exactly the problem with this DEIS.

The mitigation proposed in the current DEIS is far too general and hypothetical, and even undermines the mitigation already being implemented by WSDOT under the Interstate 90 FEIS. Therefore it fails to meet the NEPA/SEPA threshold to provide the decision maker or the public with a full understanding of the environmental consequences of any of the alternatives under consideration.

One example centers around Bull Trout, a threatened species in Lake Kachess. The plan calls for reducing the level of the lake by an additional 82.75 vertical feet. This draw down will prevent the fish from spawning in Box Canyon by creating an 82 ft high cliff impediment. Yet, there is no plan to mitigate this loss of habitat and reduction in population of the threatened species. The Gold Creek bull trout are distinct from Lake Kachess Bull Trout. Over 5 miles, 2 dam structures, and Kecheelus Ridge separate the populations. Therefore, the Gold Creek bull trout mitigation plan cannot affect the Lake Kachess bull trout population. Therefore, the proposed mitigation plan, which only affects Lake Kecheelus, cannot mitigate this loss. The DEIS alludes to vague considerations for mitigation of bull trout habitat destruction and population decline, but does not provide definitive or even viable proposals with cost estimates, which is particularly important in this case because the harmful effects are so dramatic and potentially impossible to mitigate such as 82' cliffs in spawning gateways.

In another example, the DEIS accurately states the Kachess Lake aquifer will be depleted and private wells may be compromised or fail entirely (DEIS 1-19). The only accommodation will be for "...Reclamation to develop appropriate mitigation strategies" if water levels and wells are adversely impacted. This *we will figure it out later* approach which permeates much of the DEIS is simply inadequate under NEPA and SEPA. The DEIS does not provide any indication of what mitigation efforts would be considered or appropriate. It is essential that these mitigation efforts be identified in advance, the likelihood of their need to be implemented also identified in advance, and that these estimates be quantitative based upon scientific evidence and should have been included in the Draft EIS.

The current DEIS precludes public comment on specific mitigation measures and by extension does not allow the public or the NEPA/SEPA decision maker to truly understand the implications of the proposed action. That is a violation of SEPA and NEPA.

Key Questions for Reclamation and Ecology

What is a mitigation strategy to ameliorate the loss of water for private residences?

What is the mitigation strategy to ameliorate the loss of private property use and values?

Other than vague references to the incomplete Bull Trout Enhancement (BTE) program what specific mitigation measures will occur to offset the impact to this ESA listed species in each of the affected population areas (Lake Keechelus and Lake Kachess)?

Fatal Flaw #4 - The Endangered Species Act

Section 7 of the ESA requires federal agencies to consult with either FWS or NMFS to ensure that any action authorized or carried out by the agency is not likely to jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modification of critical habitat of the species. ESA § 7, 16 U.S.C. § 1536. This process requires the Services to prepare a biological opinion that includes a finding as to whether the proposed action is likely to jeopardize the continued existence of an endangered or threatened species or its habitat. 50 C.F.R. § 402.14.

Although the current DEIS acknowledges repeatedly that there will be substantial negative impacts to ESA listed species including Bull Trout and the Northern Spotted Owl (among others) and the habitat of these species, it fails to quantify those impacts adequately. This failure stems from the fact that the Reclamation and Ecology have not initiated a Section 7 consultation under the ESA. The DEIS does state that such a consultation will occur in the future but the lack of a concrete understanding of the impacts on listed species makes the selection of a preferred alternative arbitrary and capricious. For this reason both the NEPA and ESA regulations encourage *simultaneous NEPA review and section 7 consultations.*

Reclamation's own NEPA regulations state:

> NEPA activities should be coordinated with other environmental requirements so that their requirements are, when possible, met *concurrently rather than consecutively.* This specifically includes FWCA, CWA, NHPA, ESA, and other environmental review laws and Executive orders. P 3-10, 3-11. (emphasis added).

The NEPA Guidelines state further:

> To the fullest extent possible, agencies shall prepare draft environmental impact statements *concurrently with and integrated with environmental impact analyses* and related surveys and studies required by...the Endangered Species Act...." 40 C.F.R. § 1502.25. (emphasis added).

The "studies" required by section 7 are those needed for consultation on any federal action that may affect ESA-listed species. 16 U.S.C. § 1536(b), (c).

ESA section 7(c) states that the action agency's biological assessment, a precursor to a biological opinion, "may be undertaken as part of a Federal agency's compliance with the requirements of Section 102 of the [NEPA]." 16 U.S.C § 1536(c)(1). Again, what is plainly intended is that the action agency's consultation duties regarding its proposed action may be coordinated with its NEPA review of that action. Similarly, FWS's regulations regarding section 7 state: "consultation ...procedures under section 7 may be consolidated with interagency cooperation procedures required by other statutes, such as [NEPA]." 50 C.F.R. § 402.06.

Again, Reclamation's own NEPA regulations state:

> Special attention should be given to the integration of NEPA and the ESA. Section 7(a)(2) of the ESA requires consultation with the Service and/or NOAA-NMFS for any Reclamation action which may affect a species federally listed as threatened or endangered (listed species). This consultation process may result in the Service and/or NOAA-NMFS issuing a biological opinion containing actions to be undertaken

> to avoid jeopardizing a species or to reduce the level of take associated with the proposed action. Reclamation *shall*, to the fullest extent possible, integrate ESA and NEPA analyses and schedules." (Bureau of Reclamation's NEPA Handbook Section 3.15.1) (emphasis added).

The failure to consult is especially troubling because this is the second time that Reclamation has failed to conduct an ESA consultation. The first time came in the Programmatic EIS for the entire YRBIP process. In that document Reclamation stated:

> Reclamation has concluded that consultation under Section 7 of the Endangered Species Act is not required at this time because preparation of the PEIS and selection of a preferred alternative *would have no effect on listed species in the action area*. Reclamation has discussed this conclusion with both the Service and NMFS, and neither agency found any fault with Reclamation's reasoning which led to the no effect determination. See Appendix G for a summary of the correspondence. Consultation would be conducted for individual projects that may affect listed species or critical habitat and that Reclamation would fund, authorize, and/or carry out under the Integrated Plan in the future." PEIS 6.2.2 (emphasis added).

Reclamation's failure to consult with USFWS and NOAA has led to an incomplete evaluation of the true impacts on endangered species and potential mitigation for these impacts.

Key Questions for Reclamation and Ecology

Why wasn't a Section 7 consultation completed before the DEIS was published?

How does Reclamation believe it meets its own NEPA regulations or the CEQ regulations regarding threatened and endangered species?

How can the NEPA decision maker or the public fully understand the impacts on listed species without input from the ESA expert agencies USFWS and NOAA?

Given that Reclamation and the USFWS are both part of the Department of Interior how can the lack of a Section 7 consultation be justified?

How can the Bureau contend that there is "no effect on listed species" in the PEIS and then acknowledge there will be significant effects upon listed species and habitat in the DEIS.

Fatal Flaw #5 - Cumulative Impacts

In reviewing the proposed action, NEPA requires an agency to consider the proposed action's impact in the context of all relevant circumstances, such that where "several actions have a cumulative ... environmental effect, this consequence must be considered in an [environmental impact statement]." Neighbors of Cuddy Mountain v. U.S. Forest Serv., 137 F.3d 1372, 1378 (9th Cir.1998) (quoting City of Tenakee Springs v. Clough, 915 F.2d 1308, 1312 (9th Cir.1990)). A cumulative effect is "the impact on the environment which results from the incremental impact of the action when added to other *past, present, and reasonably foreseeable future actions* regardless of what agency (Federal or non-Federal) or person undertakes such other actions." 40 C.F.R. § 1508.7 (emphasis added).

Therefore, an environmental impact statement "must analyze the combined effects of the actions in sufficient detail to be 'useful to the decision maker in deciding whether, or how, to alter the program to lessen cumulative impacts.' " Muckleshoot Indian Tribe v. U.S. Forest Serv., 177 F.3d 800, 810 (9th Cir.1999). "General statements about 'possible effects' and 'some risk' do not constitute a 'hard look' absent a justification regarding why more definitive information could not be provided." Te-Moak Tribe of W. Shoshone of Nev. v. U.S. Dept. of the Interior, 608 F.3d 592, 603 (9th Cir.2010) (citation omitted).

There are numerous cumulative impacts that the DEIS fails to adequately analyze. These include:

- The relationship to Interstate 90 mitigation projects. The conveyance project results in a physical intrusion on the wildlife connectivity corridors and may lead to a change in ecosystem function in the reservoirs and especially for Lake Keechelus in relation to Gold Creek. This seems fundamentally antagonistic to the connectivity goals of the I-90 program and to mitigation commitments that were approved and implemented in the I-90 program. Given the massive state and federal investment in habitat connectivity and conservation tied to the I-90 project the failure of the DEIS to adequately analyze this cumulative impact is surprising and deficient.

- Increased fire risk is a significant hazard in the KDRPP and KKC areas, evidenced by recent Kittitas County fires: South Cle Elum Ridge Fire, Taylor Bridge Fire, Table Mountain Fire, and others. These fires are frequently caused by sparks, construction work (e.g., welding), brake and bearing fires, and other causes related to vehicular traffic, especially heavy vehicles, and construction apparatus. (4-281). Given the large increase in traffic on Lake Kachess Road from the proposal a true analysis of the increased fire risk imposed by construction work for KDRPP and KKC, the costs associated with suppressing or managing typical fires in the area, and the responsibility for mitigation should have been disclosed and analyzed in the DEIS. The cumulative impacts of this project with the major I90 East construction project exponentially increases cumulative impacts and taxes first responder resources without consideration.

- Water Quality: The DEIS states (3-42) Keechelus Reservoir has high levels of chlorite pesticides, PCB's, Dioxins, and other pollutants that result in fish (according to a study in 2007) "exceeding the human health criteria for PCB's." It is obvious the KKC will spill this contaminated water into Kachess Lake and create higher levels of toxins to humans, fish and wildlife in and around Kachess Lake. Despite the clear hazard this represents, the DEIS does not acknowledge this risk nor does it quantify the risks.

- The DEIS acknowledges that the KDRPP threatens the Lake Kachess community's water source. Section 3.5.2.1 admits that the many wells within 2 miles of Lake Kachess will be impacted, however, it fails to recognize the impact on the Public Group "A" Water System, located several hundred feet from the lake shoreline. This water system provides water to 162 homes in the community, to fire hydrants, for use in firefighting of structures and wildfire within the boundaries of Kittitas County Fire District #8, and for firefighting via tanker and transport apparatus in contiguous districts where mutual aid and collaborative agreements exist. It fails to describe or quantify the effect, dropping the lake level an additional 112+ feet below its natural lowest level, will have on this Public water system, the wells in the area, or on the ability to conduct fire suppression activities.

Key Questions for Reclamation and Ecology

How will the projects impact Interstate 90 mitigation efforts?

How will Reclamation and Ecology mitigate for increased fire risks?

What are the water quality implications of the projects?

How will impacts on wells and water systems be addressed?

What will be the impacts on the Alpine Lakes Wilderness hiking areas adjacent to Lake Kachess and Lake Keechelus?

What will be the impact on the recreational opportunities for the Okanogan Wenatchee National Forest, Iron Horse State Park, Lake Kachess State Park, and Summit at Snoqualmie Ski areas?

Fatal Flaw #6 - The DEIS is obsolete by Reclamation's admission

Although the BOR and Ecology extended the comment period for the DEIS they did not supplement it in anyway. Despite this the BOR stated the following in their website:

> *The new comment period will end June 15, 2015. A Final EIS will be prepared after all comments have been addressed. Then, a decision will be made regarding which alternative will be selected. Before any project can be implemented, Congress would still need to provide authorization and funding.*
>
> *WE HEARD YOUR CONCERNS!*
>
> *Groundwater - You told us you are concerned that additional drawdowns could affect your wells. Water levels at Kachess already undergo annual fluctuation without any known impacts to existing wells or aquifers. During drought years, the proposed pumping plant would draw the reservoir down further. <u>Reclamation and Ecology are reexamining any potential impacts of the drawdown on wells.</u>*
>
> *Property Values - Many of you expressed concern over potential decline in long-term property values resulting from the operational changes at Kachess Reservoir. <u>Reclamation and Ecology are reevaluating potential impacts on property.</u>*
>
> *Cost and Benefits - The proposed projects are components of the Yakima River Basin Integrated Water Management Plan (Integrated Plan). The Integrated Plan as a whole has undergone economic analyses. Some of the other analyses focused only on the KDRPP and KKC Projects, without recognizing the value of the synergistic effects of Integrated Plan projects working together. The Integrated Plan—as a whole—meets and surpasses all Federal benefit-cost criteria."* (emphasis added).

These statements are an admission that the original DEIS was flawed and that Reclamation and Ecology are "reevaluating" these impacts because the original DEIS is inadequate. While we are glad that such a reevaluation is taking place, it makes the current DEIS obsolete and the new comment period a farce. If the agencies have already changed their mind about statements in the DEIS the public should have the right to comment on the "new analysis" not on the "old analysis" in the DEIS.

Furthermore, the Bureau explicitly refers to cost benefit and economic analysis that it claims, "meets and surpasses all Federal benefit-cost criteria." Yet its own Design Feasibility Study (which came out after the release of the DEIS), doubles the cost estimates used in the DEIS. Thus, the Bureau has failed to analyze this essential change in the project scope and has denied the public the opportunity to comment on the dramatically different information contained in the Feasibility Study. (For more information on the cost issues please see the public comment from Mr. Jay Schwartz on this DEIS – that letter is incorporated herein by reference.)

Key Questions for Reclamation and Ecology

Why was the DEIS not supplemented based on the new information gleaned from the initial round of public comments that according to Reclamation has led to a "reexamination" of the conclusions in the DEIS?

Why was the DEIS not supplemented based upon the new information contained in the Feasibility Study completed after the DEIS was drafted?

What studies are being done, by whom to determine the effects on water supply and how might those impacts be mitigated?

What studies are being done and by whom to determine the effects upon property values and how might those impacts be mitigated?

Why was the DEIS published before the Feasibility Study was completed?

Fatal Flaw # 7 - The Bureau's own Feasibility Study for these projects contradicts the DEIS

Where there are significant new circumstances or significant new information relating to the proposal or its impacts, supplementation of the EIS (either a new draft or new final) is necessary. *Marsh v. Ore. Natural Res. Council., 490 U.S. 360 (1989).* Supplementation follows the same procedure and employs the same standards applicable to the preceding document.

As mentioned above, the first and most obvious problem is that the Feasibility Study came out after the release of the DEIS. Thus by definition the DEIS does not evaluate the most current technical and scientific information. In addition to the cost implications, this creates a major disconnect between the alleged environmental impacts in the DEIS and those in the Feasibility Study. Specific examples include:

1. According to the Feasibility Study two Tunnel Boring Machines (TBM's) will be used to create the proposed tunnel in the KKC, as described in the Feasibility Design for KKC (p. 32-35). However there are significant differences from the description and impacts described in the KDRPP DEIS. The KKC/KDRPP DEIS contemplated the use of only one TBM and the construction impact was estimated to be approximately one trip/minute on Kachess Lake Road (p. 4. 280-285) during peak times, with adjustments for different activity levels. The simultaneous operation of two TBM's would double the road traffic of

hauling operations (two portal shafts, two excavation sites, twice the truck traffic, etc.) This new impact is not evaluated in the DEIS.

2. Related to #2 above, the Feasibility Design for KKC now contemplates a 12-foot tunnel with an approximate 20% in materials being excavated and removed for dumping (p. 31). This increase in materials being excavated for removal will cause a corresponding increase in construction materials traffic, either in duration or intensity or both. The Transportation Impact estimates of the KKC/KDRPP DEIS must be recalculated to give accurate estimates based upon the Feasibility Design data.

3. Time frames for completion of the project have been substantially increased. For example the KDRPP construction schedule in the DEIS was stated to be 3 years, but in the KDRPP Feasibility Design is stated to be 5.5 years. Similar increases in time for KKC are reported. The DEIS claimed construction effects on local citizens would be "minor" but this assertion cannot be defended when the project is nearly doubled in time frame and intensity. The DEIS must be revised to reflect the recently disclosed construction schedules and that estimates of impact be revised to state the effect on local residents will be "substantial and disruptive to normal activities."

4. With regard to KKC Feasibility Design findings, it is noted (p.44) that both North and South Tunnel Segments cross under private party parcels and will require purchase. It is further stated that the tunnel will cross under private property Northwest of Exit 62 of I-90. (p. 45). With regard to KDRPP Feasibility Design findings, it is noted (p. 11) the "East Shore alternative will require additional property easements or acquisitions."

These inconsistencies between the DEIS and the Feasibility Study mean that the DEIS is not only inadequate but also inaccurate. This is yet another fatal flaw in the DEIS.

Key Questions for Reclamation and Ecology

Where private property easements and/or acquisitions may be necessary have specific parcels been identified? Have the current owners of those properties been notified?

What is the legal authority for condemnation and acquisition of private property?

With regard to the inconsistencies between the DEIS and the Feasibility Study what are the true peak and nonpeak transportation impacts in Kachess Lake Road and other access routes?

How are the Transportation Impact Estimates in the KKC/KDRPP DEIS accurate given the change in operations to simultaneous operation of TBM's?

Conclusion

The DEIS fails to comply with the procedural and substantive requirements of NEPA and SEPA. Because it fails to provide a complete and accurate view of the environmental consequences of the proposed action it denies the NEPA/SEPA decision maker the ability to make a factually based and scientifically credible decision.

As outlined in this letter the DEIS is fatally flawed for seven reasons:

1. The "Proposed Action" is unclear and contradicts the alternatives analysis
2. The alternatives analysis is inadequate
3. The DEIS relies on vague and hypothetical mitigation measures
4. The proposal does not comply with NEPA or the ESA with regard to threatened and endangered species
5. The DEIS does not adequately analyze cumulative impacts as required by law
6. The DEIS is obsolete
7. The DEIS is contradicted by and is not informed by Reclamation's own Design Feasibility Study

For these reasons - and many others articulated in our prior comments and the comments of others - the DEIS must be rejected in its current form and redrafted to meet the legal requirements of NEPA/SEPA. Alternatively, the "no action" alternative should be selected.

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee.

The following are my comments on S. 1694 in opposition to this version of the bill.
Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced.
The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

Further, review of current water rights management in place should be examined as it relates to the region effected and use (miss use) of the resource.

S. 1695 is bad national water policy and bad national environmental policy.
Please do not pass S. 1695, as introduced.

Sincerely,
Matthew Karaus
13 Cascade Place
Snoqualmie Pass, WA 98068

From: Kathy Kearny <kathykearny@comcast.net>
Sent: Friday, July 03, 2015 12:36 AM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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1. The true costs of this controversial and misguided project have increased by a factor of 300 – 400%. What was initially represented to be a $257 million project, will now (depending upon alternatives selected) require $1 billion or more. The failure to provide accurate cost information prevents any rational evaluation of this proposal and further consideration should be terminated. At a time when we face critical unfunded needs in education, mental health services, roads and bridge infrastructure, we cannot commit taxpayer dollars to a bottomless pit.
2. As the costs have increased, the Benefit-to-Cost ratio has plummeted. Using the Bureau of Reclamation's own data, the project is now shown to have a Benefit/Cost ratio of 0.14 – 0.41, meaning it will lose between $0.59 to $0.86 for every taxpayer dollar spent. This is an unconscionable waste of public funds and cannot be tolerated.
3. The DEIS described numerous environmental hazards that could result if the project moves forward. Since then, additional hazards have been identified, including contamination of wetlands, a doubling of construction traffic, potential well failures, and unpredictable erosion and slide incidents. These are serious concerns to human, animal, and plant life in the area and cannot be tolerated.

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Katherine L Kearny
8363 NE Juanita Drive
Kirkland, WA 98034

From: Ryan Kearny <r.kearny@f5.com>
Sent: Monday, July 06, 2015 7:10 PM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office

304 Dirksen Senate Building

Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Ryan C Kearny - SVP F5 Networks

8363 NE Juanita Drive

Kirkland, WA 98034

From: Bob Kitchell <bobkitchell@gmail.com>
Sent: Friday, July 03, 2015 12:36 PM
To: Ripchensky, Darla (Energy)
Subject: S. 1694 - DO NOT PASS

FROM:
Robert W. Kitchell MD
233 26th Ave East, Seattle WA 98112

TO:
Senate Energy and Natural Resources

RE:
Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project.
July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1694, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective. Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1694 is bad national water policy and bad national environmental policy. Please do not pass S. 1694, as introduced.

From: Rives <rives.kitchell@gmail.com>
Sent: Monday, July 06, 2015 2:51 PM
To: Ripchensky, Darla (Energy)
Subject: S. 1694 - DO NOT PASS

FROM:
Virginia Rives Kitchell
233 26th Ave East, Seattle WA 98112

TO:
Senate Energy and Natural Resources

RE:
Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project.
July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1694, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective. Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1694 is bad national water policy and bad national environmental policy. Please do not pass S. 1694, as introduced.

Sent from my iPhone

From: Mel Koch <kochm@uw.edu>
Sent: Thursday, July 02, 2015 5:57 PM
To: Ripchensky, Darla (Energy)
Subject: Concern over water enhancement project

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,
Melvin Koch
3645 Ashworth Avenue N
Seattle, WA 98103

From:	Ann Lewis <roniaspamonia@gmail.com>
Sent:	Sunday, July 05, 2015 11:41 PM
To:	Ripchensky, Darla (Energy)
Subject:	Testimony for July 7, 2015 Hearing on S. 1694
Attachments:	Opposition to the Yakima Basin Integrated Plan and Kachess Projects Document Library, June 2015.docx

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments and the Document Library attached above as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1694, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective. Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

The Document Library attached outlines many reasons why the Yakima Basin Integrated Plan as a whole is economically and environmentally a bad plan. More specifically it contains information about why the projects affecting Lake Kachess are detrimental and not effective.

S. 1694 is bad national water policy and bad national environmental policy. Please do not pass S. 1694, as introduced.

Sincerely,

Ann Lewis
86-157th Ave SE
Bellevue, WA 98008

Document Library

U.S. Senate Bill 1694 to authorize Phase III of the Yakima River Basin Water Enhancement Project . See also link to Senate Energy & Natural Resources Committee.

Rep. Hans Dunshee. Opinion: Farmers need water and taxpayers need accountability. Seattle Times. June 9, 2015.

Selected comment letters on Lake Kachess drawdown and K-K pipeline draft environmental impact statements (DEIS). The U.S. Bureau of Reclamation and Office of Columbia River (Dept of Ecology) held two public comment periods.

Kachess Community Association. KDRPP and KKC DEIS public comment letter #2. June 15, 2015.

Friends of Lake Kachess. KDRPP and KKC DEIS, comment letter, Set #1. June 12, 2015.

Friends of Lake Kachess. KDRPP and KKC DEIS, comment letter, Set #2. June 12, 2015.

Washington State Dept of Transportation. KDRPP and KKC DEIS, comment letter. March 10, 2015.

Sierra Club. KDRPP and KKC DEIS, comment letter. March 10, 2015.

Wise Use Movement. KDRPP and KKC DEIS, comment letter. March 6, 2015.

Kachess Community Association. KDRPP and KKC DEIS, comment letter #1. February 28, 2015.

Jonathan Yoder, Washington State Water Research Center. Yakima Basin Integrated Plan Benefit-Cost Analysis: An appeal for evidence-based discourse about the State of Washington Water Research Center Study of the Yakima Basin Plan. The Water Report, May 2015.

See also: Full exchange with Steve Malloch and Michael Garrity, with a pair of responses.

Sierra Club. Letter to Sen. Murray raising concerns about federal funding for the Yakima Plan. April 27, 2015.

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Yakima River

Washington State Chapter

SIERRA CLUB

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Ron and Amanda Lund
Snoqualmie, WA

Energy and Natural Resources Committee Office

RECEIVED JUL 15 2015

304 Dirksen Senate Building

Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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Sincerely,

Raymie A. Lynch

Raymie Lynch

428 289th Place NE
Carnation, WA 98014

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Joel and LeaAnn Martin

31 Tranquility Lane, Easton, WA 98925

From: Maykut <maykut@serv.net>
Sent: Thursday, July 02, 2015 5:59 PM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694 in the Subject Line

Senator Murkowski (Chair) and members of the Committee.Â The following are my comments on S. 1694 in opposition to this version of the bill.Â Â Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced.Â Â The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective.Â Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation. A very important step that is being ignored is to develop a comprehensive water marketing system that would save a huge amount of water. The Yakima Basin farmers and irrigators should use the water they have more efficiently before asking the taxpayers to subsidize more water for them to waste..

The Bureau of Reclamation has been trying to build a higher dam at Bumping Lake for over 100 years. It has always failed because the higher dam does not return the value anywhere near the cost. The latest cost-benefit analysis shows this still is true. Do not be fooled by the Yakima Integrated Plan Committee's kindergarten reasoning that holding the phoney salmon number as an umbrella makes projects that are not cost-effective somehow cost-effective!

S. 1695 is bad national water policy and bad national environmental policy.
Â Please do not pass S. 1695, as introduced

Naydene Maykut, 6552 Palatine Ave. N., Seattle , Washington

Miles and Saundra McPhee
450 Clover Springs Road
Naches WA 98937

RE:
Senate Energy and Natural Resources
Hearing on S. 1694 – to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project, July 7, 2015.

Senator Murkowski (Chair) and members of the Committee:

Following are our comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

The draft legislation includes phrasing that the Integrated Plan (IP) is to be "adopted in its entirety." While there are many aspects of the IP that we support, construction of two new dams (Wymer and Bumping) produce very low benefit/cost ratios. According to an independent economic analysis prepared by the State of Washington Water Resource Center at the direction of the Washington State Legislature, the B/C ratios for Wymer and Bumping are 0.09 and 0.18, respectively. The WWRC report illustrates that much of the purported economic benefit of the project (nonuse value of restoring of a Sockeye salmon run to the Yakima Basin), could be realized without adding new storage elements, which comprise a large proportion of the IP cost. In addition, construction of a new dam at Bumping will destroy a uniquely valuable old-growth ecosystem, to which the IP gives no consideration. Both of these projects should be considered separately and judged on their own merits (or lack thereof).

In its "entirety," the IP represents bad policy, both economic and environmental.

Thank you for your consideration of these comments.

Sincerely,

Miles G. McPhee, Ph. D.
Saundra McPhee

From: Steve Oslund <SteveOslund@barnpros.com>
Sent: Monday, July 06, 2015 12:28 PM
To: Ripchensky, Darla (Energy)

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Steve R Oslund,
31802 ne 139th
Duvall wa 98019
425-864-5276
steveoslund@barnpros.com

From: C C Owens <epxccowens@gmail.com>
Sent: Sunday, July 05, 2015 11:27 PM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office

304 Dirksen Senate Building

Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

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Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Clifford Owens

20203 77TH ST Ct E

Bonney Lake WA 98391

From: J P Owens <kachess99@gmail.com>
Sent: Sunday, July 05, 2015 5:16 PM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office

304 Dirksen Senate Building

Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Joann Owens

20203 77TH ST Ct E

Bonney Lake WA 98391

From: R B Owens <epxdudmarketing@gmail.com>
Sent: Monday, July 06, 2015 11:23 PM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office

304 Dirksen Senate Building

Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Councilhttp://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Rachel Owens

20203 77TH St CT E

Bonney Lake WA 98391

From: stephanie owens <owens.stephanie206@gmail.com>
Sent: Monday, July 06, 2015 2:12 PM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office

304 Dirksen Senate Building

Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Councilhttp://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Stephanie Owens

20203 77TH St CT E

Bonney Lake WA 98391

From: jeff@parryadvertising.com
Sent: Monday, July 06, 2015 1:57 AM
To: Ripchensky, Darla (Energy)
Subject: Are you crazy? Don't drain Lake Kachess!

Dear: Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am strongly opposed to authorizing S. 1695, as introduced.

Please consider all the facts before you put this through!! I am beyond opposed to this law. It is a travesty to even consider draining a lake for this bill. Please look at the facts. Thank you and please opposed this bill.

Jeff Parry
(206) 280-4398

From: Ross Rosen <rrosen326@gmail.com>
Sent: Thursday, July 02, 2015 8:17 PM
To: Ripchensky, Darla (Energy)
Subject: RE: Hearing on S. 1694

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Councilhttp://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

Furthermore, this is but another example of the type of expensive and bad policy that has gotten California into the water mess it is in now. We can not keep using taxpayer dollars to subsidize resources so that businesses can make a profit selling subsidized goods. Water is expensive, and getting moreso. Let's not keep pretending it is free and infinitely abundant. Doing so just kicks the can down the road - at considerable short term and long-term expense.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Ross Rosen
5113 47th ave NE
Seattle, WA 98105

From: Rotondo, Mary <MaryRotondo@yvmh.org>
Sent: Monday, July 06, 2015 5:04 PM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Mary & Eric Rotondo
8704 Bristol Way
Yakima, WA 98908

June 15, 2015

From:

James Schwartz
781 26th Ave E
Seattle, WA 98112

Property Owner
104 FSR 4828-119
Easton, WA

To:

Ms. Candace McKinley
Environmental Program Manager
Bureau of Reclamation
Columbia-Cascades Area Office
1917 Marsh Road
Yakima, WA 98901-2058

Delivered via email: kkbt@usbr.gov

Subject: Economic Analysis of the YBIP and the KDRPP and KKC DEIS

Dear Ms. McKinley,

The following comments are submitted in response to the Draft Environmental Impact Statement (DEIS) for Kachess Drought Relief Pumping Plant (KDRPP) and the Keechelus to Kachess Conveyance (KKC), specifically for the re-opened comment period ending June 15, 2015. As I also submitted comments in the previous comment period on March 3, 2015, please view the below as an additional set of comments focusing more specifically on the economics and using documents published after my prior submittal. If only 1 letter is allowed, please use this letter for my formal feedback.

A Taxpayer's Economic Review of the YBIP

"How errors, inaccurate assumptions and false constraints drive the IP forward"

The current YBIP approach has taken years to develop, spent millions of dollars and published an unimaginable level of documentation. It has created a mind-numbing level of complexity that comes across as deeply analytical but in reality is nothing more than a carefully managed and curated set of assumptions gathered to support a foregone conclusion. By weaving together the specific self-interests of disparate groups into an "integrated" approach, the YBIP hopes to pursue individual projects that are economically unsupportable but somehow become acceptable when they are all done together. As the following analysis demonstrates, by simply pulling on a few single strands, the seemingly ornate and sophisticated economic bow of the IP readily falls apart. In the end, true economic benefits come in at $1.1B against costs of $3.5B and growing.

Specifically, the 4AA economic analysis has had to rely on a small number of key assumptions and constraints to generate its overall integrated B-C results. However, by simply adjusting a few parameters on future fish populations and starting points, correcting outright accounting & calculation errors, allowing for future climate change but not defaulting to the most severe climate-related economic outcomes and eliminating overly restrictive water trade assumptions, the economics of the IP and the corresponding B-C results change dramatically. With these changes, the 4AA B-C analysis changes as follows:

Present Value Preliminary Cost Allocation – 2012: With Adjustments

	Project Purposes			
	Ecological Restoration	Agriculture	Municipal & Domestic	Total ($M)
FAA Benefits	6,200	800	395	7,395
Adjustemtnts to 4AA Benefits	(5,300)	(600)	(355)	(6,255)
Revised Total Benefits	900	200	40	1,140
4AA Total Cost Allocation	2,440	729	351	3,520
Adjustments/Reallocations to 4AA Costs	(477)	679	(203)	0
Revised Total Cost Allocation	1,963	1,408	148	3,520
Revised Total Benefit-Cost	(1,063)	(1,208)	(108)	(2,380)
Revised Total Benefit-Cost Ratio	0.46	0.14	0.27	0.32
4AA Projected Total Benefit-Cost	3,760	71	44	3,875
4AA Projected Total Benefit-Cost Ratio	2.54	1.10	1.13	2.10

To further explain these conclusions, the following analysis will first identify and evaluate the impact of Benefit Calculation Errors and Cost Calculation Errors. This will be followed by revised B-C analysis correcting for the identified errors. Additional assessment of Water Supply Calculation Errors and concerns around Repayment will also be presented. After a summary of the above delineating a more refined and accurate overall B-C analysis, the impact of the identified issues will be translated into feedback and concerns for the KDRPP and KKC DEIS feedback process.

Finally, the point needs to be made that the ability of an individual taxpayer (obviously relying heavily on the WRC study and the Washington Legislature's desire to have more detailed B-C analysis) to conduct the following analysis and find the material errors and untested assumptions (again, much credit goes to the WRC) is quite disturbing. Taxpayers have paid millions of dollars for this work and yet substantial holes and errors are readily found. Taxpayers deserve much better accountability to ensure accurate, unbiased and appropriately audited economic analysis. This has not happened with the 4AA analysis (and unfortunately, the WRC study seems to gaining little attention despite its commendable treatment of many of these issues) and needs immediate attention. Specifically an updated KRDPP and KKC DEIS is needed and should be followed by a new public review and feedback period and more globally addressed in the form of corrected IP Four Accounts Analysis and updated IP cost allocation technical memorandums that will also be available for public review and feedback. Additionally, no material funding or capital budgets should be undertaken for the YBIP until these issues are addressed.

Benefit Calculation Errors

1) Benefit Calculation Errors: Benefits of the YBIP are calculated incorrectly: based on the 4AA document, the following errors and assumptions cause the 4AA to materially, and incorrectly, overstate YBIP benefits. (Note: much of this analysis and the ensuing calculations are based on the work contained in the Water Research Council's report on the YBIB).
   a) Fish Benefits of $5-7B are based on erroneous assumptions and are significantly overstated; True fish benefits are less than $1B.

      The following corrections to the current analysis lead to this conclusion:

      i) The current IP fish population growth rates of over 10% that are needed to achieve the higher ends of the fish population projections are without any meaningful scientific support. The highest rate used in current fish modeling analysis is 5%. At 5%, fish population projections should be limited to the low end of the plan with a target total increase of 181.65k fish. It will also take an additional 30 years to achieve these more accurate target populations. Further, the original pre-extirpation sockeye salmon populations in the Basin are estimated to be 100-200k. Given that sockeye represent over 85% of the total fish benefits in IP, it seems odd to be forecasting a potential increase over 2x this size given the many additional fish migration and survival challenges present now that were not there 100+ years ago.

         Perhaps a baseball analogy will help put the various fish population growth rates into perspective:

         A 5% average growth rate for salmon populations is like batting .300 in baseball. Over the years, 1000's of MLB players have batted .300 for a season or two. That said, only 139 players have done it for their career. Accordingly, modeling a 5% fish population growth rate is a reasonably achievable rate of growth, but it represents the far outside of the realistic range over a 100 year period. And, given this more reasonable rate of growth, it will take an extra 30 years for fish populations to reach the low fish population totals (i.e. 181k fish) called for in the FAA B-C calculations.

On the other side, assuming a fish population growth rate of 10%+ is similar to a .400 batting average. In MLB history, only 24 players have achieved it for one season, so it's technically possible, just like the FAA high-end fish population growth rates might be technically possible for a year or two. That said, no player has ever achieved a .400 batting average for their career. The closest was Ty Cobb who retired in 1928 with a .376 career batting average. In perhaps an interesting corollary with fish populations, the last time a player batted .400 even for a season was Bill Tyler in 1930. Much has changed in baseball since then just has much has changed in the ability for fish to reach historical population levels in the Yakima Basin. Accordingly, a 100-year fish benefit calculation that depends on any rate of growth above 5% is a substantially speculative projection without any long-term science supporting it.

ii) Accordingly, the potential for future fish populations above the low of 181.65k fish should simply be abandoned. The impact of these lower and delayed benefits on the Benefits Analysis is twofold. First, the total fish benefit of $6.2B needs to be reduced by $1.2B to constrain the total fish benefits to no more than 181k fish. Second, this lower present value total of $5.0B needs to be reduced by an additional ~$1.2B to reflect the additional 30 years it will take to achieve the total population of 181k fish.

iii) WTP fish benefits need to be adjusted for increases in fish populations not associated with the YBIP. As the 2011 Fish Benefits analysis discusses, on-going efforts not associated with the YBIP will yield an 18% increase in fish populations. Since the WTP data comes from a 1998 household study which assumed a baseline Columbia Basin fish population of ~2M and included decreasing marginal WTP values as fish populations increased, the starting point for the YBIP fish benefit should be adjusted by the 18% increase (~200k fish) and fish values decreased based on the now lower marginal WTP values. As outlined in the WRC analysis, this change reduces total benefits (on the low fish population levels assumed in (1) above by a further $2.7B.

iv) Fish Benefits should not start accruing until the projects that will benefit fish are actually completed. Fish Passage and habitat reclamation projects take time and will require several decades to fully complete. The current 4AA Benefit calculations assume fish benefits start at the beginning of the projects, which is simply not possible. The benefits start at the completion of the projects (as there can be no fish passage unless the actual fish passage infrastructure is built and functioning). Given the impact of timing on present value calculations, this error material increases fish benefits simply from a timing perspective. While project by project completion dates should be used, a simple 4 year delay provides a solid baseline assumption for this delay and decreases fish benefits a further 20% in the above present value calculations and equals a further $0.2B reduction from (1) and (2) above.

v) In summary, these changes reduce the projected $6.2B benefits associated with fish to $0.9B. Further, this benefit amount is based on 4AA calculations that include both Washington and Oregon households. As Oregon is not currently planning to financially support the IP, total fish benefits drop $333M to $0.567B when only Washington households are considered. This is an important adjustment for Washington legislators to consider when reviewing the IP and its funding.

b) Agricultural and Municipal water supply benefits of $1.4B are based on erroneous assumptions and include outright errors; True Agricultural & Municipal benefits are $0.24B or less. Thus the asserted 4AA $1.4B benefit is overstated by more than 5x the actual benefit.
   i) The following corrections to the current analysis lead to this conclusion:
   ii) The weather scenario used for the baseline 4AA Agricultural analysis is 8x more severe than historical data. Based on the WRC analysis (pp 67-68), 4AA implicitly assumes a severe drought (70% curtailment) 21.76% of the time for the next 100 years without the YBIP. Given the assumed 70% curtailment for all droughts in 4AA, this translates into an average annual curtailment of 15.232% for the 100 year period. For perspective, the actual average annual curtailment for the 1925-2009 period was 11.09%, so the implied impact of climate change in the baseline 4AA analysis is a 37% increase in average annual curtailment without the IP. According to the WRC report, 4AA also calculates the estimated impact on average annual curtailment if the Full IP had been implemented from 1925-2009. The historical estimate is 10.0% average curtailment with the IP. So the IP would have improved average annual historical curtailment by 109 absolute basis points and 9.8%. Given the 4AA assumed 30% curtailment in all drought years with the IP, the average annual curtailment with the IP drops to 6.528%, an improvement of 807 basis points and 57% improvement on the 4AA baseline of 15.232%. Since the benefits analysis calculates the value of the difference between the "no IP baseline" and the "with the IP" scenarios, it is calculating the benefit of moving from average annual curtailment of 15.232% to 6.528%, and thus the value of improving average curtailment by 807 basis points, which is ~8x greater than the calculated historical improvement of 109 basis points with the IP. Of note, the average improvement of the IP under the most severe climate projection (HADGEM) shows an improvement of 757 basis points for the IP over no IP baseline, so the "net, net" 4AA climate change impact on projected benefits aligns with the most severe climate change regime in terms of absolute $ benefits. Just as using the most severe climate regime is likely not appropriate, nor is ignoring the potential for climate change warranted. Accordingly, simply selecting a "middle of the road" climate assumption seems most appropriate. Therefore, a 4x climate change assumption (roughly 50% of the current benefit calculation) seems prudent, thus reducing the current $0.8B projected benefit by 50% to $0.4B is warranted.
   iii) The assumed constraint of no more than 10% inter-district water leasing completely compromises the analysis and more than doubles the benefits. (see http://www.roza.org/images/2015%20Water%20supply%20management.pdf) The 4AA analysis is willing to project radically different climate scenarios but is unwilling to even moderately conceptualize how the water districts might behave differently. Given the substantially different net revenue value of agricultural activities in the various water districts, but especially the low value within KRD and Kittitas County which is primarily hay, the current 4AA analysis assumption to limit inter-district trading effectively directs nearly 600 KAF of water to low value crops and leaves significantly higher value crops to be prorated. Further, it takes water that at a minimum will cost over $170 per AF to supply and uses it on crops with an average net revenue of under $100 and no more than $128 per AF of water. Given the impact of this one assumption, it seems 4AA should have at least conducted sensitivity analysis around the 10% trade limit and tested the impact of options up to 50-60% trade limit. The

WRC report details a "Full Trade" option which allows 100% trading and demonstrates (using the same data and methodology as the 4AA analysis) that the value of Agricultural benefits drops from $0.8B to $0.154B, an 81% decrease, if water is allowed to be used where it creates the greatest value. While the "Full Trade" assumption may be overly aggressive, certainly a more appropriate constraint than the 10% level should have been considered and used. So while the exact number may need further analysis, assuming a 50% inter-district trade constraint will allow 50% of the value to be captured. Accordingly, the current 4AA report overstates the Agricultural value of the IP by 2x (see the WRC analysis) and benefits should be reduced by 50%. Based on (1) above in this section, this represents a reduction of $0.2B of the remaining $0.4B in Agricultural benefits for a total of $0.2B.

iv) The 4AA and WRC reports both fail to evaluate the option of deficit watering, significantly impacting the benefits analysis. In both reports, the option to use deficit irrigation is not explored. Both assume full harvest or fallowed fields in terms of the economic impact. Interestingly, in the current 2015 drought, there is much publicity around creative deficit irrigation and the offsetting impact this can have in the face of a drought. An example will help illustrate this point. The 4AA assumes a severe drought removes ~600K AF of Agricultural water supply. Based on the same assumptions and analysis used in 4AA and WRC, this ~600K AF reduction in supply can be managed simply by reducing all hay (alfalfa, pasture, Timothy, and other hay) and wheat water appropriations (Senior & Junior) by 50% (certainly allowing a first cut for hay and a minimum of 50% production for wheat) and reducing (i.e. deficit irrigation) all other crops in the Basin by 20% (Senior and Junior). This requires no additional storage and allows those impacted to be compensated at a $ level 20% greater than their crops would generate and costs less than half of the current 4AA drought impact of $150M per drought under the IP.

v) The municipal water supply benefits in 4AA have an outright error in the formulas which overstates the benefits by 80%. 4AA alternatively uses annual lease purchases and prices in perpetuity (vs purchasing a permanent water right at 10% of the cost) and models a 1 time permanent water purchase value as an ongoing annual purchase (the permanent right only needs to be purchased 1 time, not every year) which also reduces the 4AA calculated benefit by 90%. As detailed in the WRC report (pp 156-159), adjusting for these two errors reduces the present value of municipal water benefits from $0.4B to under $0.04B, a 90% reduction.

vi) In summary, these changes reduce the projected $1.2B benefits associated with Agriculture and Municipal water to $0.24B.

c) In total, IP benefits drop from ~$7.4B to $1.14B, an 84% reduction. Without question, the above analysis reflects the significant impact a small number of assumptions and constraints has on the overall benefit calculations of the IP. By simply limiting the fish benefits to a historically relevant range (vs 2-3x historical norms), reflecting current reality in calculating fish benefits in terms of starting populations and aligning timing of benefits with the projects that produce them, providing more realistic water trading constraints (50% rather than 10%) that better reflect economics (and not holding our current water district structure as fixed in perpetuity), allowing for deficit irrigation to play its natural (and long established in fact) role in the process, and correcting a few unintended math errors, the entire group of IP benefits drops from $6.2B to $1.14B, an 82% reduction. Perhaps even more concerning, is how this process has unfolded with large outlays of public funds and years of review by government agencies, legislative bodies, work groups and consultants, and substantial review throughout can be undermined so completely by challenging a handful of assumptions and constraints. Clearly the "group think" affect is in play here with no one willing to look more objectively at the realities of this situation.

Cost Calculation Errors

2) Cost calculation Errors: Costs of the YBIP are materially understated and allocated incorrectly, dramatically favoring Agricultural interests: based on the 4AA and various Technical Memorandum documents, the following errors and assumptions cause the 4AA to materially and incorrectly understate and misallocate YBIP Agriculture costs.
   a) IP cost estimates are incomplete and changing (increasing) rapidly and the 4AA analysis fails to capture this effectively. The USBR has readily acknowledged in its recent public meetings that costs relative to a number of issues are not yet reflected in the IP calculations. Costs for domestic well mitigation, potential SEPA/NEPA issues, home value decrease mitigations, etc. are yet to be incorporated into the 4AA analysis. Further, estimated costs seem to be increasing rapidly. For example, the combined KDRPP/KKC projects have gone from $276M in the 4AA analysis, to $645M in the DEIS to now $850M in the most recently published Feasibility Design Analysis (published after the DEIS). It would seem a 3x increase in costs would warrant revisiting the 4AA B-C analysis that is clearly now outdated, incorrect and overstated. The WRC study explicitly calls for continued monitoring and incorporation of cost increases especially as it relates to construction cost changes and more accurately including mitigation costs.
   b) The cost allocation model includes material errors that significantly understate costs allocated to Agriculture by $679.3M:
      i) In the October 2012 Preliminary Cost Allocation Technical Memorandum, the present value analysis presented on page 17 shows an adjustment on Row 4 for Agriculture Justifiable Expenditure. Footnote 3 states the adjustment is for the "Lesser of values from Row 2 (Benefits at $800M) and Row 3 (Single Purpose Alternative Costs of $1,222M). [Note: "Single Purpose Alternative" (SPA) – costs that benefit more than one Project Purpose (e.g. Agriculture) and are thus allocated across Project Purposes] This is a misapplied and incorrect adjustment. While it is true that the total costs allocated should not exceed total costs, this specific calculation is used to create the appropriate weighting of costs for the actual allocation step. By incorrectly reducing the amount in Row 4 by $422M, the cost allocation process reduces allocated costs to Agriculture by $247.9M (thus over-allocating the same amount of costs to Ecological Restoration $209.7M and Municipal Use by $38.2M). The relevance of Footnote 3 is the real issue here and any basic cost accounting allocation review of this adjustment would clearly demonstrate the error in applying it to this situation/calculation.
      ii) Further in the October 2012 Preliminary Cost Allocation Technical Memorandum and in the July 2012 Reduced-Size Projects for Single Purpose Alternative (SPA) Preliminary Cost Allocation memo, there are a number of project scoping changes that are used to adjust the total cost allocation approach. Smaller costs are inserted into the analysis for potential reduced in scope projects at Wymer and Bumping Lake. Of note is the following statement on

page 1 of the July 2012 document: *"The reduced-size projects are intended solely to carry out the federal cost-allocation protocol, and do not reflect any change in the planned capacity or projects described in the Integrated Plan."* In other words, the allocation approach will use reduced costs for two projects that have a significant Agriculture benefit (thus understating the allocation to Agriculture) yet there is no plan to actually change those projects total costs or scope. This is simply bad and incorrect accounting. As a result of the above, the allocation costs for Wymer projects are reduced by $377M or 34%. Additionally, 100% of these costs are allocated to Ecological Use notwithstanding the numerous statements that Wymer benefits are 50% ecological and 50% agricultural (See 2012 Final Fish and Wildlife Coordination Report p 37). For Bumping Lake, costs for Ecological Use and Municipal Use are reduced by 15-20% and only 38% of the Bumping Lake allocation costs are assigned to Agriculture. It seems if the project cost allocation approach has significantly changed course that the overall discussion in the IP and the IP B-C analysis should be significantly restated as well. For the moment, let's assume the above statement that these adjustments are *"intended solely to carry out the federal cost-allocation protocol"* is relevant and no change is needed in IP projects scope and benefits. Accordingly, we simply have an accounting allocation error since the allocation approach should in fact mirror the benefits intended given the SPA approach. Correcting for this error, assuming 50% of the allocation costs for Wymer and Bumping Lake should be allocated to Agriculture increases the Remaining Joint Costs charged to Agriculture by an additional $431.3M and reduces Ecological Use by an additional $267.0M and Municipal Use by an additional $164.3M.

c) While the above does not change the total Remaining Joint Costs of $2,387M, i) and ii) above do reallocate the costs allocated to Agriculture from the current $532M and 22.3% of RJC costs to $1,211M and 50.7% of RJC to better align with proper accounting cost allocation methodologies and have the actual allocation calculations more accurately reflect the stated project benefit categories. This increase of $679.3M in costs for Agriculture further stresses the negative Agriculture B-C IP results with total Agriculture related costs now at $1.4B compared to Agriculture Benefits of $0.2B (see section 1) b) above).

B-C Calculation Errors

3) B-C Calculation Errors: Given the above, the overall 4AA B-C calculations need to be revised as follows (Note: much of this analysis and the ensuing calculations are based on the work contained in the Water Research Council's report on the YBIB with the exception of erroneous cost allocations):
   a) Summary of adjusted 4AA B-C analysis:

Present Value Preliminary Cost Allocation – 2012: With Adjustments

	Project Purpose			
	Ecological Restoration	Agriculture	Municipal & Domestic	Total ($M)
FAA Benefits	6,200	800	395	7,395
Adjustments to 4AA Benefits	(5,300)	(600)	(355)	(6,255)
Remove potential for Fish Populations to increase above 181k fish	(1,200)			
Adjust PV due to 30 additional years to achieve 181k fish population totals	(1,200)			
Adjust for 200k higher initial fish populations and their corresponding lower incremental WTP values	(2,700)			
Adjust for present value impact of not including fish benefits until fish projects are actually completed	(200)			
Correct for future climate scenario, reduce from 8x worse than historical to 4x worse (50% reduction)		(400)		
Correct for overly constrained water trade assumption of 10%; Allow for 50% inter-district trade reducing FAA Benefits by 50%		(200)		
Correct lease vs purchase price and calculation errors for Municipal Water Use			(355)	
Revised Total Benefits	900	200	40	1,140
4AA Total Cost Allocation	2,440	729	351	3,520
Adjustments/Reallocations to 4AA Costs	(477)	679	(203)	0
Correct Footnote 3 error: limiting SPA costs to the maximum of total benefits is an incorrect cost accounting step	(209.7)	247.9	(38.2)	0
Correct SPA allocations for Wymer and Bumping Lake to include 50% allocation for Agricultural Use; Also use full cost of projects	(267.0)	431.3	(164.3)	0
Cost Increases: KDRPP/KKC has increased over 300% from $276M to $850M+	?	?	?	?
Revised Total Cost Allocation	1,963	1,408	148	3,520

Revised Total Benefit-Cost	(1,063)	(1,208)	(108)	(2,380)
Revised Total Benefit-Cost Ratio	0.46	0.14	0.27	0.32

4AA Projected Total Benefit-Cost	3,760	71	44	3,875
4AA Projected Total Benefit-Cost Ratio	2.54	1.10	1.13	2.10

b) Given the 4AA Benefit calculation's significant reliance on sockeye salmon recovery and the singular reliance of sockeye primarily on Fish Passage (there is a small element of improved in-stream flows that can also benefit sockeye salmon) and the simple ability to separate sockeye benefits from habitat restoration and the great majority of in-stream flow benefits, the more appropriate B-C and cost allocation approach would be to separate fish passage and sockeye benefits/costs from those habitat restoration/conservation and in-stream flow project benefits/costs intended for non-sockeye fish species. In so doing, it is obvious the extent to which the fish passage and sockeye salmon related activities generate a significant proportion of the IP Fish benefits at a fraction of the total IP Fish costs. Specifically, sockeye related benefits total

$842M vs Costs of $475M for a Total B-C of +$367M. Non-Sockeye benefits total $58M vs $1,488M in costs for a Total B-C of -$1,430M. The following details the extent of these facts:

i) Overall Benefit Allocation for sockeye vs non-sockeye: As detailed above and on page 10 of the 4AA report, sockeye salmon represent 170k of the total 181.65k salmon/steelhead population increases associated with the IP (any higher increase in fish populations is simply not supported by science ... see WRC report pp 48-65). Accordingly, 93.6% of Fish Benefits should be assigned to sockeye and 6.4% to non-sockeye species.

ii) Fish Passage B-C assessment for sockeye vs non-sockeye: All sockeye will benefit from fish passage. In addition, as noted on page 93 of the WRC report, roughly 25% of the non-sockeye fish species will also benefit from fish passage. Given the total of 11.65k non-sockeye in the above total fish benefit, an additional ~3k fish needed to be added to the above sockeye count for a total of 173k benefiting from fish passage, of which 98% of the Fish Passage costs should be allocated to sockeye and 2% to non-sockeye.

iii) Habitat restoration/conservation and in-stream flow B-C assessment for sockeye vs non-sockeye: As sockeye only marginally benefit from certain in-stream flow enhancements in the IP and do not benefit from the habitat restoration/conservation elements of the IP, 100% of these costs should be allocated to non-sockeye species.

iv) Based on the "Specific Cost" (Costs directly attributable to only one Project Purpose (e.g. Ecological Use)) and "Single Purpose Alternative" (SPA – costs that benefit more than one Project Purpose and are thus allocated across Project Purposes) cost allocation methods applied in the October 2012 Preliminary Cost Allocation Technical Memorandum and now isolating Specific Costs and SPA allocated costs for Fish Passage and Habitat restoration/conservation and in-stream flows uniquely, the following results occur:

   (1) Of costs noted in the SPA category, 12.8% are for fish passage projects and 87.2% are for Habitat restoration/conservation and in-stream flows. These will be used to allocate RJC costs below.

   (2) Fish Passage: $351M in Specific Costs plus 12.8% of the Remaining Joint Costs for Ecological Use of $1.043B for a total Fish Passage cost of $485M.

   (3) Habitat restoration/conservation and in-stream flows: $568M in Specific Costs plus 87.2% of the Remaining Joint Costs for Ecological Use of $1.043B for a total Habitat restoration/conservation and in-stream flows cost of $1,478M.

v) Applying the above $ amounts to the sockeye vs non-sockeye fish species based on (1), (2) and (3) above yields the following:

   (1) Sockeye: Benefits = $842M (93.6% of $0.9B) vs Costs of $475M (98% of $485M); Total B-C of +$367M. A cost of per fish of $2,794.

   (2) Non-Sockeye: Benefits = $58M (6.4% of $0.9B) vs $1,488M (100% of $1,478M + 2% of $485M); Total B-C of -$1,430M. A cost of per fish of $127,725.

vi) The specific calculations are as follows:

Ecological/Fish Benefits - Present Value Preliminary Cost Allocation – 2012: With Adjustments

	Project Purposes: Ecological Restoration		
	Total	Sockeye	Non-Sockeye
Revised Ecological Total Benefits: Allocated to Sockeye & Non-Sockeye	**900**	**842**	**58**
Allocation of Ecological Benefits			
Allocate based on Fish Population Totals: Sockeye are 93.6% of Total Fish Population; Non-Sockeye are 6.4% at projected 181k Total Fish Population		842	58
Revised Total Ecological Cost Allocation: Allocated to Sockeye & Non-Sockeye	**1,963**	**475**	**1,488**
Allocation of Ecological Benefits			
Fish Passage: $351M in Specific Costs plus 12.8% of the Remaining Joint Costs for a Total Fish Passage of $485M. Allocate based Fish Passage Use (100% of Sockeye and 25% of Non-Sockeye Populations) = 98% Sockeye allocation and 2% non-Sockeye.	485	475	10
Habitat restoration/conservation and in-stream flows: $568M in Specific Costs plus 87.2% of the Remaining Joint Costs for a total of $1,478M. Allocated 100% to non-Sockeye.	1,478	-	1,478
Revised Ecological Restoration Total Benefit-Cost: Allocated to Sockeye & Non-Sockeye	**(1,063)**	**367**	**(1,430)**
Revised Ecological Restoration Total Benefit-Cost Ratio: Allocated to Sockeye & Non-Sockeye	**0.46**	**1.77**	**0.04**

Washington Only at 63% of Benefits & 100% of Costs

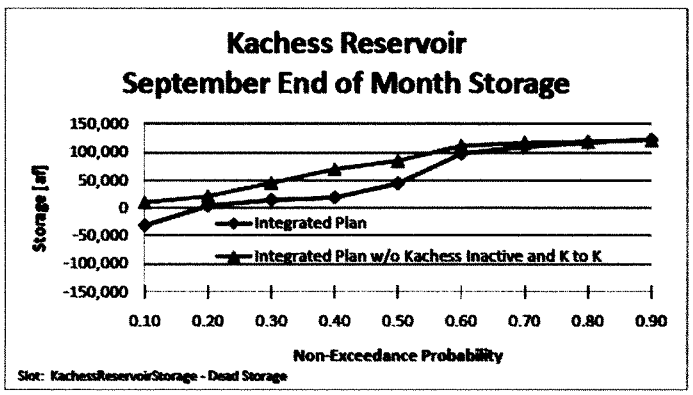
Revised Ecological Restoration Total Benefit-Cost: Allocated to Sockeye & Non-Sockeye	**(1,396)**	**55**	**(1,451)**
Revised Ecological Restoration Total Benefit-Cost Ratio: Allocated to Sockeye & Non-Sockeye	**0.29**	**1.12**	**0.02**

c) Clearly the fish passage projects related primarily to sockeye salmon and secondarily to non-sockeye species are well warranted. Equally clear is the complete failure of habitat restoration/conservation and in-stream flow projects to pass any B-C assessment.

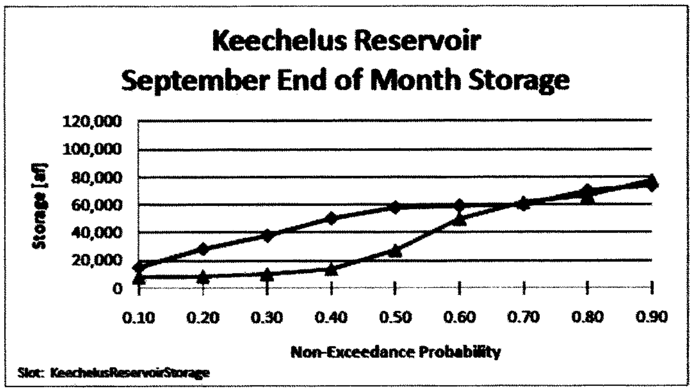
Water Supply Calculation Errors

4) Water Supply Calculation Errors: The estimated impact to Lake Kachess is significantly understated, not fully communicated to stakeholders and includes a significant error.
   a) There is already significant public feedback provided regarding the need for KDRPP and KKC DEIS to better address water levels and water supply issues. Items of significance include failure to address domestic water issues, NEPA/SEPA issues, and the impact on recreational benefits and home values. Those issues will not be repeated here.
   b) Interestingly, despite the existence of very sophisticated models, USBR has failed to provide any estimate directly to home owners on the projected impact KKDRPP and KKC on lake water levels. Given the substantial commentary in the various documents on RiverWare tools, one would expect this type of projection since it is readily available from the existing models. USBR has provided views of the how the IP would have impacted water levels at Lake Kachess over the last 25 years or

so. That said, this time period has been relatively benign with significant wet years often following drought conditions. These views do not represent the projected 30%+ drought incidence implicit in the IP benefit-cost analysis. While not presented in any of the recent stakeholder meetings, there was an analysis done on water levels in June 2011 as part of the Modeling of Reliability and Flows Technical Memorandum. In this document (p 138) they provide a probability estimate of the End of September Lake levels with and without the IP (see below). From this analysis, one can conclude that the IP increases the odds of the Lake being below 50K AF nearly 70% from roughly 30% of the time without the IP to roughly 53% of the time with the IP. Sadly, USBR officials have never shard this analysis and state "low water levels are not likely to happen" when directly questioned on the topic. Clearly providing important facts to stakeholders has been missed in this instance.



c) Unfortunately, the analysis in b) above also contains a material error. Given the existence of the KKC pipeline, the above chart/analysis assumes surplus water from Lake Keechelus will be available to help refill Lake Kachess. A similar chart of Lake Keechelus on the same page of the report shows the extent of the typical Keechelus draw down to pool minimums roughly 40% of the time and at or below 60K AF roughly 70% of the time. If there were no operational changes to Lake Keechelus, the above chart for Lake Kachess would be correct. Unfortunately, this is not the case as will be shown in d) below.



d) In the recently published March 2015 Feasibility Design Report – Draft Keechelus-to-Kachess Conveyance, section 10.2 on page 23 states *"the Keechelus target storage above which water is transferred into Kachess is critically important to maximizing the benefit to Keechelus Reach in terms of reducing summer high flows, while avoiding drawing Keechelus Reservoir down so low that adverse up-migration impacts occur to bull trout in the reservoir. ... the target would affect the amount of water that is transferred through the KKC tunnel ... [and the] Keechelus Reservoir target storage [is] set at 80,000 acre-feet"* minimum pool. In other words, transfer of water in the KKC to Lake Kachess is dependent on Keechelus water supplies being above 80K AF. Returning to the above chart for Lake Keechelus pool levels and now drawing a minimum pool level of 80K AF demonstrates a 90%+ likelihood of Keechelus being below this level and no transfers taking place during the summer to Kachess. Effectively, unless the difference of roughly 60K AF can be made up from another water source, this operating rule removes 60K AF from the summer water supply. Alternatively, if Keechelus does not maintain this minimum pool, there will be no migratory fish benefits based on access to Gold Creek and Cold Creek so the non-sockeye fish benefits of the KKC project would need to be radically changed.

e) Given this net reduction of 60K AF from the Keechelus water supply, the obvious option is to try to take this water from Lake Kachess (or recognize and model the fact that the Lake Keechelus project of the IP will remove 60K AF from the current water supply). Accordingly, the above Lake Kachess chart would need to be adjusted uniformly down by 60K AF. This means over 50% of the time the lake will be below current minimum pool levels and will be below 50K AF roughly 80% of the time, over a 250% increase from current average lake levels at the end of September. Clearly a significant impact and one that will drastically reduce recreational value and home values in the Lake Kachess area, let alone the potential impact on domestic wells.

f) Perhaps even more important is the need to correct this error based on the above analysis and share more broadly the results with the public in general but particularly the Lake Kachess area property owners.

Irrigator Repayment Issues

5) Irrigator Repayment Issues: Other than taxpayers (Washington and the Federal Government), there is no specific accountability or stated methodology for direct beneficiaries (irrigators) to help repay the appropriate costs of the IP.
   a) At a Federal level, the 4AA report provides the framework to support US Government funding for projects based on the impact across four areas (accounts) of National Economic, Regional Economic, Environmental Quality, and Other Social Effects. What it does not do is lay out any specific plan for how the primary economic benefactors of the plan, agricultural water users, will help fund the costs of the IP. This question has come up repeatedly in community meetings with the response from Work Group members and USBR staff suggesting irrigators will pay for the water they use, but no specifics are given. It seems this component of the plan should be well established within the IP and supported by legally binding agreements prior to embarking on such a large outlay of public funds.
   b) Within the Federal USBR documentation, Section 7.0 Repayment in the October 2012 Preliminary Cost Allocation Technical Memorandum (p 19) outlines a high level concept for repayment: *Reimbursable project functions included in the Integrated Plan are agricultural irrigation and municipal and domestic water supply. Construction costs allocated to agricultural irrigation are generally reimbursable without interest, while those allocated to municipal and domestic supply are reimbursable with interest. For the Integrated Plan, cost-share partners such as the State of Washington, local governments or other parties, may participate in reimbursement.* While this statement may sound good, it leaves much to interpretation. Taken literally, one would need to review costs directly allocated (i.e. "Specific Costs") to either Agricultural Use or Municipal/Domestic Use (project costs allocated under the SPA Costs would not be reimbursed) as these would be the only costs that qualify for reimbursement. Accordingly, Appendix B-1 of the above report identifies $179M of Specific Construction Costs assigned to Agricultural Irrigation and $0M of Specific Costs assigned to Municipal/Domestic Use. In other words, of total projected IP costs of over $3.5B, only 5.1% of the total costs would be subject to reimbursement. Further clouding the issue is the lack of clarity on who might qualify as the reimbursement partner. The above statement would allow WA State (and not irrigators) to qualify as the reimbursement partner.
   c) Of particular interest is the additional clarification in the above document as follows: *Ecological restoration is generally a non-reimbursable function that is typically expected to be borne by the U.S. Treasury in combination with the state and other cost-share partners.* In other words, the more the IP can identify costs as Ecological Use, the more the U.S Treasury will fund. Perhaps this explains the preponderance of costs allocated for Ecological Use in the October 2012 Preliminary Cost Allocation Technical Memorandum, despite significant documentation to water supply projects' Agricultural Irrigation use and benefits. What is important to note here is the need for specific definitions that clearly outline costs where reimbursement is required. Additionally, the cost allocation methodologies must be thoroughly reviewed to ensure the financial details align with the broader intent. Specifically, it seems if 40% of the total costs of the project can be assigned to Agricultural Irrigation use, then irrigators should pay 40% of the costs, not 5%. Otherwise, the IP is nothing more than a grand farm subsidy program that specifically benefits less

than 5,000 farmers, many of whom grow low value crops like hay and wheat. Accordingly, more specificity, more transparency and greater binding reimbursement structures are needed.

d) While Municipal/Domestic Use is also identified as a reimbursable element, the total water dedicated to these uses is minimal compared to agricultural uses. Additionally, municipal water districts and domestic well owners tend to purchase senior water rights to ensure adequate supply. Accordingly, the need for a reimbursement scenario for these uses is far less compelling.

e) Extending the same concern to the state level, WA State has already enacted stricter reimbursement guidelines than the Federal process. Via RCW RCW 90.38.120, the WA Legislature has required the following: *It is the intent of the legislature for the state to pay its fair share of the cost to implement the integrated plan. At least one-half of the total costs to finance the implementation of the integrated plan must be funded through federal, private, and other nonstate sources, including a significant contribution of funding from local project beneficiaries.* The statute also requires the State Treasurer's office to conduct an annual audit of the funding plan mandated by the law. What is still undefined, though, is the final and specific definition of the required "significant contribution" from "local project beneficiaries."

f) Funding Flip-Flop Issues: The above discussion highlights the concern associated with a funding "flip-flop" whereby the federal government allows Washington State to be the required reimbursement partner and Washington State relies primarily on the federal funding for its mandated 50% cost share with others. This lack of up-front specificity allows the IP to gain more momentum without addressing a fundamental and required issue surrounding irrigator repayment for agriculture benefits of the IP. Further, the history of similar USBR agriculture water supply projects is considered very questionable when it comes to mandated repayments actually taking place. Unless and until this issue is clearly defined and legally affirmed, the IP will continue to be viewed as a "farm subsidy" program poorly disguised as something else.

Summary

6) Summary: The current YBIP approach has taken years to develop, spent millions of dollars and published an unimaginable level of documentation. It has created a mind-numbing level of complexity that comes across as deeply analytical but in reality is nothing more than a carefully managed and curated set of assumptions gathered to support a foregone conclusion. By weaving together the specific self-interests of disparate groups into an "integrated" approach, the YBIP hopes to pursue individual projects that are economically unsupportable but somehow become acceptable when they are all done together. As the above analysis demonstrates, simply by pulling on a few single strands, the seemingly ornate and sophisticated 4AA economic bow of the IP readily falls apart. In summary, those strands single strands are as follows:

Correcting Benefit Calculation Errors reduces the benefit value of the IP by more than 84% to $1.14B.

a) The inherent assumptions for fish populations are borderline irresponsible with the IP's relevant range falling far outside of any proven, long-term scientific findings. Calculating sockeye population recovery simply on the basis of physical size of the lakes rather than any normative evaluation of pre-dam historical population sizes is also inappropriate and pushes fish growth rates well beyond accepted norms. The 4AA analysis should limit fish population growth to no more than 5% (or include costs for more aggressive human interventions). Further, it should account for the existing baseline populations of fish and adjust the starting point for benefits to align with project completion dates.

b) Agricultural Benefits incorporate flawed and incorrect assumptions regarding climate change and inappropriately constrains water use/trade dynamics. The IP hides behind a so-called "normative" future weather pattern that is 8x more severe than historical norms and aligns with science's worst case scenario. This extreme assumption dramatically overstates benefits for agricultural use. Further, the use of severe inter-district trading constraints effectively limits the IP to a "no trade" economic scenario (even though intra-district trade has been part of water district operations for decades) and becomes a circular argument to simply allow the existing water district system to remain the same for the next 100 years. It would seem the dooms day climate concerns raised by the IP would also warrant a much more aggressive review of the water district operations and allow/mandate a minimum of 50% inter-district trade to enable water use policy to align better with economic policy.

The above points are covered in much greater detail in the WRC study and point to the weaknesses inherent in the 4AA report.

c) Cost calculation and allocation errors inappropriately favor agricultural use. Correcting these errors increases agricultural use total costs by 93% to $1.4B.
   i) Correcting errors for Justifiable Expenditures and aligning Wymer and Bumping Lake cost allocations with the stated benefits (i.e. 50% agricultural use) increases Agriculture Use costs by ~$680M and brings agricultural use costs to ~40% of total IP costs – certainly in-line with what seems appropriate (vs the 20.7% in the current IP cost allocations).
   ii) Further, as individual project costs continue to increase, the pressure to redo the overall allocations and B-C analysis will only get stronger. Accordingly, defining a process for regular future review and incorporation of cost changes into the IP B-C analysis is warranted.
d) Given the errors in calculating benefits and costs, the entire 4AA B-C analysis needs to be revisited and corrected. Further, the 4AA B-C analysis should be integrated where the interdependence of projects is significant, such as for non-sockeye fish habitat restoration/conservation and in-stream flow improvements, and evaluated independently where the benefits and costs are much more discrete and have only limited interdependence, such as for sockeye/fish passage, agricultural use and municipal/domestic use. (Note: much of this analysis and the ensuing calculations are based on the work contained in the Water Research Council's report on the YBIB with the exception of erroneous cost allocations):
e) At the overall IP level, benefits shrink to $1.14B while costs are at $3.5B and growing, presenting an obvious failure to meet mandated B-C results.
   i) Sockeye/Fish Passage related benefits and costs are highly integrated and should simply be identified with a "one in the same" view. Accordingly, the overall sockeye/fish passage benefits are $842M with costs of ~$475M, clearly a strong B-C performer.

ii) Non-Sockeye habitat restoration/conservation and in-stream flow benefits and costs are also highly integrated and should similarly be treated as "one in the same" B-C components. Assuming this, benefits are $58M with costs of ~$1,488M, a clear failure of B-C analysis.

iii) Agricultural Use nets out with total benefits of $0.2B and costs of $1.4B. An unsupportable economic outcome.

iv) Municipal/Domestic Use ends up with total benefits of $0.04B and costs of $0.148B. An unattractive B-C outcome but only a small fraction of the overall IP benefits and costs.

v) Given the above results, allowing the YBIP to continue to hide behind an integrated only view of 4AA B-C analysis and provide no transparency on discrete macro benefit and cost areas is irresponsible and unacceptable. The WA Legislature recognized this concern. Accordingly, the WRC study is intended to address a disaggregated view of the YBIP and deserves much more significant review and discussion regarding the current YBIP/4AA approach and analysis. Taxpayers deserve much greater accountability.

f) The water supply analysis in the IP contains errors and needs much greater transparency. The RiverWare software is very sophisticated and can model many different scenarios. Accordingly, the existing analysis needs to clarify and correct for the 60 KAF shortfall surrounding Lake Keechelus' projected 80 KAF minimum pool size and provide much greater visibility to the 100 year impact on water levels at Lake Kachess. The models and analysis are obviously available to provide this analysis, what is disturbing is the lack of honesty and initiative to make the results available to the public.

g) Repayment needs to be firmly addressed and finalized prior to any IP implementation. The current scenario is like a bank providing a mortgage to a homeowner with no contractual obligation to repay the loan. More importantly, it is not at all clear that the homeowner (in this case, irrigators) can even repay the loan so there appears to be a concerted effort to lower the amount required for repayment by the homeowner (irrigators) and solicit a 3rd party to pay for it instead (in this case US and WA taxpayers). The IP needs to be clear and specific about irrigator repayment amounts and the mechanisms. There also needs to be independent review of this process to ensure accuracy, appropriateness and reasonableness on the part of irrigator's ability to repay the taxpayer loan represented in the IP. Given the weak B-C results identified above, it is not at all clear that irrigators would want to take out this loan if they had to pay a reasonable percent of the true costs (the costs far outstrip the benefits if irrigators had to pay for all of it), so this issue is a critical step in validating the assumed benefits of the current IP approach.

h) The IP process and Work Group have worked very hard over an extended period of time to develop the current approach. They are to be commended for exerting an extreme level of effort and bringing together organizations that typically are on opposite sides. Unfortunately, there is a deep and obvious truth that needs transparency and much stronger review. All of the special interests involved in the IP get something for their efforts. The irrigators get more water, the Yakama Nation gets fish passage and meaningfully revitalized sockeye population, land environmentalist get the Teanaway forest and other land conservation purchases, the river interests get substantial river fish habitat restoration and in-stream flow benefits and municipalities get a marginal benefit for long term water needs and security. The key ingredient for all of this to work is that none of them really have to pay for it. In all instances, the IP magic works to keep all of these groups together as long as US and WA taxpayers are willing to pay for all the costs. Knowing this, the group has thus far been able to keep the "integrated only" view of the plan together, negating the insights and diligence required to truly evaluate the plan. Accordingly, the economic analysis has had to rely on a small number of key assumptions and constraints to generate its overall integrated B-C results. However, by simply adjusting a few parameters on future fish populations and starting points, correcting outright accounting & calculation errors, allowing for future climate change but not defaulting to the most severe economic outcomes and eliminating overly restrictive water trade assumptions, the economics of the 4AA and the corresponding B-C results change dramatically. It may still be the case that the IP moves forward, but it should do so with the appropriate transparency and rigorous (and honest) analysis. We do not have that in the current 4AA analysis and it is the responsibility of taxpayer elected officials to ensure this occurs.

i) Finally, the point needs to be made that the ability of an individual taxpayer (obviously relying heavily on the WRC study and the Washington Legislature's desire to have more detailed B-C analysis) to conduct the following analysis and find the material errors and untested assumptions (again, much credit goes to the WRC) is quite disturbing. Taxpayers have paid millions of dollars for this work and yet substantial holes and errors are readily found. Taxpayers deserve much better accountability to ensure accurate, unbiased and appropriately audited economic analysis. This has not happened with the 4AA analysis (and unfortunately, the WRC study seems to gaining little attention despite its commendable treatment of many of these issues) and needs immediate attention. Specifically an updated KRDPP and KKC DEIS is needed and should be followed by a new public review and feedback period and more globally addressed in the form of corrected IP Four Accounts Analysis and updated IP cost allocation technical memorandums that will also be available for public review and feedback. Additionally, no material funding or capital budgets should be undertaken for the YBIP until these issues are addressed.

Specific Feedback for the KDRPP & KKC DEIS Process

7) Incorporating all of the above into the current KDRPP and KKC DEIS feedback process is an important final step. As the above analysis concludes, the current economic and B-C analysis of the YBIP is filled with errors and untested assumptions. The consequences of which leave the entire current B-C analysis as an insufficient body of work to be accepted. Accordingly, the impact on the current DEIS documents are so material that the current drafts fail the minimum threshold for acceptability. Therefore, the only appropriate next step is for USBR and WA DOE to correct the analysis for the above issues and re-issue an updated draft for public review. The magnitude of change and the material impact on the outcomes on the current DEIS from these issues make proceeding to a Final EIS, no matter how much it changes, completely unacceptable relative to the requirement for public review and feedback. Translating the above into specific points for the KDRPP and KKC DEIS feedback includes the following:

   a) Appropriate water level modeling is possible and needs to be incorporated into the DEIS. The Work Group and its consultants have developed a detailed RiverWare modeling tool. It needs to be used to model the water levels in Lake Kachess and Lake Keechelus given the IPs assumptions of severe 1 year droughts every five years and severe multi-year droughts (lasting 3 years) every 20 years. This analysis also needs to incorporate the fish benefit minimum pool issues already identified for Lake Keechelus (80 KAF) and to determine if a minimum pool would be enacted at

Lake Kachess. Given the discussions around know obstacles in both lakes with low pool levels, the lack of a minimum pool point should also reflect reduced fish benefits since anadromous fish will not be able to access Gold Creek, Cold Creek, upper Kachess River or Box Creek without addressing this issue. Based on the 2012 analysis mentioned above in Section 4, it appears the water levels in Lake Kachess will be especially compromised and reassurances to the contrary are simply empty promises with no basis in fact. As this has been a primary issue for homeowners in the Lake Kachess area, updating this analysis and providing further public review and feedback before issuing a Final EIS is an obvious requirement.

b) Considering the substantial impact on water levels in Lake Kachess, once the above analysis has been completed, the issue of lower water levels and how they impact domestic wells, recreational benefits and home values will need to be addressed. USBR staff agree this is an important issue for further review and grounding it in more detailed and accurate projections of lake water levels will be essential. Accordingly, a Final EIS should not be issued until a more substantial public review and feedback process has been undertaken as it relates to domestic wells, recreational benefits and home values.

c) Fish benefits need to be clarified. Based on the 4AA fish population projections, one would assume Lake Keechelus and Lake Kachess to be top priority projects for fish passage and habitat restoration since they represent ~45% of the total fish population growth benefits (Fish Benefits Analysis Technical Memorandum 2011). Surprisingly, Keechelus and Kachess are last or nearly last in all facets of fish benefit project scheduling and prioritization. It would seem that if they represent such a large percentage of the benefits, it would be top of the list for project priorities given they also offer high water supply benefits. Since this is not the case, one can assume that the calculated fish benefits for Lake Keechelus and Lake Kachess represent only assumed economic benefits for purpose of the B-C analysis and much more limited real world fish benefits, thus not warranting project prioritization within the IP.

d) Given the significantly reduced Agricultural Use benefits, the KDRPP project (which is identified as a 100% Agricultural Irrigation use project) alone fails to pass B-C analysis. Slightly moderating the severe climate change outcomes effectively modeled (though not readily identified as such) in the 4AA analysis from 8x historical norms to 4x quickly drops total IP Agricultural benefits to $0.4B. Given the recent cost estimates (most recent Feasibility Design Analysis) for KDRPP alone of ~$350M in field costs and likely over $500M in total costs, the KDRPP project alone fails to meet B-C requirements. Updating the DEIS accordingly and allowing for further public input and review is an essential next step.

e) Adding the above 4 issues to the long list of other concerns with the KDRPP and KKC DEIS process leaves available no other alternative than for an updated Draft EIS to be developed and initiate a new review process accordingly. Further, no Final EIS should be issued until this additional DEIS is published and appropriate public review occurs.

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From: Jay Schwartz <jays@jayschwartz.net>
Sent: Monday, July 13, 2015 11:06 AM
To: Ripchensky, Daria (Energy)
Cc: Jay Schwartz
Subject: Testimony for July 7, 2015 Hearing on S. 1694
Attachments: WRC - ybip_bca_swwrc_dec2014.pdf; Key Points - Review of the Economics and Benefit-Cost Analysis of the YB....pdf; Executive Summary - Review of the Economics and Benefit-Cost Analysis of....pdf; Review of the Economics and Benefit-Cost Analysis of the YBIP - 20150706....pdf; Senate Bill S1694 - Key Questions - Updated.pdf

From:
James Schwartz
781 26th Avenue E
Seattle, WA 98112
Member: Friends of Lake Kachess

To: Senate Energy and Natural Resources
Date of Hearing : July 7, 2015
Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project.

Senator Murkowski (Chair) and members of the Committee. The following comments and attached documents on S. 1694 are submitted in opposition to this version of the bill on behalf of Friends of Lake Kachess. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694. If possible, please confirm my request for adding these comments and documents to the hearing record.

I am opposed to authorizing S. 1695, as introduced. As the attached documents clearly demonstrate, the Yakima Plan includes environmentally damaging water storage projects that are not cost-effective. Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation. The attached documents include:

1. The Washington State Water Research Center's 2014 analysis of the YBIP with differs sharply from the 4AA provided by the USBR and the Work Group.
2. The economic analysis prepared by the various homeowner associations and fire districts surrounding Lake Kachess (Friends of Lake Kachess):
    a. A Key Points document which is the 1-Pager summary of the analysis
    b. An Executive Summary which outlines the findings
    c. The full Economic Review document which provides the detailed analysis supporting the overall findings.
3. A set of questions we would like included for the record and addressed by USBR in a formal response.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

James Schwartz

BENEFIT-COST ANALYSIS OF THE YAKIMA BASIN INTEGRATED PLAN PROJECTS

REPORT TO THE WASHINGTON STATE LEGISLATURE

December 15 2014

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Executive Summary

The Yakima River Basin lies in semi-arid south central Washington and supports a growing population as well as $3 billion agricultural industry that is heavily dependent on irrigation for production. The river system historically supported large runs of salmon and steelhead, but a variety of stressors both internal and external to the basin have reduced those populations substantially since the early 20th century. A reservoir system supplies water through the operation of five reservoirs with a combined storage totaling just over a million acre-feet (af). Stream flow is primarily derived from the spring snowmelt runoff. Precipitation in this area is winter-dominant, and is stored in the snowpack as a natural but seasonally declining reservoir for spring and summer water use. Water rights in the basin are over-appropriated such that a number of droughts in the last few decades have led to curtailment of water to junior water rights holders.

Historical drought impacts, concerns over the effects of climate change on snowpack, the potential for increasing anadromous fish abundance in the basin, and future municipal water demands have been the impetus for the development of the Yakima River Basin Integrated Water Resource Management Plan ("IP"). The IP includes the following elements:

- Reservoir Fish Passage
- Fish Habitat Enhancement
- Modifying Existing Structures and Operations
- Surface Storage
- Market-Based Reallocation
- Groundwater Storage
- Enhanced Water Conservation

Fish passage projects, habitat enhancements, and instream flow augmentation are designed to support increases in salmon, steelhead, and other fish populations in the basin. Proposed infrastructure and water market development are intended to mitigate instream and out-of-stream drought impacts through increased storage and improved water trading, respectively. In particular, the surface water and groundwater storage projects would increase cumulative water storage by 500,000 af for a total of 1.5 million af in the basin.

Many analyses of the IP and its components have been published to date. One of them, the "Four Accounts analysis" (2012), compares the net benefits of the IP as a whole against a no-IP alternative, and reports benefits ranging from $6.2 billion to $8.6 billion, and costs ranging from $2.7 billion to $4.4 billion. The reported Benefit/Cost (B/C) ratios are 1.4 and above, suggesting that the benefits of the IP as a whole outweigh its costs in aggregate net present value. These B/C results are provided for the full proposed implementation of the IP, but with limited exceptions, existing studies do not provide estimates of the net benefits of the individual components of the IP.

Section 5057 of the State of Washington Capital Budget for 2013 charges the State of Washington Water Research Center "to prepare separate benefit-cost [B-C] analyses for each of the projects proposed in the 2012 Yakima River basin water resource management plan [IP]". It further stipulates that "To the greatest extent possible, the center must use information from existing studies, supplemented by primary research, to measure and evaluate each project's benefits and costs." This report is in response to and framed by this charge.

Existing hydrologic and water management models of the Yakima River basin are used to examine the impact of proposed IP water storage projects, conservation, and proposed instream flows on drought impacts under a limited set of climate scenarios. A crop production model is used to assess the potential economic impact of IP projects and water market development on the economic risk of water curtailment. Municipalities in the basin are slated to receive water rights for future population growth under the IP, and these benefits to municipalities are estimated. The net benefits of fish passage for the five reservoirs in the basin, proposed IP instream flows, and habitat restoration in the basin for salmon and trout are assessed.

Because each of the proposed IP projects would operate within the Yakima Basin hydrologic system, there are extensive interdependencies among projects, so that the benefits of one project are often dependent on the implementation status of other projects. We show that the value of any given water storage projects is highest when no other water storage project is implemented, and that water market development also affects the value of water storage projects. The economic tradeoffs between instream flows for fish and out-of-stream water uses are also dependent on these factors. Selected results include the following:

- *A snapshot of IP benefit estimates for moderate climate, water market, and baseline fish scenarios.*
    - Agricultural irrigation benefits: $117 million.
    - Municipal and domestic benefits: $32 million.
    - Fish benefits: $1 to $2 billion.
- *When implemented together as part of the IP, the major water storage projects as a group do not pass a B-C test.* Net present value for out-of-stream benefits (NB) from the IP range from -$2.2 to -$2.7 billion (B/C ratios from 0.02 to 0.20) depending on market and climate assumptions. Estimated benefits of proposed instream flow increases cannot make up for this shortfall.
- *No individual water storage project provides positive net benefits for out-of-stream uses when implemented as part of the full IP, even under the most adverse climate and restrictive market conditions.*
- *Net benefits for out-of-stream use of individual water storage projects implemented with no other projects implemented are negative, with some exceptions under the most adverse climate and water market conditions.* Based on moderate climate and market outcomes, storage infrastructure projects implemented alone and without proposed IP instream flow augmentation result in the following estimated out-of-stream net present value and B/C ratios, none of which passes a B-C test:
    - Bumping Lake Expansion: NB=-$371 million; B/C ratio of 0.18.
    - Cle Elum Pool raise: NB= -$6 million; B/C ratio of 0.62. Under the most adverse climate scenario and moderate market conditions, NB=$5 million with a B/C ratio is 1.35. It is also the most likely of the storage projects to satisfy a B-C test under moderate climate based on the sum of out-of-stream and instream use value.
    - Keechelus to Kachess Conveyance: NB= -$110 million; B/C ratio of 0.20.

   - Kachess Drought Relief Pumping Plant: NB= -$107 million; B/C ratio of 0.46. Under the most adverse climate considered, Keechelus to Kachess Conveyance and Kachess Drought Relief Pumping Plant together provide net benefits of $6 million and a B/C ratio of 1.02.
   - Passive Aquifer Storage and Recovery: NB=-$82 million; B/C ratio of 0.35.
   - Wymer Dam and Reservoir: NB= -$1,217 million; B/C ratio of 0.09.
   - Due to diminishing economic returns to water in the basin, increasing the number of IP storage projects reduces the value of each water storage project implemented.
- *Instream flow benefits are insufficient to support the full suite of IP water storage projects given the net benefit shortfall in out-of-stream benefits, but proposed instream flows may be supportable through market purchases.*
   - Purchases of senior water rights to implement proposed IP instream flows would be less expensive than providing instream flows via IP storage infrastructure, with estimated costs ranging from $85 million to $500 million depending on water market and climate conditions.
   - Because of its low cost, Cle Elum pool raise is most likely to satisfy a B-C test under moderate climate based on the sum of estimated out-of-stream and instream benefits.
- *Reservoir fish passage projects are likely to provide positive net benefits through their pivotal role in supporting wild sockeye reintroduction into the basin.* Fish passage is estimated to provide benefits ranging from about $0.95 to $1.7 billion and cost a total of $0.35 billion for all fish passage projects, which provide B/C ratios ranging from 2.7 to 4.9 for the individual fish Passage projects.
- *Fish habitat restoration is unlikely to satisfy a B-C test.* Results for the net benefits of instream flow purchases and restoration investment together range from about $48 million to $294 million, which fall below their estimated combined costs of $450 million. IP restoration costs are estimated at $338 million, so our results suggest that restoration does not satisfy a B-C test. However, insufficient evidence exists to estimate the contribution of habitat restoration to fish passage productivity, which may affect the value of restoration.
- *Water markets show potential for reducing the impacts of basin-wide curtailment.* We estimate that potential net gains from trade net of estimated transaction costs range between $216 million and $1.4 billion depending on climate, the extent of market development, and the extent of IP development. We show that markets act as a substitute for IP water storage infrastructure in that more active markets reduce the value of IP water storage infrastructure.

This report is not intended as a review of prior benefit-cost assessments of the IP, but it does utilize and extend existing IP analyses, and sheds some light on the sources and accuracy of previous B-C estimates. The Four Accounts analysis estimates agricultural benefits of 0.8 billion, municipal benefits of 0.4 billion, fish benefits ranging from $5 to $7.4 billion, and costs ranging from $2.7 billion to $4.4 billion, which together provide positive net benefits and B/C ratios of 1.4 and higher. Our estimated benefits are lower for each category for a host of reasons. Notably, the assumed climate regime has substantial consequences for agricultural benefits, and the baseline salmonid abundance in the Columbia River Basin has important consequences for fish benefits.

Despite differences in results, there are important similarities in our findings. Fish passage projects alone comprise a small percentage of median IP costs but provide about 75% to 80% of the estimated benefits of the IP. In contrast, IP investments for instream and out-of-stream uses account for about 66% of median costs but provide a small fraction of benefits, although this breakdown is not explicit in the Four Accounts analysis. This distribution of costs and benefits drives the strong results for fish passage.

In accordance to the legislative charge, this report focuses sharply on Benefit-Cost analysis to assess the economic efficacy of individual projects. It does not include an economic *impact analysis* to assess the indirect economic impact of IP investments on the local economy or the statewide impacts of the potential use of state funds to support the IP. Nor does this report cover costs and benefits from ongoing, non-IP programs within the basin whose outcomes may impact IP benefit metrics, such as fish translocation or hatchery operations.

Due to data limitations, the majority of the results are based on simulation methods rather than statistical analysis, though statistical analysis is provided when feasible and useful. The consequence is that the majority of our results do not lend themselves to statistical confidence assessment, although robustness analyses are performed. Many necessary tradeoffs were made with respect to modeling approaches due to the dimensionality and scope of this research mandate. As is always true of modelling exercises, refinements are certainly possible and may provide more precision and accuracy for various aspects of this analysis.

Acknowledgements

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I. Introduction

The Yakima River Basin Integrated Water Resource Management Plan (IP) is a water management plan for Yakima River Basin of South-central Washington State that has arisen out of the Yakima River Basin Water Enhancement Project (YRBWEP), which has been in development over several decades (HDR Engineering et al. 2012). The IP includes the following elements (State of Washington Department of Ecology 2013a):

- Reservoir Fish Passage
- Fish Habitat Enhancement
- Modifying Existing Structures and Operations
- Surface Storage
- Market-Based Reallocation
- Groundwater Storage
- Enhanced Water Conservation

These elements are categories of more specific projects identified as component parts of the integrated plan. For example, there are six fish passage projects, one for each existing above-ground dams managed as a part of the existing Yakima Basin Project, there are several surface and groundwater storage projects.

An extensive legislative history and body of research has developed in relation to individual components of the IP and YRBWEP since the 1970s, much of it described and accessible from the U.S. Bureau of Reclamation Yakima River Basin Water Enhancement Project Columbia-Cascades Area Office website http://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/ (U.S. Department of the Interior Bureau of Reclamation 2013).

A Benefit-Cost analysis (referred to from here on as the *Four Accounts analysis*) has been published, which provides estimates of value of the IP as a whole against a "no action" alternative (ECONorthwest, Natural Resources Economics, and ESA Adolfson 2012). It reports net present value benefit and cost estimates of $6.2 to $8.6 billion and $2.7 to $4.4 billion, respectively, provide B/C ratios ranging above 1.4, suggesting that benefits outweigh the costs in aggregate present value terms (Table 2 and Figure 2, Four Accounts analysis).[1]

Estimated costs of implementing the IP have been reported more or less on a project by project basis. For example, Fish passage at Lake Cle Elum Dam is estimated to cost $81.5 million in present-value terms, and Wymer Dam (which would be a new dam and reservoir on Lmuma Creek) is estimated to cost $1,330 million in present value terms (HDR Engineering, Inc. 2012, page 8). While project-specific cost estimates have been reported, project-specific benefits have not been

[1] Throughout this report, we use "B/C" specifically to represent the ratio of benefits over costs. The term "B-C" will be used to represent benefit-cost analysis in general, or net benefits in particular (that is, the benefits minus the costs).

reported for most of the projects in the IP, so project-specific benefit-cost assessment as mandated for this report is not possible without additional analysis.

A. Objective of this study

The objective of this analysis is to perform benefit-cost analyses for the individual component projects of the integrated plan. Section 5057 of the State of Washington Capital Budget for 2013 charges the State of Washington Water Research Center "to prepare separate benefit-cost analyses for each of the projects proposed in the 2012 Yakima river basin integrated water resources management plan (Yakima integrated plan)." Further, "[t]o the greatest extent possible, the center must use information from existing studies, supplemented by primary research, to measure and evaluate each project's benefits and costs." Finally, "The center must measure and report the economic benefits of each project on a disaggregated basis, so that it is clear the extent to which an individual project is expected to result in increases in fish populations, increases in the reliability of irrigation water during severe drought years, and improvements in municipal and domestic water supply." This report is in response to this charge.[2]

B. Analytical framework

Analysis of the impacts of such a diverse set of projects in an interconnected environment such as the Yakima River Basin requires a suite of analytical tools, applied with recognition that the impacts of each project may be dependent on the implementation of other projects in the IP. Our analytical framework to examine the impacts of IP projects, operations, and market developments on drought risk to agriculture, municipalities, and fish abundance includes the following elements:

- RiverWare™ hydrological model, modified specifically for the Yakima River basin and parameterized for IP projects and operations,
- An agricultural crop production model to estimate the value of water use and the cost of curtailment in terms of agricultural production,
- A water market simulation model,
- A model for estimating municipal benefits,
- Models for estimating the impact of fish passage, instream flows, and habitat restoration,
- A model for estimating the economic value of fish abundance changes due to IP projects.

For each of these modeling components we rely heavily on the models that have already been developed for assessing various aspects of the IP. However, we modify these models as necessary in part because the objectives of this project are different than preceding research efforts, and in some cases we make modifications based on additional methodological and empirical grounds. In these

[2]Benefit-Cost analysis is a required for federal water resource planning and funding. The Principles and Guidelines for Water and Land Related Resources Implementation Studies (P&G) guides Federal evaluation of proposed water resource development projects (U.S. Water Resources Council 1983). The analysis in this report is generally consistent with these guidelines. The methods in this report are also generally consistent with the draft "Updated Principles and Guidelines" (Council on Environmental Quality 2013). However, our primary strategy for research is based primarily on our mandate from the Washington State Legislature.

cases we explain these changes in relation to the original models upon which we draw in hopes to better place our results in the context of prior reports.

C. Overview of results

As a point of comparison, a summary of reported aggregate benefits reported in the Four Accounts analysis is useful. The Four Accounts reports estimates benefits of the IP to range from $6.2 to $8.6 billion. Of this, $5.0 to 7.4 billion are attributed to forecasted improvements in fish populations (primarily salmon and steelhead), $0.8 billion to agricultural irrigation benefits, and $0.4 billion to municipal and domestic water supply benefits. The estimated costs for the IP reported in the Four Accounts analysis range from $2.7 billion to $4.4 billion.

For a host of reasons explained in this report, our range of benefit estimates are lower for all three categories of benefits. A snapshot of results representing moderate climate change, water market, and baseline fish conditions are

- Agricultural irrigation benefits: $100 million.
- Municipal and domestic benefits: $30 million.
- Fish benefits: $1 to $2 billion.

While these results are informative, our legislative mandate is to provide B-C analysis for each of the listed projects in the IP. Our results show the following:

- All individual fish passage projects are likely to positive estimated net benefits.
- All water storage and conservation projects fail to pass a benefit-cost test for out-of-stream uses, with limited exceptions under most adverse of the climate scenarios we consider.
- The net benefits of proposed instream flows for fish are negative when provided via implementation of IP storage, which is to say that instream flow benefits do not appear to be sufficient to make up for the shortfall in net benefits for out-of-stream uses.
- The costs of providing proposed IP instream flows are likely to be substantially lower if acquired via a (heretofore underdeveloped) market for instream flows. However, the net benefit of such transactions for the proposed IP instream flow augmentation is ambiguous due to uncertainty surrounding their impact on fish abundance.
- Water market development shows promise as a way to mitigate the impact of out-of-stream curtailment, and these benefits increase with more adverse climate.

D. Scope and limitations of this report

The scope of this report as defined by its underlying legislative mandate is in some ways expansive, and in many ways narrow. First, due to the number of projects within the IP and the complexity of the problem, we examine only the projects as defined by the Yakima River Basin Watershed Enhancement Project Workgroup (YRBWEP), the US Bureau of Reclamation (Reclamation), Washington State Department of Ecology (Ecology), and the private consulting firms who have been involved in the design of IP proposal and implementation. We do not examine any other design possibilities.

Second, our legislative charge explicitly calls for *benefit-cost analyses* of the component parts of the integrated plan. It is not uncommon for *economic impact analysis* to be carried out to assess indirect economic impacts of infrastructure projects on the regional or national economy, including, for example, impacts on job availability and employment, regional or national production and income, and/or the same types of economic impacts on the State economy that could result from the potential use of state funds to support IP projects. Economic impact analysis and benefit-cost analysis are distinct analyses that provide different information. Our legislative charge does not call for an economic impact analysis of the integrated plan, and we do not carry out such analysis. This analysis specifically focuses on the direct benefits and costs of the IP projects.

Third, an extensive amount of research has been carried out over the last 30 years working toward additional water storage infrastructure and fish habitat and conservation improvements. As charged in the enabling legislation, the analysis in this report relies heavily on research and modeling infrastructure that now exists from this extended effort. We owe a great deal of gratitude to HDR Engineering, ECONorthwest, Reclamation, and Ecology as well as other firms who have openly shared the models that they have been developing for the Yakima Basin and the Integrated Plan projects. That said, our legislative charge requires us to answer a set of questions that differ in many respects than those addressed in the existing body of literature, and we modify some aspects of the existing analyses on methodological and empirical grounds. We are indebted to those listed above and others for their contributions and prior work, but this research team, and the Project Lead specifically, accepts full responsibility for any shortcomings or errors in this report.

The large set of projects and potential benefits that we are examining requires a balance between expansive and exhaustive analysis versus clarity of results. We therefore limit our analysis in several ways. First, we examine only a subset of the combinations of projects, and choose our focus to best illustrate the range of possible outcomes. That said, due to the large number combinations of outcomes, we rely on the outcomes of these combinations themselves to provide some sense of robustness. Beyond this, analysis of variance in certain parts of the analysis, especially simulations, is limited. When we have statistical results to convey, we do so to shed light on the substantial uncertainty surrounding the impact outcomes. There are myriad assumptions implicit in each of the models, and the validity of the results is dependent on the validity of these underlying assumptions. We attempt to be clear about the most consequential assumptions underlying our results.

While we examine the impacts of various market and climate scenarios, we do not as a matter of course predict which of these scenarios are most likely within the range that we consider. For market outcomes, this is in part because water market development is actually part of the proposed IP. For climate outcomes, even the Intergovernmental Panel on Climate Change avoids making statements about the likelihood of one simulated climate scenario over another. What we do instead is report on the variation in outcomes within the domain of future market and climate outcomes. In terms of fish impacts, we would like to have been able to address a number of potential environmental and management realities in the Yakima basin that are likely to affect IP outcomes, including the spatial structure in water temperature variability, short-term fluctuations in ocean conditions and its effect on fish survival, multi-species, multi-objective hatchery operation decisions, and out of basin management that affects in-basin fish abundance. Unfortunately, the requisite data and information bases to address these issues are either unavailable, unknowable, or outside the mandate of the Legislative charge. More detailed discussion the weaknesses of the individual model frameworks are discussed in their respective sections.

Section II provides background of the Yakima Basin and descriptions of the individual projects examined; Section III describes the methods used in the analysis as well as methodological background and data that we rely on from previous studies; Section IV provides results for agricultural irrigation and municipal benefits and the opportunity cost of instream flows, fish benefit discussion, and individual project summaries. Section V concludes. An appendix provides additional background and technical analysis.

II. Context and IP project descriptions

The existing Yakima River reservoir system supplies water through the operation of five reservoirs with cumulative storage of 1.07 million af, which is about 30% of mean annual river flow. Runoff is derived mostly from winter precipitation in the Cascade Mountains, much of which is stored as snowpack (Vano et al. 2010a) . The largest use of water in the Basin is for irrigated agriculture, covering about 464,000 irrigated acres based on about 2.5 million af of irrigation water rights (ECONorthwest, Natural Resources Economics, and ESA Adolfson 2012). The primary source of water for this purpose is the federal Yakima Irrigation Project operated by the U.S. Bureau of Reclamation. The Yakima Project includes six irrigation divisions holding about 2 million af of water entitlements, and additional water is also supplied from non-federal diversions of surface water groundwater (HDR Engineering and Anchor QEA 2011). Figure 2 provides another graphic of the Yakima River Basin with a focus on the hydrologic system, the major water storage projects proposed under the IP, and the major irrigation districts.

Several droughts over the last 20 years have led to irrigation curtailments. Because of the characteristics of their water rights, three of the irrigation districts, Kittitas Reclamation District (KRD), Roza Irrigation District (Roza), and Wapato Irrigation Project (WIP) hold about 96% of the proratable water entitlements among the districts (ECONorthwest, Natural Resources Economics, and ESA Adolfson 2012), are subject to curtailment of irrigation water during droughts more than the other districts in the Basin. They are therefore among the primary beneficiaries of the water storage components of the IP. Municipal and domestic water use in the basin is also affected by water scarcity. Municipal water rights are primarily junior, and may be (and in limited cases have been) subject to water curtailment during drought, and residential development in part of the basin is required to mitigate new groundwater development with the purchase of surface water rights due to concerns about surface/groundwater interaction (Washington State Department of Ecology 2010). Benefits to municipalities of the IP include new (presumably uninterruptible) water supply of 50,000 acre feet per year to support municipal water demand growth in the Yakima River basin

(HDR Engineering and Anchor QEA 2011). In all, the proposed water storage projects are designed to provide approximately 500,000 af of additional storage to the basin, for a total of 1.5 million af of storage.

The Yakima River historically supported large anadromous salmonid populations, with runs estimated at 300,000 to 960,000 fish per year in the 1880s. Since then anadromous fish abundance has declined substantially, and three salmon species have be substantively extirpated from the basin – sockeye, summer chinook, and coho, and Steelhead and bull trout are listed as threatened under the Federal Endangered Species Act (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012). Reasons for the decline in these fisheries include the construction of storage dams in the Basin, the Columbia River dams, irrigation diversions that have altered stream flow, and numerous other factors (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012).

The Yakima Basin Integrated Plan (IP) has developed by a workgroup including the U.S. Bureau of Reclamation, Washington State Department of Ecology, the Yakama Nation and various Yakima river basin stakeholders, with a goal to "protect, mitigate, and enhance fish and wildlife habitat; provide increased operational flexibility to manage instream flows to meet ecological objectives, and improve the reliability of the water supply for irrigation, municipal supply and domestic uses" (HDR Engineering et al. 2012). Section II.A provides an overview of IP projects developed by the Washington State Department of Ecology. The IP includes fish passage at the five major dams designed to open up habitat above the dams. Proposed instream flow augmentation and habitat restoration are designed to provide additional fish abundance benefits as well (U.S. Bureau of Reclamation, HDR Engineering Inc., and Anchor QEA 2011).

This is meant only as a brief overview for context. Numerous other articles and reports are accessible for more extensive background on the basin and water related issues (including, but not limited to HDR Engineering et al. 2012; U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012; HDR Engineering Inc. et al. 2011). For extensive archives of reports, see the U.S. Bureau of Reclamation's Yakima River Basin Water Enhancement Project webpage at http://www.usbr.gov/pn/programs/yrbwep/2011 integratedplan/ and Washington State Department of Ecology's Yakima Basin Integrated Water Resource Management Plan website at http://www.ecy.wa.gov/programs/wr/cwp/ybip.html.

A. Summary of projects

The Integrated Plan consists of the following elements: (A) water storage, (B) conservation, (C) water operational changes, (D) water marketing, and (E) fish passage and habitat improvements. However, the projects included within each are variously named in existing reports, and the listed projects are in many cases categories of projects (e.g. "municipal conservation" and "agricultural conservation" represent sets of activities to reduce consumptive use or loss from municipal and agricultural water diversions). Further, project names used by the YRBWEP have changed for some of the projects. As such, we found that modest reclassification (within the spirit of the legislation) to be useful, so the projects specified in the legislation were grouped by element as follows:

1) Reservoir fish passage
    a) Kachess fish passage
    b) Box canyon creek fish passage
    c) Keechelus fish passage
    d) Tieton (Rimrock) fish passage
    e) Cle Elum fish passage
    f) Clear Lake fish passage
2) Tributary/mainstem fish habitat enhancement
3) Surface storage
    a) Wymer reservoir
    b) Bumping reservoir enlargement
    c) Cle Elum pool raise
    d) Kachess drought relief pumping station
4) Groundwater storage
    a) Shallow groundwater recharge
    b) Aquifer storage and recovery
5) Enhanced water conservation
    a) Agricultural conservation
    b) Municipal conservation
6) Modifications to existing structures and operations
    a) Subordination of power generation (Roza and Chandler)
    b) Keechelus to Kachess conveyance
7) Market-based reallocation

Despite some reclassification, elements of the IP have remained fundamentally unchanged since being tasked by the Legislature to provide benefit costs analyses for individual project components (Washington State Legislature 2013a). Individual projects continue to be refined, studied, and otherwise informed by stakeholder discussions as reflected in the Yakima River Basin Study (HDR Engineering Inc. et al. 2011), Yakima River Basin Final Programmatic Environmental Impact Statement (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012), technical memoranda for individual project components, and YBIP Workgroup meeting minutes and presentations. Where discrepancies exist, the following project descriptions are consistent with the Yakima Basin Riverware model (YAKRW) as implemented by HDR Engineering and Ancho QEA (2011) and its updated operational rules (HDR Engineering, Inc. 2014).

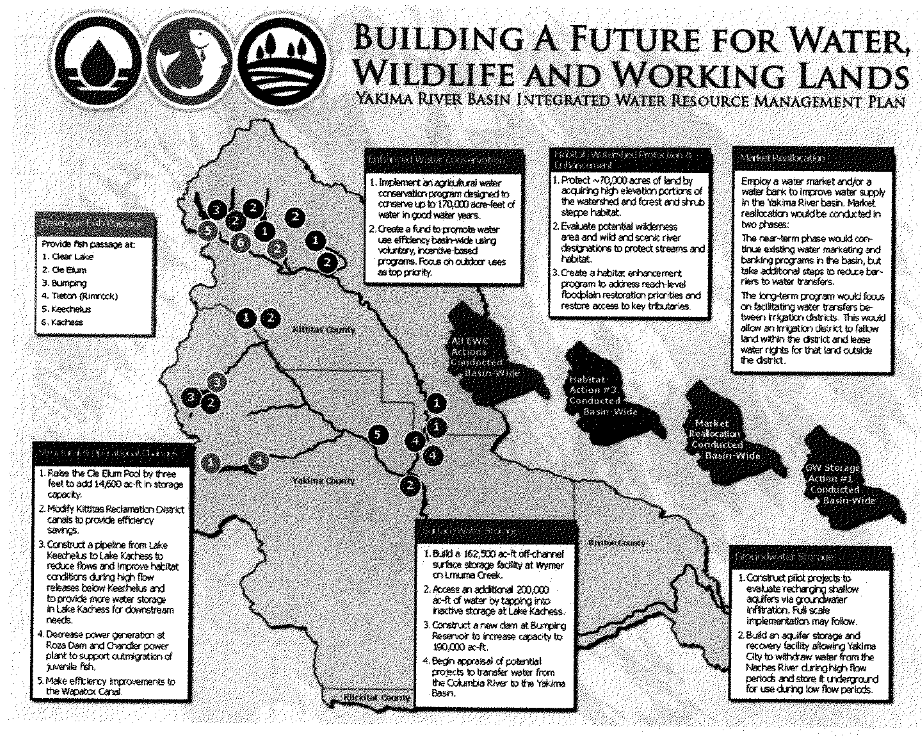

Figure 1: Description and general locations of IP projects (source: http://www.ecy.wa.gov/programs/wr/cwp/ybip.html. Also available in The Yakima River Basin Integrated Water Resource Management Plan Final Programmatic Environmental Impact Statement (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012))

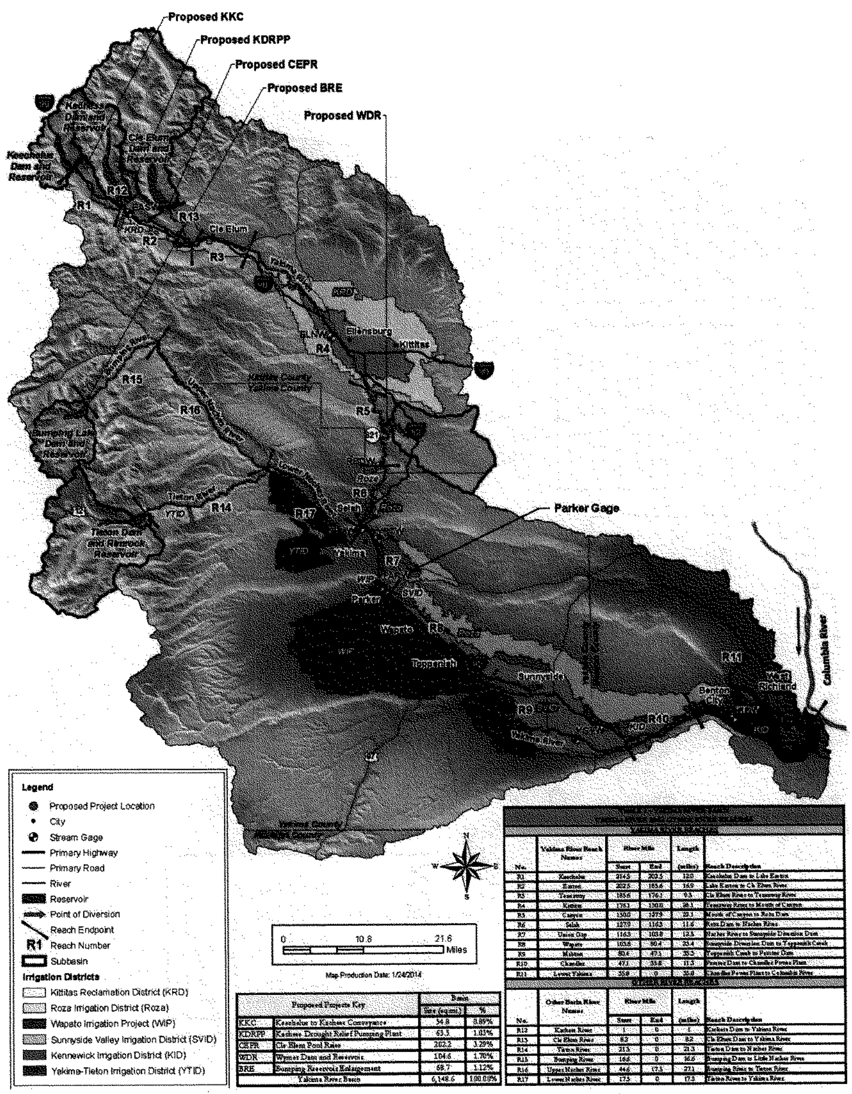

Figure 2: Yakima Basin and Integrated Plan water projects. Map and content courtesy of HDR Engineering, Inc.

B. Water storage projects

Wymer Reservoir. Located in Lmuma Creek eight miles upstream from the Roza Diversion Dam, Wymer Reservoir will provide 162,500 af in new water storage. A portion (82,500 af) would be used to improve annual instream flows for fish with the remaining 80,000 af reserved for irrigation needs (Operational Guidelines Committee 2013; Lynch 2013). There are two alternatives for releasing water from Wymer. The Riverware model assumes that water would be released directly below the dam in accordance with the "Wymer 1" alternative (HDR Engineering, Inc. 2014). Construction would include a new pump station at Thorp, a new pipeline connecting the pump station to the upgraded KRD Canal system, and a new intake tunnel to deliver water to the Wymer reservoir (HDR Engineering Inc. et al. 2011, 43; U.S. Bureau of Reclamation 2011b). An alternative plan for Wymer releases could include a new pump station on the Yakima River upstream of Lmuma Creek and a new pipeline that would convey water between the pump station and the reservoir (HDR Engineering 2012). Major components of Wymer reservoir originally outlined in a 2007 technical memorandum (U.S. Bureau of Reclamation 2011b; HDR Engineering Inc. et al. 2011) have since been updated to reflect modifications to the proposed power plant and revised construction cost estimates (HDR Engineering Inc. 2014). An additional technical memorandum quantifies the impact of Wymer releases on instream flow temperature (YRBWEP Workgroup 2013c), an important component of water quality affecting salmon survival. Results from the Riverware model suggests that Wymer releases have the potential to decrease downstream river temperature significantly in the summer and increase temperatures in the mid-fall period (Anchor QEA, 2014).

Previous benefit costs analyses of Wymer Reservoir were conducted as part of the Yakima River Basin Water Storage and Feasibility Study (2008b). Reclamation found that alternative versions of Wymer Reservoir – with and without a pump exchange on the Yakima River – had benefit-cost ratios less than 0.08 and 0.33, respectively (U.S. Bureau of Reclamation 2008b, 6).

Kachess Drought Relief Pumping Station (KDRPP). The construction of a new pumping plant would provide access to an additional 200,000 af in drought years. Water supplies would be used by irrigators during years when supplies fall below 70% of proratable entitlements (Operational Guidelines Committee 2013), because "the capacity for transferring Lake Kachess water to the Yakima River…was established based on the need to convey the additional 200,000 af of water over an approximately four-to-six month irrigation season" (U.S. Bureau of Reclamation, Washington State Department of Ecology, and Prepared by HDR Engineering, Inc and Anchor QEA 2011, 2). However, drought relief water would also be available to municipal and domestic water users (U.S. Bureau of Reclamation and Washington State Department of Ecology 2014). It is expected that the drought relief water supply, currently stored but considered inactive, would be made available three out of every 10 years throughout the IP's 100-year planning horizon (U.S. Bureau of Reclamation and prepared by HDR Engineering Inc 2013).

Aquifer Storage (ASR). Previous analysis of the Yakima Basin's groundwater storage capacity suggest that underground storage is a feasible alternative in the Yakima Basin (Golder Associates 2001). The IP provides for both passive and active aquifer storage and recovery projects (ASR).

The 2011 appraisal-level study explains that water for shallow aquifer recharge, or groundwater infiltration, would be applied to spreading areas like ponds and canals, each of which would be roughly 2-10 acres in size (2011). This infiltrated water would reduce the volume of water required from reservoir releases, supplementing the total water supply available (TWSA) and base flows in the Yakima River during low-water seasons (U.S. Bureau of Reclamation, Washington State Department of Ecology, and Prepared by Golder Associates, Inc and HDR Engineering, Inc 2011). Between 160 and 500 acres of infiltration area would be required to store 100,000 af (Golder Associates and Washington State Department of Ecology 2009), the annual average that could be made available for other uses (Reclamation and Ecology 2011n). Data collection and modelling efforts are currently underway to refine the timing of well injection and removal processes (YRBWEP Workgroup 2014b) at various test sites throughout the Yakima Basin (YRBWEP Workgroup 2014c).

Ahtanum ASR. The city of Yakima is proposing an active aquifer storage and recovery project described in Golder Associates (2014). This project is parameterized as part of the future municipal and industrial specification option in the YAKRW model. We incorporate it as a component of their baseline scenario. The city would divert and treat 5,000-10,000 af from the Naches River during winter, store the excess water underground, and recover the water reserves during the summer (HDR Engineering Inc. et al. 2011, 45). When completed the recovery wells, operating at a 3000 gallons-per-minute (gmp) capacity, would meet 100% of the city's peak demand. The project would also provide streamflow benefits, especially between the months of April and September (Golder Associates and Washington State Department of Ecology 2009), because a small amount of seepage (8% over one year and 40% over ten years) would supplement TWSA. (Golder Associates 2014). Given that this ASR project is not a named part of the IP, we do not provide a benefit-cost assessment of it.

Cle Elum Pool Raise (CEPR). Modifications to the radial gates at Cle Elum dam would allow water resource managers to raise the pool level by 3 feet, increasing total storage capacity by 14,600 af (HDR Engineering Inc. et al. 2011, 37). The additional water supply would be used for fisheries benefits (Operational Guidelines Committee 2013) in accordance with YRBWEP authorizing legislation (United States Congress 1994). A new release in the amount of 30,000 af would improve winter fish flows; the magnitude of spring releases have not been finalized (Lynch 2013).

Bumping Reservoir Enlargement (Bumping) The proposed Bumping Reservoir expansion would be smaller than those previously considered (United States Bureau of Reclamation 1979). The IP would expand Bumping Reservoir by building a new dam 4,500 feet downstream of the existing dam, expanding storage capacity from 33,700 af to 190,000 af (HDR Engineering 2012). A June 2013 presentation by the Operational Guidelines Workgroup Committee suggests how additional water supplies would be allocated among instream, flood control and irrigation needs. Winter and spring releases in the amount of 10,000 af and 32,000 af, respectively, would supplement instream flows. At least 34,000 af would be available for flood control at all times, and 34,000 af would augment TWSA (Lynch 2013).

C. Conservation

Agricultural water conservation measures include lining or piping existing canals, automating canals, constructing re-regulating reservoirs on irrigation canals, improving water measurement and accounting systems, and voluntary on-farm water conservation improvements, as well as other measures (HDR Engineering Inc. et al. 2011). The YRBWEP Conservation Advisory Group is tasked with establishing a prioritized list of projects and making selections on the basis of detailed feasibility studies (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012). RiverWare model guidelines identify the specific set of agricultural conservation projects reflected in the benefit-cost estimates (HDR Engineering, Inc. and Anchor QEA 2011; HDR Engineering, Inc. 2014). It is estimated that these projects would affect the control and distribution of 171,700 af of irrigation water in full water years, though this does not represent net water savings because reducing proximate water loss will reduce instream flows downstream. A portion of the water savings could be placed into the State Trust Water Rights Program to serve instream needs (YRBWEP Workgroup 2013a), but this is not accounted for in the YAKRW guidelines. The conservation savings estimates exclude conserved water that would result from projects that have been previously planned under YRBWEP (HDR Engineering, Inc. 2014).

Under the IP *municipal conservation program*, educational measures and incentive-based actions to achieve municipal and domestic conservation estimates set forth in the Integrated Plan (HDR Engineering Inc. et al. 2011, 58). Average municipal conservation savings under the Integrated Plan are estimated to be 22,100 af annually in total water use (HDR Engineering, Inc. 2011). Of this 7,600 af/year will be consumptive use savings. It is assumed that 60% of these annual savings will be accrued by 2030, and 100 percent by 2060. Examples of incentive-based actions currently under consideration include investing in infrastructure improvements to reduce leakage, distributing more water efficient equipment (appliances, shower heads), funding public education programs, and changing indoor plumbing codes and water rate structures (HDR Engineering, Inc. 2011).

D. Water operations

Power Subordination at Roza and Chandler. Water supply use for hydropower production at the Roza and Chandler power plants will be decreased in order to provide more water instream for local fisheries. The IP assumes that the Roza plant will not produce power in April and May and that the Chandler plant would stop production in April, May and June. This level of subordination would result in 25,000 MWH of foregone annual power production (U.S. Bureau of Reclamation 2011d). The precise decrease in power production is under discussion, and actual levels of subordination would be determined by a management team that would provide recommendations on an annual basis (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012, 5–17).

Keechelus to Kachess Conveyance (KKC). A new conveyance between Keechelus and Kachess Reservoirs would help moderate Upper Yakima River fish flows and make the process of refilling Kachess more efficient (U.S. Bureau of Reclamation 2011c). The conveyance would capture excess runoff in the Keechelus Reservoir drainage basin and store the water in the Kachess Reservoir (U.S. Bureau of Reclamation and Washington State Department of Ecology 2014). While the preferred method for the conveyance is either of two tunnel alternatives ranging in length from 17,000 to 19,000 feet (YRBWEP Workgroup 2013b), the model assumed that the conveyance would take the form of a shorter pipeline consistent with the YAKRW model (HDR Engineering, Inc. 2014; HDR Engineering, Inc. 2014) . The conveyance would provide the most benefits in drought years, but transfers between the two reservoirs would be made in all years. The YBIP model simulated average transfers of 92,182 af in annual conveyances from Keechelus to Kachess based on actual flows from 1981-2003 with a fully implemented Integrated Plan (YRBWEP Workgroup 2012, 8–9). Note that this included simulated transfers of 43,565 af and 55,806 af in the 2001 and 2005 severe drought years, respectively. YAKRW modelling guidelines assume that conveyances occur if Keechelus storage exceeds minimum target pool levels, which vary throughout the year. Transfers serve to increase the additional storage capacity of Keechelus and decrease additional storage capacity of Kachess by the amount of water transferred. Project goals could be accomplished through average flows of 400 cubic feet per second (cfs) (U.S. Bureau of Reclamation and Washington State Department of Ecology 2014).

Water Marketing. Water marketing programs facilitate the reallocation of water from willing sellers to willing buyers. The benefits from water marketing are the result of the increased productivity of water, namely the substitution of lower-valued uses for higher-valued uses. Despite a budgeted capital cost of $2.1 million and annual O&M costs of $212,000 (HDR Engineering et al. 2012, 18), there is no detail in the IP regarding which actions are envisioned in the water marketing component, nor how proposed changes would differ from current market infrastructure and conditions. Although the Framework for Implementation document discusses some of the barriers to water markets (pg. 46), the IP's planning documents and technical appendices only make generic references to how these barriers would be surmounted (i.e. building trust, increasing the transparency of information; a document compiling all of the detailed quotes from these documents regarding water markets is available on request). The Technical Appendix on water marketing (U.S. Bureau of Reclamation, ECONorthwest, and State of Washington Department of Ecology 2011) describes a number of assumptions about the potential for markets, but does not describe what legislative, regulatory or operational changes would lead to these outcomes. The only reference we have found to specific actions is in response to comment letter 28 on the IP's EIS, where the agencies report that:

"Details about the Market Reallocation Element can be found in the Ecology's 2009 Integrated Water Resource Management Alternative Final EIS and its supporting documents and in the "*Market- based Reallocation of Water Technical Memorandum*" (Reclamation and Ecology, 2011j). Ecology considered a wide range of marketing options and the Integrated Plan proposes the removal of legal barriers to implementing an open water marketing system. A rotation fallow program is included in the Long-Term Option for the Market Reallocation Element." (pg. CR-231)

Ecology's 2009 Alternative Final EIS pertained to a program that is a precursor to the current IP; it is not part of the current set of IP planning documents. Nonetheless, we make the assumption that the actions proposed in Ecology's 2009 Alternative Final EIS (Washington State Department of

Ecology 2009), and the 2009 Technical Appendix on water marketing (Mary McCrea and Ernest Niemi 2009) are the basis for the specific actions of the water marketing component. As such, the recommended options for the near term would include expanding the jurisdiction of the Yakima Superior Court to handle both permanent and temporary transfers, and seeking funding from the Legislature to support this work (Washington State Department of Ecology 2009, 2–63). Further funding would be necessary to support the Superior Court in this work after the *Acquavella* adjudication is completed. Ecology would also explore the possibility of temporary approval of permanent transfers that were "unlikely to result in an impairment." None of the documents describe specifically how this change would lead to the increased use of markets assumed in the 2011 Technical Report on markets.

The "long-term" option would involve market transfers between irrigation districts who participate in voluntary fallowing, but again no detailed changes are specified. This long-term scenario is not a guaranteed outcome in the IP documents. Ecology's 2009 EIS points out that irrigation districts can act as a barrier to water markets by preventing transfers outside the district (pg. 2-59), and stresses that the participation of districts in the long term option would be voluntary - "if they so desired" (pg. 2-64). Furthermore, the IP's 2011 Technical Report describes limits on water markets that are weakly justified, most notably limiting out-of-district transfers to 10% of the district's water supply.

Proposed instream flow changes under the IP. Instream flow augmentation as proposed under the IP is primarily intended to promote abundance of (primarily) anadromous fish in the basin. Table 5-3 in the Final Programmatic Environmental Impact Statement for the IP (FPEIS) shows flow augmentation objectives for each river reach, and provides a categorical assessment of the degree to which these flow goals are successfully met (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012). As described in the FPEIS, the additional flows used to augment current instream conditions would be partially obtained from the new storage projects and agricultural water conservation measures, in part at the expense of out-of-stream uses; as well as by diverting less water for power production at Roza and Chandler power plants.

E. Fish passage and habitat

The IP's estimated impact on future fish populations are justified by the proposed fish passage projects at Cle Elum Reservoir, Wymer Reservoir, Keechelus Reservoir, Kachess Reservoir, Tieton reservoir, Clear Creek Dam and Box Canyon Creek. Fish benefit estimates presented in the Four Accounts analysis (ECONorthwest, Natural Resources Economics, and ESA Adolfson 2012) reflect estimated increases in adult salmon populations that result from simulated instream flows (HDR Engineering, Inc. and Anchor QEA 2011) and different combinations of individual projects (U.S. Bureau of Reclamation, HDR Engineering Inc., and Anchor QEA 2011). The IP estimates fish passage benefits by comparing expected fish populations under an IP that is fully implemented with fish passage components ("Restoration + Passage") to fish populations under the same IP, but without fish passage components ("Restoration" only) (U.S. Bureau of Reclamation, HDR Engineering Inc., and Anchor QEA 2011). Previous studies have estimated the effect of fish passage projects on basin fish populations at a limited number of individual reservoir sites

(Ackerman, Cramer, and Carlson 2002; U.S. Bureau of Reclamation 2008a). Fish passage projects have the potential to make upstream habitat accessible for spawning six to eight miles above Bumping, 0.8 miles above Kachess, 34.8 miles above Tieton, 13.8 miles above Keechelus, 29.4 miles above Cle Elum, 1.6 miles in Box Canyon Creek, and 2 miles above Clear Lake Dam (U.S. Bureau of Reclamation 2011a; U.S. Bureau of Reclamation 2003).

Cle Elum and Bumping Reservoirs. Cle Elum has been singled out as particularly important for the reintroduction of sockeye (U.S. Bureau of Reclamation 2011a; Yakima Basin Fish and Wildlife Recovery Board 2004; HDR Engineering Inc. et al. 2011). The proposed Cle Elum fish passage facilities would include a helix bypass conduit for juvenile fish and a fish ladder leading to a separate collection site where adult fish are trapped and hauled upstream via tanker truck (HDR Engineering Inc. et al. 2011; HDR Engineering 2012). A series of schematics are shown in the project-specific Technical Memorandum (U.S. Department of the Interior Bureau of Reclamation 2011)- the design of the helix conduit is currently being refined (YRBWEP Workgroup 2014b). The final design for the fish passage facilities at Cle Elum was 30% complete as of March 2014 (YRBWEP Workgroup 2014b) with a 60% final design review scheduled for July 2014 (YRBWEP Workgroup 2014a), though this final design update is not yet published to our knowledge. Fish passage facilities at Bumping dam may be similar to those at Cle Elum (HDR Engineering Inc. et al. 2011)

Keechelus, Kachess and Tieton (Rimrock) Reservoirs. As described in Volume 1 of the Proposed Integrated Water Resource Management Plan, upstream and downstream fish passage would be installed at the Keechelus, Kachess and Tieton Reservoirs (HDR Engineering Inc. et al. 2011). While construction details are "subject to further evaluation of alternatives to determine the most feasible approach" (2011, 34), project development is scheduled to proceed similarly at each site. Following a three year study period, two subsequent years for environmental review and permitting, and a three year construction window, it is expected that fish passage construction will be completed by the end of 2023 (HDR Engineering Inc. et al. 2011, 61). While each fish passage facility would benefit a variety of species, the passage at Tieton Reservoir is anticipated to also connect bull trout populations with those in the Naches Basin, and enhance the ability of steelhead to colonize tributaries to Rimrock Reservoir (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012).

Box Canyon Creek & Clear Lake Dam. Fish passage improvements at Box Canyon Creek and Clear Lake Dam are important for upstream bull trout populations. YBIP actions in Box Canyon Creek would expand the amount of accessible habitat as well as enhance the quality of existing shoreline habitat for fish (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012). The proposed improvements at Box Canyon Creek complement the Kachess Drought Relief Pumping Plant project, which would lower creek flows in severe drought years (HDR Engineering Inc. et al. 2011). The Clear Lake dam is located upstream of Tieton Reservoir. The proposed fish passage improvements would overcome the limitations of the current fish ladders, promoting upstream fish migration and enhance the value of fish passage improvements at Tieton (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012).

Habitat Improvements. This component of the YBIP contains an extensive fish habitat enhancement program that aims to restore critical habitat, augment instream flows and remove additional barriers to fish passage. Habitat improvements would occur throughout the mainstem of the Yakima River and on tributaries in the middle and upper reaches of the Yakima basin. Consequent to much of the decision making for design and prioritization of habitat management actions being decentralized and vested with local agents, as per for example the Washington State Salmon Recovery Act of 1998, a single detailed list of management actions is not at hand. Prioritized lists of currently planned and "in-process" projects (YRBWEP Workgroup 2013a), subsets of the entire IP, are maintained by the Habitat Subcommittee, who is formally tasked with prioritizing projects that are: "1) scientifically defensible; 2) synergistic with other projects and funding sources; 3) expand on the Yakama Nation, Kittitas, and Yakima County floodplain restoration efforts; 4) improve bull trout populations in relation to the KKC and KDRPP projects; 5) enhance watershed protections for fish and water supply; and 6) support other elements of the Integrated Plan" (YRBWEP Workgroup 2014a, 6). In order to prioritize habitat enhancement actions, Reclamation and Ecology have set up a coordinating group similar to YRBWEP's Conservation Advisory Group (HDR Engineering Inc. et al. 2011). Future habitat enhancement would build on past work by other stakeholder groups in the Yakima Basin. In particular, YBIP would rely on strategies identified in the Yakima Subbasin Plan (Yakima Basin Fish and Wildlife Recovery Board 2004) and complete most of the priority action types described in the Yakima Steelhead Recovery Plan (Ch. 5.5, Yakima Basin Fish and Wildlife Recovery Board 2009), as stated in the Final Programmatic Environmental Impact Statement (2012). A variety of conservation projects have already been completed in the upper basin near Manatash Creek and the Teanaway River. These upper basin projects contribute to the 553 total known restoration actions to improve fish habitat completed (and 36 additional, as yet incomplete projects) in the Yakima basin since 1989 (Pacific Northwest Salmon Habitat Project Database, accessed 9/16/2014; Katz et al. 2007a; Barnas and Katz 2010).

III. Methods

The legislative mandate (Washington State Legislature 2013, p180) calls for project-specific benefit-cost analyses for individual YBIP projects, which requires modeling the Yakima Basin hydrological system with and without specific projects such that the economic outcomes of each scenario in terms of irrigated agriculture, municipal water availability, and fish populations may be compared. The physical and economic outcomes of the YBIP projects are the results of complex interactions between the natural ecosystem, the built infrastructure, infrastructure operations, water use, and economic factors. To carry out our legislative charge, a suite of modeling approaches is used to represent different components of this complex system. The legislative mandate also explicitly requires that existing YBIP data and study findings be utilized to the greatest extent possible (see U.S. Department of the Interior Bureau of Reclamation 2013, for examples). We therefore use those available models, data and other information provided in these studies directly as a starting point, or at a minimum, as a frame of reference for this research.

While the legislation calls for benefit-cost estimates for each project in the IP, it is likely that the net benefits on one project are dependent on whether another project in the plan is implemented. This economic interdependence does not mean that projects cannot be implemented or assessed separately from each other. Indeed, this study assesses the benefits and costs of individual projects. that the economic outcomes are for one project depend on the status of the other, and so the benefit-cost assessment for each project is *conditional* on the status of the other project, and must be interpreted as such. This condition is also often referred to as economic *non-separability*, which again does not mean that the project are not implementable separately, but that the benefits and/or costs of each project depends on (cannot be separated unconditionally from) other projects.

There are several sources of economic interdependence in outcomes: 1) Technical complementarity and/or substitutability across projects, 2) Diminishing marginal productivity across projects, and 3) Diminishing marginal value of impacts. Technical complementarity or substitutability occurs when the productivity of a project is dependent on the implementation of another project. Within the IP, this may pertain to fish habitat and fish passage productivity and water availability and distribution. For example, the effectiveness of fish passage at Cle Elum dam may be enhanced by increasing minimum allowable instream flows during low-water periods (but this does not mean that one cannot or necessarily should not be implemented without the other). In contrast, water allocation benefits through facilitated water market transactions may be reduced if water storage is increased because gains from trade between senior and junior water rights holders will be lower with reduced curtailment risk. Diminishing marginal productivity and diminishing marginal value are important in cases where a project augments the outcome of another project, and is important to examine in cases where additional water storage and fish habitat or passage projects are considered. For example, irrigators have recognized that the marginal impact of minor diversion curtailments have minimal economic impact, but that major curtailments have larger marginal impacts, suggesting diminishing marginal productivity of irrigation water (HDR Engineering and Anchor QEA 2011). For increases in fish production, diminishing marginal value of fish populations was considered in the Four Accounts analysis of the IP (ECONorthwest, Natural Resources Economics, and ESA Adolfson 2012).

These three types of non-separability across projects suggest that the net benefits of any proposed project depends, to some extent, on the implementation of other portions of the IP. However, the number of possible combinations of projects is very large (2^n possible combinations of n projects), so we limit the number of conditional analyses by balancing the likely magnitude of conditionality effects with the costs of the analysis (e.g. computation and coding time, clarity in results). For instance, the implementation status of fish passage projects will have little effect on water storage outcomes, so we treat these two categories of projects separately.

In this section we provide an overview of the modeling framework used in the analysis, a detailed description of the component models, and describe how benefits and costs are calculated and aggregated.

A. Modeling overview

This modeling framework incorporates several components, including a hydrological model that accounts for both snowpack and rainfall when quantifying the total water available for out-of-stream use and instream flow requirements within the basin; agricultural and municipal water demand/value models for estimating the economic cost of curtailments; fish impact assessments that examine the suitability of instream flows and habitat access and quality; fish value estimates as a function of fish populations, as well as other factors such as the predicted cost of lost hydroelectric power to provide instream flows.

Figure 3 is a modeling overview that describes the general relationship between data inputs and outputs at each stage of analysis for one IP scenario. A ***scenario*** is defined for this report as one specific combination of IP infrastructure projects in conjunction with one set of proposed operations. For example, one of the water storage scenarios considered in this report is the implementation of (a) the Keechelus to Kachess conveyance project, (b) the Kachess Drought Relief Pumping Plant, and (c) the Cle Elum Pool Raise (all others unbuilt), along with (d) operations to implement augmented instream flows. If any of these elements are changed, it would represent a different scenario. The can be interpreted to represent short time-frames (e.g. one year) or longer time frames and is explained as follows (from left to right):

(1) Information inputs (grey) including (1a) inflows into the hydrological system (denoted "Weather"), (1b) a specific set of IP water storage projects and (1c) proposed operations, along with (1d) IP habitat project scenarios. Scenarios on which we report are presented in Table 1.
(2) Costs of building and operating associated with each scenario project (green).
(3) Two models (yellow) relating inputs in (1) to physical outcomes:
    (a) A hydrologic model that quantifies the total water supply available in the basin (TWSA) based on water inflows, and the distribution of water as a function of YBIP projects considered and their operations. We utilize the YAKRW implementation of RiverWare, developed initially by USBR and parameterized for YBIP by HDR Engineering, Inc.
    (b) A fish habitat model that assesses potential fish abundance as a function of spawning habitat made available by fish passage projects, instream flow augmentation and fish habitat restoration activities.

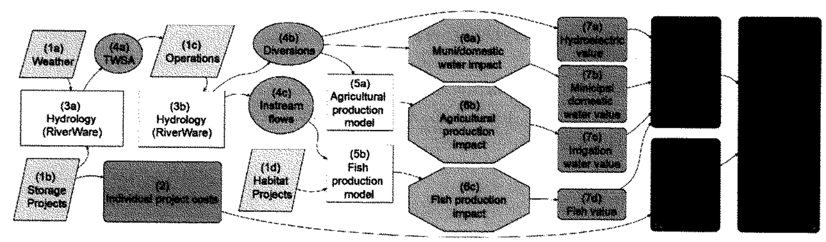

Figure 3: Schematic overview of the model framework for one YBIP scenario.

(4) Hydrologic modeling outputs (blue) including (4a) estimates of the total water supply available (TWSA) in the basin for any given season, which is distributed through operations (1c) as out-of-stream water in the form of (4b) diversions to the various water-rights holders and (4c) instream flows.
(5) Benefits gained from a distribution of TWSA among competing uses (yellow) including:
    (a) An agricultural production model relating water availability, in the form of proration and curtailment relative to entitlements non-drought-year water use, to irrigated agricultural production in the basin.
    (b) A municipal benefit analysis relating the benefits of IP infrastructure and water market development to current and future municipal water users
    (c) A fish productivity analysis relating instream flows (4c) and fish habitat (1d) to fish population impacts (6c).
(6) Outputs from the agriculture, municipal/domestic, and fish production models (orange) including crop production values as a function of water proration rates defined by a given climate and IP scenario, water provided to municipalities as part of the proposed IP, and changes in fish populations due to IP habitat and instream flow modifications.
(7) Economic value of the availability or curtailment of municipal water, irrigation water, instream flows, and hydroelectric flows (green) as estimated by relating the marginal value of water for uses to the physical impacts in (6).
(8) Benefits and costs (green) that are aggregated, discounted, and characterized as statistical expectations when appropriate to provide summary statistics for a given scenario.
(9) Aggregate expected net present value estimates (green) for both benefits and costs of a given scenario when compared against the baseline (future without any YBIP implantation) or another scenario.

The availability and distribution of water among competing uses hinges on the risk of curtailment of water rights during drought years. In this work, variability in water availability is simulated from historical data (1925-2009) and three future climate change scenarios using the YAKRW RiverWare model (HDR Engineering, Inc. and Anchor QEA 2011). The hydrologic output (4a and 4b in Figure 3) is used to generate empirical probability distributions over water curtailments and annualized economic impacts, which in turn is the basis for estimating the expected net present value of reducing curtailments in a given year, which is then the basis for calculating the expected net present value of these impacts over the 100 year planning horizon. This process is illustrated in Figure 4. Present value calculations rely on a 4% discount rate to be consistent with the Four Accounts analysis and its supporting reports, although a brief examination of the implications of a lower interest rate of 3.5% to be consistent with current federal water resources planning requirements (U.S. Bureau of Reclamation 2013).

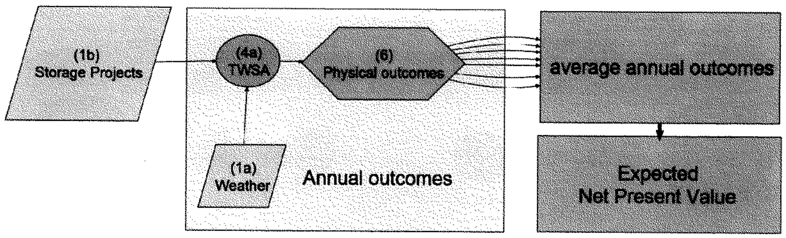

Figure 4: Generating average annual outcomes and expected net present value from annual modeling outcomes

One important difference between previous reports and this analysis centers on how the connection between fish impacts versus agricultural and municipal impacts of IP scenarios are characterized. Ideally, a complete integration of fish, agricultural, municipal, and other impacts would be used as a definitive benefit-cost metric for policy decisions. However, due to various data deficiencies, there is a large difference in the precision and confidence placed on fish impact estimates versus agricultural and municipal impacts. To compensate, instream and out-of-stream scenarios are assessed independently to the extent necessary, and jointly when possible.

Despite the high level of uncertainty associated with benefits from instream flows for fish populations, two types of information can be derived from any given IP scenario based solely on out-of-stream benefits. One type utilizes the B-C metric, calculating the value that fish must accrue (i.e. the "break-even" value) given the estimated out-of-stream value and cost of implementation for a proposed scenario. The other type uses the cost of providing those instream flows as estimated in terms of foregone out-of-stream beneficial uses. There is a direct economic trade-off between the benefits from diversion (out-of-stream) and the costs in terms of fish impacts. As such, the opportunity cost of providing instream flows is the foregone agricultural and municipal benefits that could accrue were instream flows allocated for out-of-stream use. Figure 5 illustrates this trade-off. For any given set of IP water storage and habitat projects, a restriction on diversions to increase instream flows leads to smaller out-of-stream benefits. The difference in the size of out-of-stream use value (6a-b) on the left compared to the right is symbolic of this trade-off. Therefore even if fish benefits cannot be confidently estimated, this trade-off can still serve as the basis for calculating the opportunity cost of instream flows in terms of foregone out-of-stream uses. These opportunity costs can be compared to the costs of providing instream flow augmentation through augmenting dry-season water availability through IP water storage infrastructure.

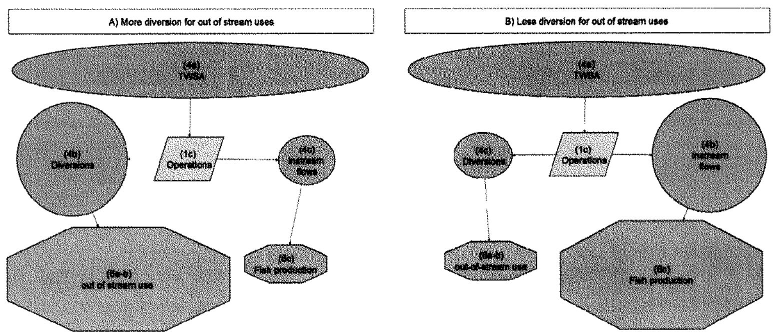

Figure 5: Trade-offs between diversions for out-of-stream beneficial uses and instream flows for fish benefits.

Fish abundance and its economic value follow from three categories of IP activities: instream flows (as discussed above), fish habitat restoration, and fish passage. Each of these categories of activities impact fish in different ways (Figure 6). The way in which fish passage in particular impacts fish abundance differs substantially from instream flow and restoration changes, and is modeled very differently. Again we use existing studies that form the foundation of the Four Accounts analysis as our starting point (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012). Sockeye salmon is the primary beneficiary of fish passage, and also the single most important contributor to IP benefits as estimated in the Four Accounts analysis. They require lake/reservoir access for reproduction, and were therefore essentially extirpated from the Yakima Basin when the existing dams were completed in the early 1900s. Estimates of sockeye abundance potential in the basin were generated using a model based on lake/reservoir size and subsequent survival rates conditional on fish passage. We assess the estimates used in the Four Accounts analysis in light of additional data on sockeye potential in the basin, and infer potential contributions of the various fish passage based on their relative size. Instream flow and restoration activity impacts were estimated in previous studies for the IP using an entirely different method, and were estimated together in such a way that it is difficult to discern their relative impacts. We perform empirical analysis on a newly created dataset for the basin to assess the estimates relied

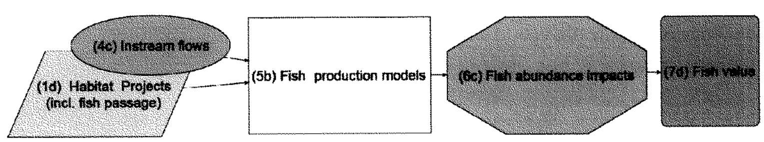

Figure 6: Fish abundance and fish value.

upon in the Four Accounts analysis, and we make use of available information to discern to the extent possible the relative potential contributions of instream flow augmentation and habitat restoration.

To place a value on fish, the Four Accounts analysis utilizes a combination of stated preference and benefits transfer methods, both of which are commonly used in non-market valuation estimation. We rely substantially on the analysis presented in the Four Accounts analysis for fish values but assess its veracity and the potential implications.

The remaining subsections and their associated appendix content describe in detail the methods used in the analysis. It should be noted at the outset however that where we rely directly on existing models we will cite the supporting documentation and rely on it heavily as a reference.

B. Hydrologic modeling

For the analysis of instream and out-of-stream benefits from water storage, this report relies on the hydrologic model RiverWare™ and modifications of it developed by various research teams to represent the Yakima Basin and the specific hydrologic effects of the water storage projects and operations proposed in the YBIP. We also rely on the Variable Infiltration Capacity (VIC) model for future climate regime inflow data. We provide a brief description of the models and the specific YBIP scenarios that we use as a basis for analysis.

1. RiverWare (RW) and Yakima RiverWare (YAKRW)

RiverWare (RW) is a general multi-objective modeling tool. It can handle complex river systems with multiple reservoirs and diversions and with different operation objectives (Zagona et al. 2001). First developed in 1994, RiverWare is collaboration between the Bureau of Reclamation, the Center for Advanced Decision Support for Water and Environmental Systems (CADSWES) at the University of Colorado and the Tennessee Valley Authority.

RiverWare provides a graphical interface with an object-oriented modeling framework. Different objects can be schematically drawn in RW and rules and policies corresponding to each can be defined by the user. The primary objects in RW represent river reaches, canals, reservoirs, diversions, etc. (Carron, Zagona, and Fulp 2000). These objects are connected in a network that represents water flow between objects. RW has been parameterized to simulate different river basins such as the Colorado River (Fulp and Harkins 2001), and the Truckee-Carson River system (Coors 2006) as well as the Yakima Basin.

YAKRW is a daily time-step reservoir and river operation computer model of the Yakima Basin Project developed using the RiverWare software (HDR Engineering Inc. et al. 2011, 109).

YAKRW (Mastin and Vaccaro 2002) is used to apply detailed information about operation rules of dams and diversions, water rights and other basin characteristics within the RiverWare software. YAKRW was first introduced by USBR's Yakima Field Office and the Upper Columbia Area Office as a component of the Watershed and Rivers System Management Program (WARSMP) (U.S.B.R., 2011). YAKRW was modified and used in the Yakima River Basin Water Storage Feasibility Study

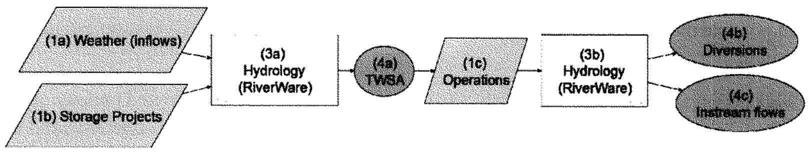

Figure 7: Schematic of YAKRW modeling process. (TWSA is total water supply available.)

(USBR 2008) to assess the effectiveness of different proposed alternative actions on Yakima River Basin water availability and environmental conditions.

HDR received a modified version of YAKRW that could handle climate change scenarios from Reclamation's Technical Service Center (TSC). This group was also responsible for further modifying the TSC model for options proposed in the integrated water resource management plan (U.S. Bureau of Reclamation, Washington State Department of Ecology, and Prepared by HDR Engineering, Inc. & Anchor QEA 2011, 46). HDR has also implemented within YAKRW anticipated future demand and potential conservation scenarios in the basin.

2. YAKRW inputs and outputs

YAKRW is parameterized to represent the hydrologic behavior of the Yakima Basin conditional on water inflows into the system, water storage characteristics, and operations. Figure 7 provides a schematic of the YAKRW modeling process.[3] The numbered items in the figure correspond to those in Figure 3 representing the overall modeling process.

For purposes of this analysis, operational inputs to YAKRW for a single simulation run include:

1) The choice among one of four climate regimes (historical and three simulated future regimes), which implement specific inflows ((1a) in Figure 1 and described below) on a daily time-step.
2) The choice of integrated plan (IP) infrastructure project(s) implemented (1b). These are parameterized as modules within YAKRW, and are implemented with parameter switches.
3) Specific operations scenarios in the form of dam spill and diversions. The only operations that we directly manage are via a module that either implements (or not) the proposed IP instream flows.

YAKRW provides extensive output on a daily time-step for a given simulation run. We use three variables from the YAKRW output in our analysis: Total Water Supply Available (TWSA), the daily simulated basin-wide proration level, and the date.[4] Both the TWSA and the proration rate represent the basin as a whole. TWSA represents the sum of the total water in reservoir storage, the

[3]3The linear configuration of Figure 7 is slightly misleading, because TWSA can be affected to some degree by water storage carry-over from the prior year, which is operations-dependent.

[4] The variable names for TWSA, the daily proration rate, and date outputted from YAKRW are TWSA PARW DataDaily TWSA, TWSA PARW_DataDaily Proration Level, and Run0, respectively.

expected runoff through the remainder of water year, and the expected return flows from diversions. Calculations begin on April 1 of each year and are updated throughout the irrigation season (HDR Engineering, Inc. 2014). District-specific proration rates depend on their individual shares of proratable and non-proratable rights as described in Section III.C.1.a.

Four climate scenarios are used in this analysis, one based on historical outcomes, and three others representing potential future climate change outcomes (described in more detail below). The historical climate regime used for the analysis of IP projects spans the years 1925 - 2009 (85 annual observations per scenario).[5] However, when comparing historical conditions to those in our three future climate conditions, we use the period of record spanning 1925 - 2006 (82 annual observations per scenario). The disparity in the periods of record used arises from differences in how future climate data were generated. This disparity and the climate scenarios in general are described in more detail later in this section.

A primary limitation of the YAKRW model is that it does not capture interactions between the river system and the hydrologic cycle in a sophisticated way. YAKRW is a river management model that takes surface water inflows at a few key locations. Return flows are assigned as a percentage of water diversion and there are similarly simplistic ways of handling surface-groundwater interactions. Land surface hydrology is heavily impacted by climate change through changes in evapotranspiration and crop water demands, which impacts infiltration, return flows, and groundwater recharge. YAKRW's simplistic handling of hydrologic processes is a weakness that is most relevant when running the model under scenarios of change, particularly if inflows and return flows rates are altered, as they would be under climate change. Thus, along with the substantial uncertainty that exists about which climate scenario might best represent future states of the world, YAKRW suffers from increased modeling error under these conditions also.

3. YAKRW output use and post-processing

The outputs from YAKRW are used to populate an annual crop production model. However, because irrigation district water entitlements occur on a monthly basis and YAKRW model outputs are given in a daily time-step, data are translated first to a monthly then an annual time-step in two stages. Hydrologic outputs are first aggregated to monthly values to conform to the monthly data available for irrigation district water entitlements. Using district-specific water entitlement data, district-level proration are then calculated based on each district's share of proratable rights and the monthly mean basin-wide proration rate (calculated as the monthly mean of the YAKRW daily proration rates). This allows the volume of water available for irrigation to be calculated on a monthly basis. Monthly data for irrigation seasons are then aggregated to an annual time-step, which provides the mean proration rate for the irrigation district and the associated water available for irrigation (the sum of water available by month and district, subject to entitlements and proration). The annual hydrologic outputs from YAKRW for each specific IP project

[5] The original observed flow data under which the scenarios were modeled represent conditions that occurred historically from 1981 through 2005 (HDR Engineering Inc. et al. 2011, 65) but HDR recently has extended this period from 1924 to 2009.

implementation and climate regime scenario are then used as inputs in the crop production model described in Section III.C.1.

One of the fundamental differences between the Four Accounts report and the current analysis is the use of YAKRW to provide curtailment data (ECONorthwest, Natural Resources Economics, and ESA Adolfson 2012). Instead of using the history of proration/curtailment and climate variances as we do, the Four Accounts analysis assumes just two types of curtailment outcomes: no curtailment (proration rate = 100%), and severe drought which is defined as a basin-wide curtailment of proratable rights of 70% (proration rate = 30%). The implications of this difference are discussed in some detail in Section IV.A.

4. *YAKRW scenarios used in this analysis*

To assess the economic benefits of incremental changes in water storage capacity within the Yakima River Basin, YAKRW provided the TWSA and curtailment data used for numerous IP storage scenarios. The outputs from these runs are then used to simulate agricultural productivity. Each scenario outcome is compared to appropriate baseline scenarios. Comparing scenarios with different agricultural production values allows us to estimate the economic impact of different IP projects. The full set of scenarios used is described in Table 1. See Section II for a more detailed description of the projects implemented in YAKRW. Each of these scenarios can be applied to any climate scenario (detailed in Table 1).

In the analysis, there are two primary baseline scenarios of interest for modeling purposes. The "Base" scenario describes a case with no IP projects.[6] We also use the full IP scenario as a base to estimate the value (cost) of excluding a project when the IP is otherwise fully implemented. These two sets of comparisons are included because, as evident in the results of section IV.F, implementing a project alone without other IP storage projects provides benefits that are different (and in all cases greater) than when the project is implemented along with other storage projects. Also worth noting is the one set of scenarios that indicates whether or not the proposed IP instream flows are implemented (Base + Instream). This scenario differs from the other scenarios described in Table 1 in two ways, 1) it represents an operations change instead of an infrastructure investment, and 2) in contrast to storage projects, implementing the (augmented) proposed instream flows reduces water for out-of-stream uses.

[6] The "Base" scenario modeled in YAKRW to include projects underway in the basin but not considered part of the IP.

Table 1: Project Scenarios. Each scenario is applicable to any climate regime.

Name	Description
Base	HDR scenario 7.1. No IP projects, includes Future M&I demand, Yakima (Ahtanum) ASR, non-IP conservation Project (HDR Engineering, Inc. 2013).
Baseline plus one project only	
Base+Bumping	Baseline plus Bumping Lake expansion only
Base+CEPR	Baseline plus Cle Elum Pool Raise (CEPR) only
Base+Conservation	Baseline plus IP agricultural water conservation measures (Conserv)
Base+ASR[1]	Baseline plus passive groundwater recharge at Thorp + WIP only
Base+KKC	Baseline plus Keechelus to Kachess Conveyance (KKC) only
Base+KDRPP	Baseline plus Kachess Drought Relief Pumping Plant (KDRPP) only
Base+KKC&KDRPP[2]	Baseline plus KKC + KDRPP only
Base+Wymer	Baseline plus Wymer Dam and reservoir only
Base+Instream	Baseline plus proposed IP instream flows implemented only
Full IP with project exclusion	
IP	Full IP: HDR scenario 7.8 (HDR Engineering, Inc. 2013).
IP-Bumping	IP excluding Bumping Lake expansion only
IP-Conservation	IP excluding IP agricultural water conservation measures (Conserv)
IP-CEPR	IP excluding Cle Elum Pool Raise (CEPR) only
IP-ASR	IP excluding passive groundwater recharge at Thorp + WIP only
IP-KKC	IP excluding Keechelus to Kachess Conveyance (KKC) only
IP-KDRPP	IP excluding Kachess Drought Relief Pumping Plant (KDRPP) only
IP-KKC&KDRPP[1]	IP excluding KKC + KDRPP only
IP-Wymer	IP excluding Wymer Dam and reservoir only
IP-Instream	IP excluding proposed IP instream flows

1ASR for YAKRW runs does not pertain to the Ahtanum ASR; only Thorpe and WIP passive Aquifer Storage and Recovery.
2 KKC and KDRPP may be treated and pursued by IP developers as one project. It is therefore considered as a pair here.

Note that in the Base scenario (HDR 7.1), future municipal, industrial, and domestic water demand (M&I) for the year 2040 is applied to the upper Yakima River using data described by (HDR Engineering and Anchor QEA 2011, 31–32.). Furthermore, The City of Yakima is assumed to implement the Ahtanum Valley ASR project (not part of the IP) as described in HDR Engineering, Inc. (2014) and Golder Associates (2014) and briefly summarized in Section II.A. Together, these two components of the Base case (as well as the scenarios to which the base case are compared) represent the assumption that IP water will be provided to municipalities based on future population and water demand growth needs. This assumption implies that these municipal demands are met using water available for other instream and out-of-stream uses, and allows for the estimation of municipal benefits in Section IV.A.2 without double-counting water.

In addition to the scenarios above, we also include results for a series of sequenced project scenarios being developed by HDR Engineering representing the proposed plan for implementation. These scenarios are summarized in (HDR Engineering, Inc. 2013).

Table 2: HDR sequenced implementation Project scenarios (HDR Engineering, Inc. 2013)

Scenario name	Description
HDR 7.1	Base in Table 1
HDR 7.2	HDR 7.1 + GW + Conserv ["Non-storage" scenario]
HDR 7.3	HDR 7.2 + KKC [Add KKC]
HDR 7.4	HDR 7.3 +KDRPP [Add KDRPP]
HDR 7.5	HDR 7.4 + CEPR [Add CEPR]
HDR 7.6	HDR 7.5 + Wymer [Add Wymer]
HDR 7.7	HDR 7.6 + Bumping [Add bumping]

5. Climate scenarios

The historical flow data used as an input to YAKRW represents a naturalized flow regime. This historical regime corresponds to flows that would have occurred in the absence of any anthropogenic changes in the basin or river. The observed flow was developed by the U.S.B.R. by taking into account detailed information related to diversions, reservoirs, and dam operations. In YAKRW, the future flow data are taken from Brekke (2010). The scenarios associated with these future flow data are from the Third Climate Model Intercomparison Project (CMIP3). The scenarios are from the Third Climate Model Intercomparison Project (CMIP3).

All climate change results are generated using the Variable Infiltration Capacity (VIC) model (Liang et al. 1994): a distributed hydrologic model that simulates continuous water and energy balances at daily or sub-daily time-steps. The model has been validated and used in number of different studies to project future hydrologic conditions over the Columbia and Yakima River basins (Elsner et al. 2010; Hamlet and Lettenmaier 1999; Vano et al. 2010b; Yorgey, G et al. 2011; Barnett, Adam, and Lettenmaier 2005; Mote et al. 2005). The Period of Record (POR) for VIC-generated flows available in the YAKRW model is 1915-2006.

The forcing data used to run the VIC model are available in 1/16 degree resolution over the Pacific Northwest region (Elsner et al. 2010). Downscaling of the meteorological data was done using the hybrid-delta change approach (Mote and Jr 2010; Elsner et al. 2010). Future climate data represent the climatological condition of year the 2040 by adjusting the statistics of the historical period (1915-2006) to capture changes in precipitation and temperature as projected by the Global Climate Models (GCMs) for each of the scenarios in Table 3. Therefore, there are 92 years of different climate realizations for the year 2040; although, to avoid issues related to spin-up of the hydrologic model, we did not include the first 10 years of data in our analysis. When comparing historical and future climate results, it is important to use a consistent baseline period. Therefore, the POR for our climate change impact scenarios is 1925-2006.

Table 3: Climate scenario description and summary.

Scenario	Climate Model	Emission scenario	RMJOC label	Average Temperature change	Average precipitation change	Annual reservoir inflow
Historical	Historically Based	Historically Based	–	0	0	1.66 MAF
Less Adverse	CGCM3.1 [HADCM]	B1	LW/W: Low Warming	+1.3 °C	+11.5%	1.86 MAF
Moderate Scenario	HADCM	B1	C: Central Change	+1.7 °C	+3.7%	1.48 MAF
More Adverse	HADGEM1 [HADGEM]	A1B	MW/D: More Warming	+2.8 °C	-2.5%	1.38 MAF

*RMJOC : Reservoir Management Joint Operation Committee

To retain consistency with earlier HDR reports, we utilized the three CMIP3 climate scenarios described in Table 3, which provided the basis of the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC). However, it is important to mention that the more up-to-date CMIP5 scenarios are currently available as part of the Fifth Assessment Report (ASR5) of the IPCC (Rogelj, Meinshausen, and Knutti 2012). Rogelj et al., (2012) compared CMIP3 and CMIP5 scenarios and found that the greenhouse gas (GHG) concentrations used in CMIP5 represent a higher range of possible outcomes related to temperature as well as higher temperatures on average. Therefore, application of the more updated CMIP5 scenarios may result in more adverse effects. This question will be addressed in subsequent studies. Finally, it is important to mention that it is beyond the scope of the AR4 Working Groups to assess the likelihood of emission scenarios, as there is no widely accepted method of assigning probabilities to them (Nakicenovic and Swart 2000; Webster et al. 2002).

C. Out-of-stream impacts of IP projects

Out-of-stream benefits of the IP are primarily in the form of the value of agricultural production due to irrigation, and benefits to municipalities of being provided water for future water demand growth. Methods for water market analysis are also summarized in this section.

1. *Water for agriculture*

The benefits for agriculture from the IP water storage projects accrue during droughts when irrigated farmers are permitted to use more water than they would without the IP storage. As such, the additional storage increases water availability during the irrigation season. The benefit to agriculture for a given drought year is measured as the difference between total net revenues generated from agriculture without the IP project(s) (less water available, more severe curtailment) compared to total net revenues with the IP project(s).

The risk of curtailment over time in part determines the distribution of irrigation water and agricultural production value over time. This information can then be used to calculate the average agricultural production value (expected value) for a given IP scenario, as well as the net present value of an IP project scenario relative to a baseline.

While prorated entitlements are the basis for estimating the volume of water available for irrigation in any district, water market transactions in the form leases or purchases can in principle move available water to higher valued crops both within and/or across districts. This decreases the impacts of curtailment and affects the aggregate value of agricultural production for a given basin-wide curtailment.

To measure the value of additional storage projects in terms of agricultural irrigation benefits, we follow the following procedure:

1) We relate annualized basin-wide curtailments from YAKRW simulations (See sections III. B.2 and 3) for a given IP/climate scenario to irrigation district curtailment rates based on district entitlements. This provides the volume of prorated water available to a district based on their entitlements and the basin-wide proration rate for the year.
2) We relate the volume of available water in a district to the value of agricultural production. This relationship represents the ***marginal value of water*** for crop production (also known as the ***inverse demand function***).
3) Given district-specific proration rates and marginal value functions, we calculate annual values of agricultural production for each district for the simulation period. The value of production depends on how water is used (distributed across crops) within and across districts. Three different market regimes are simulated, which affect the relative impact of proration in the basin. Thus, we generate annual production values for a given IP/climate/market scenario.
4) The average annual production value for a given IP/climate/market scenario is used to calculate the expected net present value of agricultural production over 100 years assuming a discount rate of 4% (again, in keeping with the existing YBIP literature).
5) Differences in the net present value of production across any pair of IP scenarios represents the difference in benefits of one scenario compared to the other, and can be compared to the difference in the cost of implementing these scenarios.

To begin, we describe the irrigation districts and their water entitlements. Construction of the marginal value of water functions (by district) is described next, followed by an explanation of how the market scenarios are defined and implemented, and how they affect aggregate market production value. The process of aggregating annual values into expected net present values for a given project/climate/market scenario is then discussed, followed by a brief description of how these net present values are used to assess the expected net present value of benefits from IP project(s) relative to base cases.

a. *Irrigation districts and their water rights*

Water rights in the Yakima Basin are defined in terms of seniority and are grouped into four categories for this analysis. A majority of water rights in the Yakima basin are held by irrigation districts whose rights were defined by a 1945 Consent Decree and can be categorized as either non-proratable or proratable based on their status as of May 1905. In drought years, proratable rights in the basin are curtailed by the same proportion based on a basin-wide proration rate. Water rights acquired prior to 1905 are senior to non-proratable rights. Water rights acquired after the 1945 consent decree we will call junior water rights. Virtually all municipal water rights are junior rights.

As described in the Four Accounts analysis, five irrigation districts account for the majority of water rights in the basin that may be directly or indirectly affected by the development of additional storage in the basin; Roza Irrigation District (Roza), Wapato Irrigation Project (WIP), Kittitas Reclamation District (KRD), Sunnyside Valley Irrigation District (SVID), and Yakima Tieton Irrigation District (YTID). All of these districts have proratable and/or non-proratable rights. Some of these districts, such as Roza and KRD, are directly affected by curtailment because 100% of their water rights are proratable and therefore subject to curtailment in dry years. Others face substantially less curtailment risk, such as YTID and SVID, as they hold a higher proportion of non-proratable rights. SVID has sold water in past droughts (e.g. 2006) to Roza.

Because we are charged with examining the benefits of improving water markets (i.e. facilitating gains from trade), we include an additional set of senior water rights owners in Kittitas County (Ecology subbasins 1-15) who we categorize as Kittitas Senior (KSR). They are not part of a single irrigation district, though we will refer to them as a district simply as a shorthand reference along with the other districts. As a group these are senior water rights and so do not face any substantive risk of water curtailment. However, they may be well positioned to participate in water markets during drought years, and so we include them for their role in market simulations. Table 4 provides information about these irrigation districts.

Table 4. District level entitlement, water use, and profit.

District	Entitlement (af)	% Proratable Rights	Average water use in non-drought year (af)	Total profit in non-drought year ($)
Roza Irrigation District (Roza)	393,000	100	322,496	130,284,737
Wapato Irrigation Project (WIP)	655,613	53	565,949	144,712,511
Kittitas Reclamation District (KRD)	336,000	100	287,369	31,782,923
Sunnyside Valley Irr. District (SVID)	447,422	35	430,411	129,077,002
Yakima Tieton Irrigation District (YTID)	106,290	33	78,776	41,753,411
Kittitas Senior Right holders (KSR).[1]	222,925	0	190,429	20,011,692

[1]KSR is not a single irrigation district. It is an aggregation of smaller districts and senior water rights holders in Upper Kittitas County as described in this section. Source for all but KSR data: (HDR Engineering and Anchor QEA 2011). The source for KSR data is Cook and Rabotyagov (2014).

There are a few characteristics of these districts that are worth noting. Firstly, the average water use in non-drought years tends to be lower than the entitlement for each district. Indeed, due to changes in irrigation technology, and to a lesser extent crop mix, non-drought water use has declined relatively steadily over the last few decades.

Secondly, a district's share of proratable rights defines its proration rate for any given basin-wide proration. If a share of its rights are non-proratable, their district-level proration rate will be higher than the basin-wide proration rate (hence their curtailment requirement will be lower than the basin-wide curtailment rate).[7] Some districts have a mix of proratable and non-proratable rights based on the historical water rights of the landowners within the basin. In these districts, curtailment requirements are applied equally across all shareholders in the district- each is curtailed by the same amount (though shareholders may in principle purchase or sell water which would lead to differences in water entitlements after a sale). These characteristics, as well as their location within the basin (discussed below) will affect how outcomes are calculated, in turn affecting the degree to which IP projects impact irrigation water availability in these districts.

b. *The value of water for agricultural production by district*

The methodological approach used in this study to estimate the benefits to agriculture from the individual YBIP projects builds on the spreadsheet model (Scott et al. **(2004)** used in the Four Accounts. A number of modeling capabilities are added to this previous work and detailed in Appendix VII.A. These changes allow for greater flexibility in implementing and designing scenarios.

The model uses three sets of information to estimate the value of agricultural production as a function of water availability:

1) Net revenue per acre by crop ($/acre)
2) Water use requirement for each crop/irrigation district combination (af/acre)
3) Acres by crop type for each irrigation district (acres),

The data for these categories are provided in Table 5. With the exception of Kittitas Senior (KSR), these data are taken directly from assumptions used in the Four Accounts analysis.

A useful way to understand the value of water for crop production is in terms of net revenue per af of water ($/af) as a function of water use (in af). Net revenue per af for a crop is calculated by dividing net revenue per acre (1) by the crops water requirement (2): $\$/af = \left(\frac{\$/acre}{af/acre}\right)$. The number of af of water used to grow a crop in a district is water use per acre (2) times the number of acres of that crop planted in the district: $af = \frac{af}{acre} \times acres$.

[7] A district's proration rate can be calculated as $\mathrm{p_d} = (\mathrm{E}(1-\mathrm{s}) + \mathrm{p\,E\,s})/\mathrm{E}$, where E is the total entitlement, p is the basin-wide proration rate, s is the district's non-proratable entitlement. For example, if the basin-wide proration rate is 0.3 (70% curtailment), then the proration rate for WIP for example is $p_{WIP} = \frac{655{,}613\times(1-0.53)+0.3\times655{,}613\times0.53}{655{,}613} = 0.63$, which means that if the basinwide curtailment rate is 70% (proration rate of 30%), WIP's district proration rate is 63%.

Table 5. Crop by district values for net revenue per acre, water use per acre, and total acres.

		Af/ acre						Acres					
Crop Group	Net Revenue $/ac	Roza	WIP	KRD	SVID	YTID	KSR	Roza	WIP	KRD	SVID	YTID	KSR
Alfalfa	678	4.7	6	5	4.8	3.1	5	2,878	12,939	1,778	12,219	124	1,800
Apples	2,248	5.6	7	6	6	3.7	6	23,969	10,445	548	6,720	17,288	6
Asparagus	238	4.2	5	0	4.4	0	0	635	1,831	0	2,657	0	0
Concord	1,509	3.3	4.7	0	3.8	0	0	11,913	4,954	0	20,784	0	0
Hops	3,481	3.4	4.3	0	3.7	0	0	3,540	15,350	0	10,955	0	0
Mint	804	4.9	6.1	0	5.1	0	0	578	9,424	0	1,770	0	411
Miscell.	785	3.9	5	4.7	4	3.3	4.7	3,613	24,017	81	21,050	355	95
Other Grain	3	3	4	4.6	3.2	2.1	4.6	2,670	662	1,963	3,246	21	2,182
Other Hay	240	4.8	6.2	5.5	5	3.2	5.5	431	3,204	4,971	3,719	1,058	3,077
Other Tree	833	5.5	6.7	5.3	5.8	3.6	5.3	8,797	3,211	256	9,534	2,729	1
Other Veg	5,422	2.5	4.1	4.1	3	0	4.1	270	3,286	6	525	0	6
Pasture	479	3.8	4.8	4.5	3.7	0	4.5	62	1,960	13,129	1,141	0	18,032
Potatoes	1,155	4.2	5.1	4.3	0	0	4.3	72	1,161	89	0	0	0
Sweet Corn	436	3.1	3.3	3.1	2.8	0	3.1	173	912	1,368	39	0	408
Timothy	701	0	6.4	5.6	0	0	5.6	0	126	29,607	0	0	12,468
Wheat	40	3	4	4.4	3.2	0	4.4	1,333	15,621	1,710	2,892	0	386
Wine	2,630	3.3	4.7	3.1	3.8	2.1	3.1	11,998	12	10	1,992	0	9

Figure 8 shows revenues ($/af) as a function of water use for the specific crop acreage allocation in the Kittitas Reclamation District (KRD). There are three distinct features in this figure. First, the flat line shows the average value of water across all acres in the district. Second, a step-function reflects the value per acre-foot of irrigation, from highest (left) to lowest (right), for each crop considered. This step function is approximated by a continuous, decreasing curve (curved line) for market impact analyses. The methodology for converting step functions to continuous functions for modeling irrigation water use was developed by (Burt 1964).

As arranged, the step-function in Figure 8 and its continuous counterpart (the curved function) can also be interpreted as an inverse demand function. In this case, the inverse demand function represents the marginal value of water for different volumes of available water assuming that water is applied to its highest valued use first, and then to crops with lower values as more water becomes available.[8] Conversely, if water is curtailed and crops are *selectively fallowed* sequentially from lowest- to highest valued uses, the functions represent the marginal cost of irrigation curtailment in terms of lost agricultural production value per aft removed. Analogously, the flat line represents the average value of water across crop acreage in the district and reflects the marginal cost of water reductions if fallowing occurs *proportionally* across all crop acres regardless of the relative value of water. The distinction between proportional and selective fallowing will be important for understanding the

[8] Furthermore, the areas under these curves between any two water use levels can be interpreted as the difference in total production value between the two points.

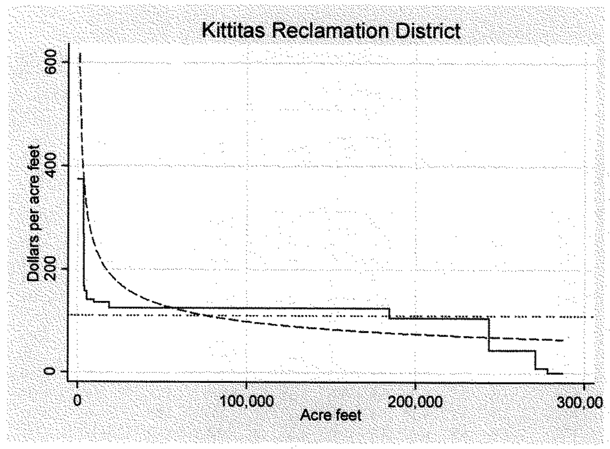

Figure 8: Water value curve for Kittitas Reclamation District.

potential impact of water market performance in the basin. Before describing the impacts of water market simulations, several limitations of this method for assessing water value and water curtailment impacts should be discussed.

Deficit irrigation and other management decisions: An important assumption made in the model developed by (Scott et al. 2004) that is commonly applied when modeling drought impacts is that a reduced water budget is met only through fallowing (R. Howitt et al. 2014). This assumption prohibits what is often referred to as deficit irrigation where the volume of water applied is less than the level required for maximum yield. The result of this assumption is that the production relationships between water, land, and crops are in fixed-proportions, and thus the number of acres that are chosen to fallow for each crop directly determines how much water is used for each crop. Assuming/allowing no deficit irrigation or other management options leads to overestimation of curtailment impacts to the extent crop producers actually do choose to deficit irrigate and overestimates the marginal value of irrigation water (D. J. Bernardo et al. 1988; D. Bernardo et al. 1987). This in turn suggests that the actual inverse demand curves (read from right to left as the cost of curtail) would be flatter than estimated.

Multi-year impacts of irrigation curtailment: Another simplifying assumption underlying this model is that the impact of irrigation curtailment spans only one year. For crops that are not replanted every year, such as tree-fruit and timothy hay, deficit or no irrigation in one year can negatively affect yield in subsequent years. To the extent that this is true, assuming the impacts of irrigation curtailment are reset on a yearly basis will lead to underestimation of the true impacts of curtailment.

Crop mix: The model assumes a fixed and unchanging mix of crops and crop acreage (shown in Table 5). In reality, producers not only change their crop mix during crop rotations, but also have the capacity to change their crop mix in response to changes in the economic or physical environment, which includes irrigation curtailment risk. If curtailment risk changes due to IP project implementation or climate change, for example, producers have the capacity across one or more years to change their crop mix to mitigate the effects of these risks. However, assuming a fixed crop mix may lead to an over- or under-estimation of curtailment impacts over the long term, depending on the situation. For instance, if the IP reduces curtailment risk relative to the status quo, crop substitution toward more water-dependent crops may increase the value of the IP. On the other hand, if climate change leads to increases in curtailment (as in some of the scenarios we consider), these impacts may be mitigated by crop substitution. In the most extreme cases considered, producers switching from simple fallowing to dryland crops will also mitigate the impacts of curtailment risk.

Differences in production costs and irrigation efficiency across districts: The net revenue in $/af in Table 5 are assumed to be the same across districts. This implicitly assumes that production costs, irrigation efficiency --- and therefore consumptive use rates, and other production factors are the same across districts. This simplifying assumption is discussed in the Four Accounts analysis, and so will not be reviewed in detail here, except to say that it is likely that intra-district variation in these factors for a given crop is likely to be larger than average differences across districts for a given crop, so this assumption likely would not have a substantial impact on outcomes. The consequence of assuming that consumptive use rates are the same across districts implies that water trading based on diversions across and within districts is equivalent to trading based on consumptive use. There are most likely larger differences in consumptive use between agricultural irrigation and municipal use. This is addressed in the discussion of municipal benefits (Sections III.C.3 and IV.C).

These simplifying assumptions, as well as others, create countervailing and offsetting biases in our water value function estimates. However, when considered together, it is unclear which direction the aggregate bias would be on our marginal value (inverse demand) functions.

c. *The impact of curtailment risk on expected future agricultural production*

The above description relates an annual water availability and curtailment outcome to the marginal value of water in terms of agricultural production value of crops by district. The impact of the risk of water curtailment on agricultural production value are summarized by the following two steps:

1) Simulation of market transactions that can lead to reallocation of water among competing uses in the event of curtailment,
2) Estimation of future expected annual value of production in the face of curtailment risk, and the net present value of the stream of annual expected outcomes over the planning horizon.

Figure 9 illustrates the relationship between annual and expected future water outcomes. Climate regimes and IP scenarios (including operations) define the TWSA, instream flows and basin-wide curtailment outcomes as simulated by YAKRW, and water entitlements define the district-level curtailment rates. After district-level curtailment requirements are set, water market transactions ---

modeled as leases in response to short-term curtailments --- may then be used to reallocate water to alternative uses. Reallocation affects both district-level and aggregate production values for any basin-wide curtailment rate.

Using the annual production values for each irrigation district, the expected future outcomes and the expected net present value of agricultural production for a given IP scenario/climate /market combination are calculated. These present values are the basis for assessing the value of IP projects.

In this analysis, three different water market scenarios are considered: "no trade", "intra-district trade", and "full trade". Each scenario is described in detail below, including the methodology for calculating the expected net present value of production for agricultural irrigation, and the steps followed for comparing scenarios.

The relationship between the basin-wide and district-level curtailment risk includes an important caveat. Many producers have access to supplemental well rights in the event of curtailment. For these producers, groundwater may be substituted for their proratable or junior water rights in drought years if emergency withdrawals are authorized. This will reduce the impact of curtailment and increase the likelihood that our estimates of curtailment impacts, and the value of IP storage projects, are overestimated.

(1) *The expected net present value of IP projects*

As described in Section III.B, for each simulation run, YAKRW uses specific IP projects and climate regime scenarios to simulate annual basin-wide curtailment rates (after post-processing) for an 85 year period (82 years for future climate runs). The distribution of these annual curtailment rates differ depending on project and climate scenarios selected. For example, Table 9 in Section IV.A illustrates that the probability of curtailment (proration less than 100%) and the average curtailment rate increases with increasingly adverse future climate scenarios. Water allocations rights for each district, represented by district-level curtailment rates, are then defined by their total entitlements and share of proratable rights.

After curtailment rates are announced, water is reallocated via leases within and across districts, water is applied to crops, and district-level and aggregate agricultural production value is generated. However, for any given curtailment, the district-level and aggregate value of production also depends on the market scenario as well. In short, YAKRW provides annual curtailment rates, and the water value function links curtailments to agricultural production value for a given market

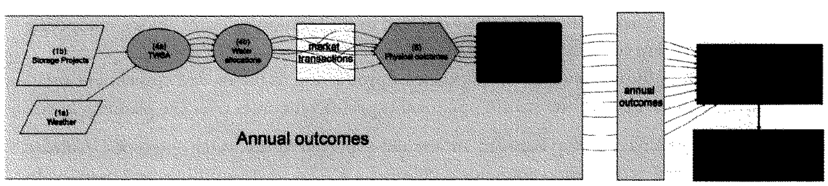

Figure 9: Annual outcomes as a basis for net present value calculations

scenario, by district.

Once the annual production value is simulated for each district based on a chosen IP/climate/market scenario, the district production values are summed as $V_t(X) = \sum_{i=1}^{m} V_{it}(X)$, where V_{it} is the district-level production value and X is an index that represents a given IP/climate/market scenario (Figure 9). The expected value of future agricultural production is estimated as the average production value across all years in the sample:

$$EV(X) = \frac{1}{T}\sum_{t=1}^{T} V_t(X),$$

where T is the number of years in the simulation sample (85 for the historical climate regime and 82 for future climate simulations). Using this value as the expected agricultural production value for each year over the 100 year planning horizon for the IP, the expected net present value of this 100 year annuity can be calculated as

$$ENPV(X) = \sum_{t=0}^{99} \frac{EV(X)}{(1+r)^t} = d \times EV(X)$$

where $d = \sum_{t=0}^{99} \frac{1}{(1+r)^t} = \left(1 - (1+r)^{(-100)}\right)/r$, and r is the discount (interest) rate. To be consistent with the Four Account analysis, we assume a 4% interest rate $(\mathrm{r} = 0.04)$, which implies $\mathrm{d} = 24.505$.[9] However, the current Federal rules for water resource planning require an interest rate of 3.5%, which provides $d = 27.655$, which leads to a present value 13% higher than with r=4%. We provide comparisons for a few of our results, but the qualitative implications in terms of B-C results remain unchanged in all cases we examine.

(2) *Calculating IP project benefits*

The benefits received from an IP scenario can be estimated by comparing the expected net present value, $ENPV(X)$, against an appropriate baseline. As an example, suppose we want to estimate the benefits accrue for a scenario in which only the Wymer Dam is implemented, assuming the historical climate regime and an intermediate trade scenario that assumes intra-district trading only. Benefits are quantified by comparing the described scenario (Wymer Only, historical climate, intra-district trade), denoted here as X_1, with the appropriate baseline (no IP projects implemented, historical

[9] Climate regimes correspond to CMIP3 forecasts for 2040 and are implemented for tractability as stationary for the entire planning horizon. However, climate forecasts show a drift in the distribution of curtailment rates and the distribution mean. The consequence of this stationarity for our estimates is that near-term impacts are biased upward until 2040, and then biased downward thereafter. Because temporally distant values are discounted in present value calculations, this is may lead to an overestimate of the impact of climate change in expected net present value terms. A coarse estimate of this bias can be developed by linearly interpolating EV(X) (X representing a specific IP/trade scenario) from the historical to future climate between 2015 and 2040 and extrapolating through 2114, calculating ENPV(X), and comparing this value to the ENPV(X) that we report. ENPV(X) based on this linear progression are 91% of our estimates, suggesting that we overestimate ENPV(X) for any future climate regime by about 10% to the extent that such a linear interpolation is valid (which we do not claim to be the case).

climate, and intra-district trade), denoted as X_0, where "Base" means that no IP projects are implemented. The net present value of adding Wymer is:

$$\Delta_{01}ENPV = ENPV(X_1) - ENPV(X_0).$$

The above example represents the net value of agricultural production that additional Wymer storage provides assuming no other part of the IP is implemented. In an alternate example, the described scenario could be compared to the Full IP implementation with the exclusion of one project. If the project excluded were Wymer, the relevant comparison would be X_0=(IP excluding Wymer, historical climate, intra-district trade) against X_1=(Full IP, historical climate, intra-district trade). In this case, $\Delta_{01}ENPV$ would represent the incremental benefits of Wymer conditional on all other IP components implemented.

With six water storage projects under consideration, there are about $(6-1)^2 = 25$ different project comparisons against a baseline. When assessed across the three climate and three market scenarios, the number of potential scenarios to compare increases to $(5 \times 3 \times 3)^2 = 2025$ scenarios to compare. We choose a limited set of these to convey the breadth of possible outcomes.

(3) *B/C and B-C estimates*

Cost estimates are described in their own section below. Once the expected net present value of benefits and costs are calculated, they are compared in two ways. Let B denote the expected net present value of benefits, and C denote the comparable costs. The benefit-cost ratio is the ratio of benefits over costs and is denoted B/C. The B/C ratio can be interpreted as the benefits per dollar of cost expenditures. A B/C ratio greater than one indicates that benefits are larger than the costs, a B/C ratio equaling one indicates that the benefits exactly equal the costs, and a B/C ratio less than one indicates that costs are larger than benefits. Net benefits are benefits minus costs B-C, and represent the value of a project minus its costs. B-C is zero if benefits equal costs, positive if benefits are larger than costs, and negative when costs are larger than benefits. Throughout this report, we use B/C to represent the benefit-cost ratio, and B-C to represent net benefits. B/C will always be greater than 0 if B-C is positive; it will equal one if B-C is zero, and will be between zero and 1 if B-C is negative. At various points in the report we refer to the "B-C criterion". This criterion, in our usage, is satisfied if B-C is positive and B/C is greater than one.

2. *Water markets*

The water marginal value functions for each district described in the previous section (and Appendix VII.A) show the relationship between water use, curtailment by fallowing, and agricultural production value. The economic impact of curtailment depends on how fallowing decisions are made, which depends in part on how much flexibility irrigators have to move water between crops which in turn depends in part on the effectiveness of markets to allow water reallocation across crops within a district and across districts. While we use the Four Accounts analysis as a starting point for our analysis, there are substantial differences in the way we approach market assessment, in part due to the difference in the focus of the report. Appendix VII.B provides an overview of the Four Accounts analysis and how our analysis differs.

To examine the impact of curtailments with and without market activity, we define three market regimes that provide useful benchmarks against which not only the gains from trade, but the economic impact of IP projects under different market conditions, may be assessed. The three market regimes that we consider are:

- No water trading
- Intra-district water trading
- Full trading: both intra- and inter-district trading

The no trading regime imposes the restriction that when water is curtailed during a drought, all crops are curtailed in the same proportion. The intra-district trading regime allows frictionless, efficient water distribution within irrigation districts, but no trading across districts. Full trading allows both intra- and inter-district trading such that water is distributed efficiently to its highest valued uses across districts, with some cross-district trade limitations described below.

To implement Full Trading, inverse demand curves (marginal value functions) and proportional curtailment values were estimated for all five irrigation districts included in the study, as well as the Kittitas Senior water rights holders as described in Section III.C.1 and in more detail in Appendix VII.A.

a. *No Trading and proportional fallowing*

Proportional fallowing within (and across) districts is a process whereby acres allocated to each crop are fallowed in proportion to the curtailment rate faced by the irrigation district. Consequently, the cost of one af of curtailment is equal to the area-weighted, mean marginal value of water for the crops grown in that district. Calculation of this value is straightforward: it can be calculated as the total net revenue in a non-drought year divided by the number of af of water used in a non-drought year (which on average is less than full entitlement for the districts in this analysis). The values required for the Roza district are shown here to illustrate this calculation:

- Roza entitlement: 393,000 aft
- Roza's maximum water use in non-drought year: 322,495 af
- Roza's total net revenue in non-drought year: $130,284,737

The constant marginal value of water can be calculated as total net revenue divided by water use in a non-drought year. For Roza this is ($130,284,737/acre)/(322,495 af/acre) = $403.99/af.

The analogous values for Wapato, Kittitas, and Sunnyside are $255.7/af, $110.60/af, and $299.89/af, respectively. Table 6 includes these marginal water values under proportional curtailment rounded to the nearest dollar. Note that the marginal value of water is constant regardless of the level of curtailment within each district, but is different across districts depending on their crop mix.

Table 6: The marginal value of water under proportional curtailment.

District	Acre-weighted marginal value of water ($/af)
Roza	404
WIP	256
KRD	111
SVID	300
YTID	530
KSR	106

Proportional curtailment is a behavior implied by the most restrictive assumption about trade. It is consistent with the assumption that there is no trade among irrigators within or across districts in the face of curtailment, and that individual irrigators cannot selectively move water from lower to higher valued uses within their own enterprise by "trading with themselves".

The economic impact of curtailment is at its highest under proportional fallowing. Further, because intra-enterprise and intra-district trading does occur, the proportional fallowing "no trade" regime represents an outer bound on both actual trading outcomes and the costs of curtailment. Drought impacts decrease as restrictions on water moving from low to high valued uses decrease.

b. *Intra-district trading only*

In contrast to proportional fallowing, the "intra-district trading" scenario assumes that water is reallocated from low to high value uses without restriction within a district, but that no water is traded between districts. This type of scenario is illustrated using the SVID the blue (steeper) inverse water demand curve in Figure 10, which represents the profit generated per unit volume of additional water for the district. Suppose 100,000 af of water were available to SVID. The district would generate approximately $250 in additional profit by having one additional af of water available (equal to the height of the curve at 100,000 af). The decrease in the marginal value along the x-axis from left to right occurs because the crop acreages are ordered from highest (left) to lowest (right) value. Under a particular drought scenario, the district receives a particular volume of water allotted based on their entitlement and share of proratable rights (say 100,000 af), and the total value of production is equal to the area under the inverse demand curve between 0 af and the amount available (100,000 af).

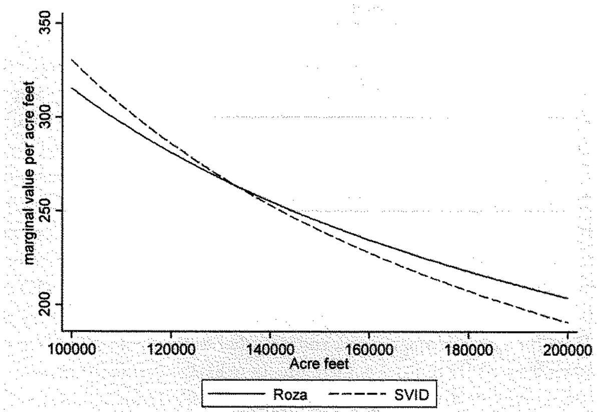

Figure 10. Water value curves for Roza and SVID.

When intra-district trading is possible, the cost of a drought is less than when proportional fallowing is assumed. This occurs because intra-district trading promotes two types of drought mitigation. First, crop diversity at the farm level allows each grower with multiple crops to fallow their low value crops in favor of irrigating their higher value crops. While technically this is not a trade between two farms, it can be thought of as "on-farm trading". Second, farms within an irrigation district can contract to buy and sell water across farms. By assuming perfect selective fallowing within districts, there is frictionless, unrestricted trading within a district. From a legal perspective, this type of trading is feasible because legislation allows place-of-use changes within districts without regulatory oversight (RCW 90.03.383 sect 3). However, there are numerous factors that could limit trading relative to this upper bound, including but not limited to:

- Poor information on potential trades and transaction costs that limit willingness to trade. For example, Yakima Tieton Irrigation District charges a $150 fee for all intra-district transfers + another $20-$50 for connection changes + mandatory escrow fees payable to a third party provider of an unspecified amount (http://www.yakimatietonirrigation.com/water-transfer-guidelines.html).
- Irrigation timing conflicts such that moving water from low- to high-value uses is constrained by differences in the appropriate timing of irrigation across crops.
- Infrastructure constraints that may limit actual transfer of water among two potential buyers.

The process of selective fallowing through implied intra-district trading as described here represents the upper bound on trade within a district, which in turn provides the lowest possible impact of curtailment on agricultural production value given no out-of-district trading.

c. *Intra-district and Inter-district Trading*

When inter-district trading is also possible, water can be moved from low to high value crops across districts as well via water trading, leading to additional reductions in curtailment impacts. To provide a sense of how water is reallocated during inter-district trading, the water value curves for Roza and SVID are overlaid in Figure 10. Using an economic optimization model, the volume of water that can be allocated across districts to maximize the total combined profit of the two districts can be calculated. Implicit trading occurs when the value of the last af of water that one district receives is worth less than the last af received by another district. Water is traded toward higher value uses at the margin, until the marginal value of water is equal across all uses. The point where the marginal value functions cross in Figure 10 illustrates such a point when the marginal value of water is equal across the districts.[10] Historically, water has been traded between SVID and Roza because SVID has a higher share of non-proratable rights. This means that SVID has access to more water than Roza for a given drought level, and is further to the right on their water value curves. Water trading from SVID to Roza is therefore more likely because the inverse demand curve (marginal value curve) for Roza is higher than that for the SVID for all but the largest curtailments (available water below about 25,000 af).

d. *Market constraints and frictions as context for interpreting market simulation results*

The market model described above represents frictionless trading regimes for both intra- and inter-district trading, and provides the upper bound on possible water market performance among the districts as trading partners. There are several constraints that we impose on the trading model. In the case of inter-district trading, we assume that WIP and YTID do not trade between districts. We impose this constraint on WIP because it retains institutional limitations that are likely to limit its market participation in the intermediate, and potentially even in the long run (Ross 2014; U.S. General Accounting Office 1997). We preclude YTID from trading because, hydrologically-speaking, it is relatively isolated in such a way to limit water sales, and because its crop values and non-proratable status limits its incentive to buy. Another constraint to be cognizant of is the potential for third-party effects of transactions, especially in the case of transactions between downstream sellers and upstream buyers, which can negatively impact instream flows (and therefore also the diversion capacity of other water rights holders) between the transactants. For the irrigation districts among which we allow active trading, however, the idiosyncrasies of the irrigation districts considered here generally preclude this from happening. In particular, we would be concerned about KRD buying from SVID for this reason, but the crop mix and associated water value functions essentially preclude it from happening. Although our market model is not spatially explicit, the simulated trading outcomes are such that the KRD does not buy from SVID. In this simulated trading environment, KRD only buys if curtailment reaches above 90%, at which point Kittitas Senior sells more than enough water to cover KRD purchases.

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[10] This trading outcome occurs regardless of a district's initial endowment as long as the differences in production value across districts are not too great such that the marginal value curves do not cross within the constraints of total available water (i.e. a corner solution).

There are also many constraints on water markets that are "soft" over the long-term, diminishing or disappearing if and when market development occurs. Here, we discuss five important soft constraints that would lower the impact and value of market-based reallocation, making our results overly-optimistic in terms of market performance.

First, water right transfers involve real economic resources in applicant time, Department of Ecology and Superior Court staff time, financial outlays on consultants and attorneys, etc. A transaction between a seller who was earning $50 per af of water and a buyer who would earn $150 per af would not occur if the transaction costs are $100 per af or higher. These transaction costs, particularly the long review times, are identified as a barrier to water markets in the IP. A number of studies have examined water market transaction costs (Colby, Crandall, and Bush 1993; Colby 1990a) and have found that in some cases they can add approximately one-third to the purchase price (McCann et al. 2005). Surveying public/administrative transaction costs for environmental purchases in several states and basins, Garrick and Aylward (2012) identified the public administrative costs to be on the order of $6/af in the Yakima Basin. We do not have an estimate for the private transaction costs (e.g. time, lawyer fees, specialized water right examiner fees). While we do not model transaction costs explicitly in our simulations, we would again note that transaction costs should decrease market activity increases and transfers become more standardized.

Second, although the Yakima Adjudication has clarified the status of rights in the basin, there may remain some legal uncertainty for an individual interested in selling or leasing water. If Ecology or the Water Transfer Workgroup examine their right for a possible transfer and find that the water has not been put to beneficial use, the right could be at risk of curtailment. This report is a public record, and Ecology has noted that this may be an impediment to sellers coming forward (McCrea and Niemi 2007; Clifford 2012). The non-profit Washington Water Trust is one of the few organizations that can provide confidential initial reviews of a water right's validity. Although several options to avoid this problem were discussed in Ecology's 2009 EIS, none were carried forward as recommended options. Furthermore, although the Washington State Department of Ecology has successfully used its Trust Water Right program for a number of years, there is anecdotal evidence that many still believe a temporary transfer would endanger their water right. The growing mitigation market in the upper Kittitas valley is evidence, though, that the legal issues are not insurmountable, at least for transactions between "senior" Kittitas sellers and domestic buyers.

Third, our estimate of the net revenue per acre may understate the value that growers place on their ability to farm as a livelihood and their feeling of contributing to the local farm economy. Previous research has documented a reluctance to transfer water out of agriculture among farmers in the Yakima Basin (Lovrich et al. 2004), Northeast Washington State (MacDonnell 2008) and the Western United States more generally (Western States Water Council 2008). Farmers may be concerned about lost wages in the farm economy and reduced control over the use of water. Potential risks to the farm economy are larger to the extent that local economies are less diversified and where water use is disproportionately reliant on irrigated agriculture and where transfers would fallow more irrigated acres (Hanak 2003) (NRC 1990). Cook and Rabotyagov (2014) find that farmers in the upper Kittitas preferred split-season leases over full-season lease agreements that would fallow land for an entire irrigation season. Our treatment of silage corn for dairies may also understate its value; given the high transport costs it is uneconomical to import silage corn from distances greater than 8 miles (van Gundy, R. pers. Comm.). Similarly, the net revenue estimates used in the Four Accounts and here for hay and timothy hay may underestimate the revenue lost when a hay stand is fallowed in the middle of its 4-year rotation period. The stand will not return to its full productivity the following year, so foregone revenues may be double our estimates. An upper bound estimate would be the costs to re-establish the stand.

Fourth, although the mitigation market has grown in recent years, the market is still "thin" (in the parlance of economics) and sellers may be concerned about their ability to negotiate a fair price. They must have a clear knowledge of their own opportunity costs (foregone net revenues) for a short-term lease, and for longer-term leases or sales, must project those net revenues into a future with increasing supply variability (Scott et al. 2004). Irrigators may also be reluctant to sell water for instream flows if they question whether contract enforcement will be effective in securing benefits for fisheries rather than downstream water users (Lovrich et al. 2004).

For long-term leases or sales, the separation of water from land and its appraisal is another concern. Clifford observes that "many landowners are uncomfortable separating their water right from their land... Landowners are concerned about the effect the loss of the water right could have on the value and future use of the land" (Clifford 2012, 11). The fact that Ecology cannot purchase land and water together can make it more difficult for the state to participate as a buyer in local water markets. While Reclamation, unlike Ecology, can purchase bundled land and water, federal acquisition rules require Reclamation to estimate a single (combined) value of land and water in purchases of real property (Linne, Kane, and Dell 2000, A–19). Doing so typically results in lower water right valuations than if water rights were valued separately from land (Clifford 2012). The acquisition rules can serve as a deterrent to price negotiations in public water purchases to the extent that Reclamation acts as a buyer or seller. Reclamation is limited to "just compensation," or "fair market value" (Code of Federal Regulations [CFR] sec 24.103) that is lower than private sector appraisers commonly estimate at the request of potential sellers. Additionally, there may exist contractual restrictions on change of use for federal project water --- which describes the water held by the large irrigation districts in the Yakima Basin. Sales from agriculture to municipalities or for instream flows may call for legislative action to facilitate, as was the case for California (e.g. the Central Valley Improvement Act, 1992, Sec 3405.[11] As another example, the California water code also was also modified to allow the sale of conserved federal water to municipalities.[12] This legal issue may be pertinent in the Yakima basin, because irrigation diversions in full-water years have steadily declined below full entitlement over the last few decades.

Although irrigators in our "senior" Kittitas group do have the legal ability to lease or sell their water rights, individual irrigators in federal irrigation districts do not have the same capacity for doing so. Irrigation districts – with some exceptions – have generally been less enthusiastic about the role of

[11] See http://www.usbr.gov/mp/cvpia/title_34/public_law_complete.html.
[12] See http://www.sdcwa.org/quantification-settlement-agreement.

water markets and less likely to participate (Ghimire and Griffin 2014). In the State of Washington, irrigation districts may sell water to any user outside the district "on such terms and conditions as the Board of Directors shall determine" (RCW 90.03.380). What might prevent more transactions between irrigation districts? Transfers outside of a district may hinder the operational ability of the district to meet its obligation to deliver water to its customers (for example, those customers who did not wish to participate in a voluntary fallowing program). Indeed, a district's justification for blocking transfers is strengthened to the extent that a proposed transfer would "adversely affect the ability to deliver water to other landowners or impair the financial integrity of the districts" (RCW 90.03.115). The IP models cap out-of-district trades at 10% of a district's supply on these grounds, but provide no further guidance on why this number was chosen.

Finally, where the new place of use is located in a different county than the point of diversion, the Board of County Commissioners in the originating County must be notified (RCW 90.03.380.10) in addition to the normal public comment period. County Commissioners in some Northeast Washington Counties have shown increasing interest in restricting the amount of water transferred out of a county of origin through limits and taxes on exported water (MacDonnell 2008). While no such restriction currently exists in the Yakima Basin, it is conceivable that Kittitas County might consider such a regulation in the future. Should such a rule be implemented, it could take the form of weed management and re-vegetation requirements for fallowed lands. Alternatively, the rule could require annual compensation payable to the purchasing county for a period of 20 years to offset lost property tax revenues or take the form of a fixed fee per af of water transferred (MacDonnell 2008).

The discussion above pertains the extent to which our estimates (and those of the Four Accounts analysis) of the benefits of market-based reallocation are overly-optimistic. There remains the question of precisely what actions the Integrated Plan will undertake to achieve the increased market-based allocation results in the Four Accounts. As discussed in Section II (Project Descriptions), we can find no references to proposed legal or administrative changes, and essentially no basis for the estimated costs reported in the Four Accounts analysis associated with this element of the Integrated Plan.

3. Water for municipal and domestic use

Our analysis of municipal benefits takes the Four Accounts analysis (ECONorthwest, Natural Resources Economics, and ESA Adolfson 2012; HDR Engineering and Anchor QEA 2011) as a starting point. We take their assumptions of population growth and related water demand increases as given. We use our interpretation of their methods as a starting point for our analysis, but with modifications where warranted. These modifications fall under three categories: 1) correcting methods where we believe values were arrived at incorrectly relative to Four Accounts stated approach, 2) introducing changes to methodology that we believe represent improvements to the approach used in the Four Accounts study, and (3) applying of alternative price scenarios that are within a reasonable domain of future outcomes.

a. *Summary of Four Accounts Analysis for municipal benefits*

Municipal benefits come from two sources in the Four Accounts analysis (1) benefits from the provision of new IP-based proratable summer water entitlements to municipalities to cover demand increases from population growth, and (2) benefits from the IP for providing water security against curtailment of (junior) groundwater rights that municipalities in the basins relied upon. Below we summarize our interpretation of the methods used in the Four Accounts analysis.

For the demand growth component of the Four Accounts analysis, the benefits of the IP stem from their assumptions that (1) entitlements to summer water from IP storage development would be allocated to municipalities and domestic uses to cover all of their development needs for the next 100 years at zero cost to municipalities, and (2) in the absence of the IP these municipalities and domestic users would have to purchase senior water rights to provide water for all growth.[13]

To estimate the cost of new water for population-based demand growth (under the no IP scenario), the Four Accounts analysis assumes that new municipal and domestic water use beyond 2020 would be purchased annually. The cost per af of water is assumed to be a wholesale municipal water price of $258 per af. While these annual purchases are described as wholesale water purchases, they can be usefully thought of as water leases to distinguish them from permanent purchases of water rights.[14] The amount of water purchased increases annually to cover forecasted population and water demand growth in the basin. The net present value of this accumulating set of annual water purchases is then interpreted as the cost to municipal and domestic users of not implementing the IP, and therefore the benefits of implementing it. The estimated benefit arrived at for this component of the municipal/domestic analysis is $115 million, which we have replicated within rounding error of <$1 million.

For the water security component, the Four Accounts analysis assumes that current groundwater rights will be curtailed during drought, and that the IP will improve markets to allow municipalities to replace their current junior groundwater rights with senior water rights. Benefits of the IP arise entirely from presumed IP improvements to water markets that allow groundwater users to replace their junior water rights by purchasing senior water rights. To estimate these values, groundwater users are assumed to purchase senior water rights at $2,500/af per year from owners of senior agricultural irrigation water rights holders, for whom the opportunity cost of this water is assumed to be $1,000, providing net gains from trade of $1,500 per af. Their estimated benefits for water security for existing rights is $280 million, which we have been able to replicate within rounding error of < $30,000. Adding up their two estimates provides $395 million, or about $0.4 billion, which they report as the benefits of the IP received by the municipal and domestic water use sector.

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13 While not directly pertinent to this analysis of municipal benefits, note that our results for agriculture rely on the assumption optionally implemented in HDR the implementation RiverWare YAKRW model that municipal/domestic water demand is set at projected 2040 levels(HDR Engineering, Inc. and Anchor QEA 2011, p. 31-32), which is the midpoint between the 2020 and 2060 time window assumed on the Four Accounts analysis for municipal growth.
14 In addition, to the extent that this wholesale water price includes the cost of conveyance and processing, this cost is likely to overstate the marginal opportunity cost of water, which is the marginal value of water in a quantity-constrained system.

b. *Modifications to the Four Accounts methods and assumptions*

We begin with issues that apply to both the water security component and the future demand growth component, and then examine each independently thereafter.

First, for both new demand and security for current municipal/domestic groundwater users, the analyses hinge on whether leasing or purchasing senior water rights is available for municipal and domestic use, but water prices are applied inconsistently. The Four Accounts analysis uses a price of \$2500 per af as a municipal water value for water security, as explained in the Four Accounts text on page 52:

"Recent small transactions to mitigate the impacts of residential development have occurred with prices equivalent to about \$30,000 per acre-foot, but information obtained during efforts by Ecology and others to expand the amount of market activity suggests the price will likely fall to about \$2,500 per acre-foot (Barwin, 2012)."

The reference to mitigating new residential development and the magnitude of these values suggest that this price refers to a sale price rather than a lease price.[15] A competitive sale price for an asset such as a permanent water right can be approximated by an annual annuity. The present value of a permanent annuity A at interest rate r is $\mathrm{PV} = A/r$. In this case, the sale price of a permanent water right in a competitive market equilibrium is PV=\$2,500/af. Given a 4% interest rate, $A = PV \times r = \$2{,}500 \times 0.04 = \$100$. Thus, a permanent water right price of \$2,500 is equivalent in present value terms to an annual annuity (i.e. repeated lease) of \$100/af/year.[16] This value is lower than the \$258/af/year used in the Four Accounts analysis to model water rights leases to satisfy population growth-based demand increases (U.S. Department of the Interior Bureau of Reclamation 2008; ECONorthwest, Natural Resources Economics, and ESA Adolfson 2012).[17] Thus, the values for annual lease versus permanent water rights purchases are used inconsistently in the water security versus new demand components of the Four Accounts municipal/domestic benefit analysis.

For our analysis, we rely primarily on the following values either drawn or inferred from the Four Accounts municipal and domestic analysis:

- The opportunity cost of a permanent sale from agriculture is \$1,000/af of water sold. This implies an annual annuity (lease) value of \$40/af/year.
- A water purchase price of \$2,500/af for a transfer from a representative agricultural seller to a municipal buyer for water purchased, which implies an annual annuity (lease) value of

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[15] They also cite Brewer et al. (2007) in discussing water sales prices, which supports our interpretation.

[16] We are not suggesting that water sales prices will tend to exactly equal the present value of lease prices. Indeed, based on a limited dataset on western states water transfers available from UC Santa Barbara (Libecap 2014), we find that water sale prices for agriculture to urban transactions averaged \$612.25/af and lease prices average 79.38/af/year, the latter of which has a present value of \$1,984.67 (these prices are inflated to 2012 dollars). Analogous averages for WA, OR, and ID tend to be lower, at \$434.61/af for sales and 42.61/af/year (present value \$1,061.72). There are many reasons why we would not expect the present value of market lease prices treated as a perpetual annuity to equal water sales prices, including the fact that transaction costs are different between the two, uncertainty about future water availability, and other factors will affect the outcomes. What is most useful here is that the range of these values is within the ballpark of the \$1,000-\$2,500 sale and lease prices discussed in this section.

[17] The permanent water right purchase price corresponding to an annuity of \$285 is \$258/0.04=\$6,450.

$100/af/year.[18] This is taken to be the cost avoided by municipalities if uninterruptible rights are received by municipalities at no cost to them under the IP.

We justify the use of these prices and price differentials instead of $258/af/year in Appendix VII.D. However, we also show in the appendix that based on the marginal value of water for agriculture, the assumed opportunity cost of water of $1,000 is if anything too low based on our simulations, and so the net gains to municipalities would be too high based on these assumptions.

As in the Four Accounts analysis, we assume that these increases in demand to 2060 will not have significant impacts on the prices of average ag-to-urban trades. This is likely not to be an egregious assumption for three reasons. Firstly, the aggregate additional consumptive water use is forecasted to grow to at 1193 af/year, reaching a total of 48,900 af/year of additional demand relative to current conditions and is a relatively small volume in relation to the 1 million non-proratable entitlements in the basin (HDR Engineering and Anchor QEA 2011, page 9, Table 1). Secondly, the assumption falls within the amount of entitlements not used in an average year by the five major districts. Finally, the demand for municipal water is price inelastic relative to that of agricultural demand, so we presume that while transaction prices may be volatile, this increase in municipal demand is likely not by itself going to impose much upward pressure on water prices in the basin, all else constant. We defer additional details of our water security and new demand analyses for the municipal benefits results in Section IV.C.

None of the above suggests that the marginal value of water to municipalities is limited to the equilibrium price of agriculture-to-municipal trades. In principle, the price negotiated between a buyer and a seller lies between the marginal willingness to accept for the seller and the marginal willingness to pay for the buyer. While estimates of the full gains from trade are unnecessary to estimate the value of IP water for new demand as a function of foregone water purchase costs, the full gains from trade would be useful for assessing the value of water security for current water users. However, we do not have sufficient information about the marginal value of water for municipalities in the basin. Nonetheless, we perform some robustness analysis in Section IV.C.1. The Appendix Section VII.D includes details of calculations, as well as the summary of a review of the non-economic foundations of the municipal demand analysis, including estimates of municipal water use and potential growth in use.

D. Fish impacts

To assess the economic value of the IP from fish abundance impacts, the impacts of these projects/operational changes on fish abundance must be estimated, and their economic value must be estimated.

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[18] While water rights are generally based on diversion rights, water transactions are generally predicated on consumptive use. Implicit in the Four Accounts accounting is that the transaction numbers that they use account, on average, for the differences in consumptive use across sectors. Generally speaking, municipal and domestic consumptive use tends to be lower than that of agriculture. The $1,500 difference in market price per af between intra-agriculture trades and trades between agriculture and municipalities is taken here to implicitly account for these differences in consumptive use rates.

1. *Fish productivity*

For the purposes of this report, actions to improve fish populations in the basin can be categorized as follows:

1) Fish passage for one or more existing dams in the basin
2) Operation changes to improve instream flow conditions for fish
3) Other fish habitat restoration

The effects of these activities are crucially dependent on the life histories of the fish species of interest. We therefore begin with background information on fish populations within the Yakima Basin in the context of the larger habitat and management in the basin, with a focus on sockeye (*Oncorhynchus nerka*), chinook (*Oncorhynchus tshawytscha*), and coho salmon (*Oncorhynchus kisutch*), and Steelhead trout (*Oncorhynchus mykiss*). These life histories inform the modeling methods used in the existing analyses as well as our reassessment of both methods and results.

2. *Fish life histories, fish passage, and restoration*

Expectations for the impacts of passage, restoration and flow are constrained by aspects of fish ecology and life history—all of which in turn have species-specific differences. The life history diversity of salmon and other highly mobile fish in the Columbia River System therefore specifies the frameworks available to evaluate the specific benefits from the YBIP. For example, the distance from the Yakima River headwaters to the Pacific Ocean is 547 river miles, and anadromous fish leaving the Yakima may travel several thousand ocean miles after they leave the mouth of the Columbia and before they return as adult spawners. The projects described in the IP however will only affect fish along approximately the first and last 200 river miles within the Yakima basin.

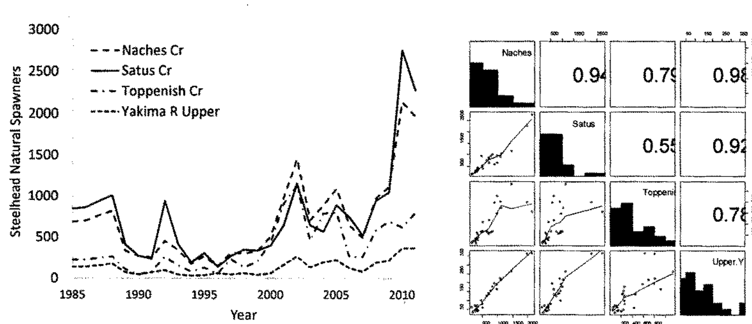

Figure 11: Time series of estimates of steelhead trout spawners in each of four identified Yakima Basin sub-populations, along with pairs plot indicating the degree of temporal cross correlation among the time series.

This has a number of consequences. Most importantly, there are a large number of potential sources of mortality occurring outside the basin, with as little as 34 - 64% of mortality occurring in the freshwater life history of anadromous salmonids (Bradford 1995). This is illustrated when we plot the time series of abundance of adult returns to different parts of the Yakima basin (Figure 11). In this case we have plotted Steelhead trout returns to the Naches, Satus, Toppenish creek and Upper Yakima River systems from 1985 to 2012 (period over which NOAA-Fisheries has published recovery data). In each case, the fish experience different habitat conditions and potential sources of mortality within each of their natal creeks, but common histories of mortality risk only occur in common areas: the lower Yakima, mainstem Columbia and Ocean systems. If habitat conditions within their discrete population areas were a principle determinant of population status, we might expect to see these times series not well correlated given the diversity of habitat among these four areas. On the right hand side of the figure are scatter plots of the correlated time series as well as their correlation coefficients. In each case, spawner correlations across tributaries are quite high and statistically significant, with the relationship between Satus creek and Toppenish creek steelhead being the weakest, but still having 30% of their variability in common. Thus, validation of the plan based entirely on adult returns means that improvements in early life survivorship due to the YBIP may be entirely successful, but out-of-basin mortality may prevent any of that success from being measurable into the future.

Another issue is that any given habitat project or flow enhancement will only be encountered by an individual fish for a matter of days in the case of an outmigrant, or perhaps hours by a returning spawner. These are very short times in the three to seven year life history to have an effect on individuals from which we would then impute a population-level effect. Therefore, all of the impacts of these projects are interpreted as changes to population-level survivorship related to a specific location or event, as they were the Four Accounts EDT forecasts. The net survivorship is the resulting cumulative probability of all the steps or life-stage transitions over the lifetime of the fish. Calculations of net survivorship are executed as a long series of multiplications of numbers between zero and one (probabilities range from 0 to 1), which culminate as a very long series for the whole life history. Consequently, even if survivorship for a specific step is high, or made high by a specific management action, the net survivorship works out close to zero. This is not a surprise when we remember that female fish may lay 3,000 to 7,000 eggs in a redd (Groot and Margolis 1991), but only two fish survive to reproduce if the population is just replacing itself. The other consequence however, is that our sensitivity to detect small changes at specific life history steps is relatively low when we are looking at a population level outcome, such as numbers of returning adult fish.

a. *The recovery paradigm*

This representation of survivorship has another important consequence: the effect of any change in survival itself is probabilistic. We cannot specify how many fish will survive passing a given dam, or other threat, we can only say what the probability of survival is, and if sufficient monitoring data exists, what the change in probability will likely be for a given management action. While we cannot predict the fate of a given fish, the probabilistic nature of survival provides a mechanism to estimate our uncertainty in any estimate.

Any forecast that is presented as a point estimate (e.g. numbers of adult fish returns) should be interpreted carefully as a number, a metric, for which there exists some probability that it will be realized in the future. Sometimes the point estimate is chosen because its probability is higher than any alternative, but sometimes it is chosen because of its position within the range of other estimates (i.e. the median, the maximum, the "best case", etc.). Regardless of the type summary metric used, however, there is some likelihood for each of the other possible outcomes (numbers of returning adults other than the point estimate presented), some of which may be very far from the point estimate. This uncertainty about any point estimate presented is not to be equated with not knowing the answer; it is part of the answer. As a consequence, the language we have to use for communicating within the framework of fish benefits is in terms of changes in fish survivorship probabilities and any value has to be communicated with its uncertainty, and the uncertainty has to be understood correctly and acknowledged. This characteristic applies to all estimates presented in this report.

It is also critical to remember that these fish are wild rather than domestic. This means that human activity can reduce the numbers of fish deterministically (harvest, habitat loss, etc.), but cannot force the production of new wild fish. The premise of a restoration enterprise is that by reducing the contribution to mortality from specific sources such as poor habitat quality a consequent increase in the number of wild fish may follow. This is not unreasonable, but these restoration mechanisms are passive, and even if the habitat alteration is successful, there may be other reasons why restoration correlates poorly with increasing numbers of fish.

If current fish abundance is below the current carrying capacity of the habitat, there may be some

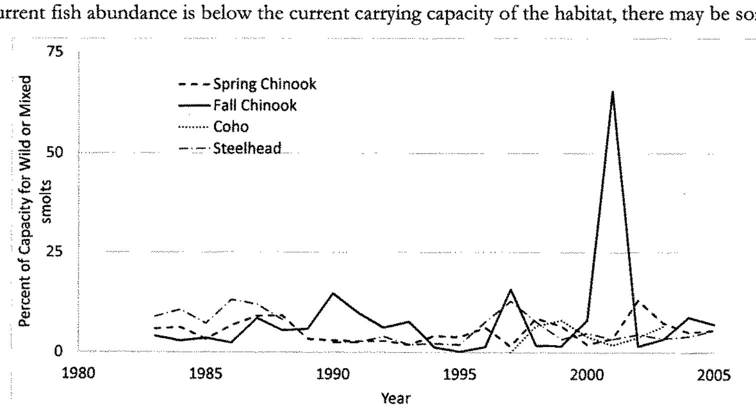

Figure 12 Estimates of smolt abundance for four species of salmonid in the Yakima basin expressed as the percent of carrying capacity based on habitat characterizations.

other factor limiting population size such that further increasing habitat capacity via restoration is unlikely to increase population size. One extreme ecological illustration is the middle fork of the Salmon river; the Frank Church Point of No Return wilderness has habitat quality unmatched anywhere in the Columbia River basin. As such, there would be no need for remedial actions to increase the quality and quantity of habitat, yet chinook salmon in this area are below carrying capacity and are listed as endangered under the Endangered Species Act (ESA).

Data available for the Yakima basin allow us to illustrate the relevance of the recovery paradigm. Figure 12 shows a time series of estimates of out-migrating smolts of various species as they pass the counting facility at the Prosser diversion dam expressed as the percentage of capacity for each species determined from habitat assessments (Fast, D. et al. 2001). In each case, the number of smolts produced generally ranges from 1-16% of habitat capacity, with the exception of fall chinook smolts in 2001 which were anomalously abundant and exceeded 65% of the estimated habitat carrying capacity. The observed rate of production suggests two things. One, that habitat conditions within the basin are not the ultimate limits to net fish production; and two, that habitat improvements alone are unlikely to produce large increases in fish abundance in the Yakima basin.

b. *Species differences*

There are important life-history and ecology differences among the fish species considered in the YBIP. The biggest difference is that while bull trout (*Salvelinus confluentus*) do move within the basin, they are not anadromous. They are also listed for protection under the Endangered Species Act so they are not commercially harvested. Bull trout are highly sensitive to water quality, requiring cold, clear water and connectivity between the main channel and the off-channel habitats that they prefer (Rieman and McIntyre 1995; Watson and Hillman 1997; U.S. Fish and Wildlife Service 2010). While bull trout are mentioned in the Fish benefits memo (U.S. Bureau of Reclamation, HDR Engineering Inc., and Anchor QEA 2011), and it is stated that the fish benefits attributed to bull trout will be characterized by a "qualitative score card" (Section 1.3, page 2) no further mention of bull trout, in terms of related benefits or the score card, is made in the entire report. A scoring system that characterizes "Environmental Quality" is described in the Four Accounts Memo (ECONorthwest, Natural Resources Economics, and ESA 2012), and this does include information on bull trout. Although none of that information provides forecast estimates for abundance of bull trout, nor the consequent economic benefits. This is a particular challenge, since any action that would affect bull trout habitat would be subject to consultation with the US Fish and Wildlife Service under the ESA, which would be greatly facilitated by an analysis of population impacts of the potential action.

Among the anadromous species, the life histories and habitat usage of coho and chinook salmon and steelhead trout are similar in their use of stream habitat for migration, holding and spawning, and distinct from the sockeye salmon that largely use lake habitat for spawning and holding. These life-history differences are the basis for the former species' habitat associations being modeled with the Ecosystem Diagnosis and Treatment (EDT) model framework in the Four Accounts assessment, while sockeye were modeled with a reservoir surface area-habitat capacity model instead (U.S. Bureau of Reclamation, HDR Engineering Inc., and Anchor QEA 2011). The different approaches taken with these species groups are common. Among the stream-using species, Steelhead occur in the greatest diversity of habitats and across the largest extent of habitats within the river network, with coho and chinook occurring lower in the network within a smaller number of reaches (Groot and Margolis 1991).

Sockeye are distinct from the other species in several other aspects. Principle among these differences is being almost completely extirpated from the Yakima basin in the early 20th century due to passage limitations (Gustafson et al. 1997). Dam construction eliminated access to the Kachess and Keechelus lakes in 1904, Cle Elum lake in 1905 (Bryant and Parkhurst 1950; Davidson 1953; Fulton 1970; Mullan 1986), and Bumping lake in 1910 (Davidson 1953; Fulton 1970). Thus, the reintroduction of sockeye to the Yakima under the YBIP represents a different conservation and management enterprise than the maintenance and growth of existing populations of the other stream spawning species. Consequently, the analysis of the potential fish benefits for sockeye salmon is treated differently from the other anadromous species.

Like sockeye, wild coho salmon were also largely extirpated from the Yakima basin in the early 1980's from overexploitation, and to a lesser extent habitat destruction (YSFWPB 2004; Yakima Nation 1997). Unlike sockeye, coho populations within the Yakima were being supplemented with hatchery smolts (ca. >700,000/annum) over this entire period to support harvest (Dunnigan, Bosch, and Hubble 2002). Starting in the mid 1990's these hatchery releases were recruited as a reintroduction program, intended to develop a self-sustaining wild population of coho salmon in the Yakima (Bosch et al. 2007). The coho reintroduction differs from the reintroduction of sockeye in that coho habitat quantity has been similar over this time, although quality may have changed. Thus, the coho recovery effort involves increasing fish abundance only, while the sockeye reintroduction is designed to radically increase habitat quantity over historical levels (i.e. pre-reservoirs) while increasing fish abundance.

c. *Sockeye and non-sockeye impact modeling in relation to fish passage, instream flow, and habitat restoration*

The practical implication of the difference between sockeye life histories and non-sockeye salmonid life histories is that very different models have been used to estimate the analysis of IP project impacts on the different species.

Sockeye are modeled using the "Spawner per Hectare Method" as described in the Fish Benefits Analysis Technical Memorandum (2011) and by Hubble (2012). This method relies on an understanding of the spawning capacity of lakes and assumptions about egg-to-smolt and smolt-to-adult survival rates. Because access to lakes is dependent on fish passage to the five lakes/ reservoirs in the basin, and wild sockeye populations almost entirely depend on access to lakes for spawning, sockeye impacts are modeled as being entirely dependent on fish passage. While factors such as instream flow and restoration in the Yakima Basin may affect the adult survival rates in principle, these sockeye survival rates are treated as independent of IP restoration and instream flow changes.

In contrast to sockeye, the recruitment benefits to non-sockeye species focused on by previous studies (chinook, steelhead, coho) come primarily from restoration efforts and instream flow changes, and are modeled using the Yakima Basin Ecosystem Diagnosis and Treatment (EDT) model in conjunction with the All H Analyzer to provide a wild and hatchery abundance estimate (U.S. Bureau of Reclamation, HDR Engineering Inc., and Anchor QEA 2011). The All-H Simulator is an accessory to the population process model that considers alternative management scenarios, but its outputs are dependent on the population estimates it receives from EDT.

Importantly, while these studies quantitatively distinguish between fish passage impacts and restoration impacts, they do not identify quantitative differences between instream flow contributions and other restoration contributions to non-sockeye species. This latter distinction is important for this present report because of its connection to the net benefits of water storage, to which both out-of-stream uses and instream flows may contribute.

d. *Complementary analyses and assessment*

While we use the existing analyses as a starting point for assessing the impacts of IP projects on fish populations, we can re-examine the relevance of these previous estimates in several ways. These instream or fish-based benefit estimates arise from the EDT process (described above), and are based on expectations for changes in habitat unit-based survival impacts, rather than on historical relationships between survival and habitat variability. Data on in-stream flow in the basin, the history of habitat restoration in the Yakima basin and contemporary estimates of smolt production and adult spawner abundance are available.

Smolt to Adult Return rate (SAR) is a commonly reported measure of salmonid survival, and in this case provides an index of fish survival for the part of the life history outside the Yakima basin. Relative survival over this period is anticipated to reflect in part fish condition or size as they leave the basin (Henderson and Cass 1991; Koenings, Geiger, and Hasbrouck 1993; Tipping 2011; Tomaro et al. 2012), but is also largely affected by out-of-basin mortality. The Smolt Per Adult spawner production (SPA) on the other hand is a measure of the smolts produced by adults returning at a prior time and should reflect changes in within-basin survival. It is less commonly evaluated because most analyses of salmon survival have relied on dam counts which have limited precision with respect to survival and non-tagged fish identity once outside the mainstem Columbia. Data on adult and smolt abundance were obtained from monitoring reports from the WDFW and Yakima/Klickitat Fisheries project of the Yakima Tribe. Estimates of SAR were collected but were not available in all cases (e.g. some species and some years of others). The SPA and any missing SAR values were estimated using the time series of smolt and adult abundances and an assumption of fixed age distribution within populations. The assumption of a fixed age distribution is a gross oversimplification, but lacking data for each species, it is commonly applied for developing an index of survival for these fish (e.g. Bosch et al. 2007). SAR values estimated in the source literature were found to be highly correlated with SAR estimates using a fixed age distribution assumption and the correlations were high in all cases ($r > 0.91$).

Using these time series, statistical regression models were built to predict the SAR and SPA for each species against measures of restoration project abundance, flow within the Yakima basin and spill at McNary dam on the mainstem Columbia River for the years for which data are available. These models were used to identify any measurable effects of Flow and Restoration that would allow us to better evaluate the fish benefits in the YBIP that are attributable to these management outcomes.

Habitat restoration projects are measured by the total number of projects with a completion date in the year prior to the salmon outmigration year. These "Project" data were compiled from the Pacific Northwest Salmon Habitat Project Database (PNSHP Katz et al. 2007a; updated July 2014). Restoration project data are reported as the total number of projects regardless of type, because the metadata for extent and complexity of each project are not available.

In June 2005, the U.S. district court ("the Redden Court") granted a preliminary injunction requiring National Marine Fisheries Service (NMFS), via the USACE & Bonneville Power Administration, to increase flow and spill at certain Federal Columbia River Power System (FCRPS) dams starting in the summer of 2005 and continuing to date (U.S. Court of Appeals for the Ninth Circuit - 481 F.3d 1224). The premise was that increasing the water flux through the Columbia mainstem hydropower system would improve survival of outmigrating fish. Under this injunction a set of operating rules were put in place where some dams (e.g. McNary) had spill that was a specified fraction of discharge and was therefore variable. To evaluate the potential effect of spill on Yakima Basin fish, we used the average spill for the months of May-June-July-August as the index of "Spill" for each year because these were the months with the greatest year-to-year variability and peak outmigrant numbers.

Measures of flow within the Yakima basin were reported at the USGS stream gauge at Kiona, WA (USGA Stream Gauge 12510500; http://waterdata.usgs.gov/usa/nwis/uv?site_no=12510500). Analysis of monthly average flow over the prior 25 years indicates that the greatest variance, and therefore statistical signal of year-to-year variability, occurs in the spring months. This also coincides with a large fraction of smolt outmigration (Groot and Margolis 1991). Based on this information, flow for each year is reported as the average of April-May-June (AMJ). These indices of Flow and Spill are significantly correlation ($r = 0.8$) which creates problems for linear model interpretation. Therefore, Flow was regressed on Spill, and the residuals used in the linear models are under the label "Flow". The regression results are presented in Appendix VII.E.b.

e. *Assessment of Four Accounts fish abundance methods and estimates*

Appendix Sections VII.E provides an extensive assessment of the Four Accounts fish abundance impact estimates. While the technical details are relegated to the appendix, the analysis leads to the following conclusions. First, the Four Accounts sockeye abundance impacts, especially the high-end estimates, are likely to be overly optimistic for the following reasons:

1) The range of forecasts for sockeye adult abundance in all reservoirs (escapement rather than recruitment) relied upon in the Four Accounts analysis was 73,631 to 446,903. Subsequent estimates are 112,428 to 251,310 (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012). The latter high-end abundance estimate, based on a more refined modeling process that incorporates more specific ecological information, is only 56% of the initial estimate.

2) Estimates of historical sockeye runs range from 100,000 to 200,000 before the reservoirs were built. While the new lake area due to these dams would provide more spawning habitat than was available historically, the quality of this newly created habitat is unknown. Considering also the new threats and barriers faced by sockeye along their entire runs up the Columbia River and Pacific Ocean, the prospect of doubling or even quadrupling historical runs is highly speculative and uncertain.
3) High-end estimates are less likely than the low end estimates and therefore should be attributed less weight in assessing outcome likelihoods.
4) The sockeye population growth rates assumed by the Four Accounts analysis exceed marginal growth rates for comparable fish populations by a factor of 7 or more, suggesting that either fish benefits would accrue substantially more slowly (and hence provide lower present value due to discounting), or additional investment (and cost accounting) would be necessary to support population growth with hatchery fish or transplantation. The closest historical analog to potential sockeye reintroduction success is arguably the coho salmon in the Yakima, which illustrates these points.

While reintroduction of sockeye to even a modest fraction of the range relied upon in the Four Accounts analysis would be considered a major conservation success by most, the range of sockeye abundance forecasts relied upon for the economic analysis is in our assessment is overly optimistic in terms of quantity, timing, and likelihood. Having said that, the uncertainties surrounding sockeye reintroduction are so large that we cannot rule out even the higher estimates, except to say that they would, for sockeye in particular, amount to unprecedented reintroduction success.

Second, non-sockeye abundance impacts are more likely to be at the low end of the estimated range of impacts. Our limited statistical analysis and the broader literature support this conclusion, but only weakly. Non-sockeye estimates relied upon in the Four Accounts analysis are generated using a separate and very different modeling approach (EDT, as described in Section III.D) which has substantive methodological weaknesses but is commonly used. Uncertainty over these forecasts relative to the magnitude of their ranges is very large, and data do not exist to support an analysis with sufficient statistical power to say more than this.

Third, it is not possible to discern instream flow impact relative to other habitat restoration based on the existing studies, but our statistical analysis weakly suggests that instream flows have a weaker impact on abundance than do other restoration activities as a group. Appendix VII.E provides detailed discussion and analysis to support these conclusions.

3. Fish valuation

The Four Accounts analysis identifies two broad categories of economic values arising from increases in fish populations. "Use" values represent the value to commercial and recreational fisheries of harvested adult fish, as well as tribal harvest for subsistence, religious or ceremonial use. "Non-use" (sometimes called "passive use") values are a measure of what society would be willing to pay (in increased taxes, higher electricity bills, etc.) solely for the knowledge that the fish populations are improving, even if they expect never to use or come into physical contact with the resource. Because of the potential for overlap between these two categories in the process of valuation, the

Four Accounts report does not estimate use and non-use separately and add them together, but instead estimates what fraction of the total economic value is attributed to "use". The Four Accounts report estimates the total present value (use and non-use) from improved fish populations to be \$5.0 - \$7.4 billion, or approximately 80-85% of the total benefits from the IP. Non-use value comprises approximately 95% of the total economic value of improved fisheries (ECONorthwest, Natural Resources Economics, and ESA Adolfson 2012, 32). Because of the importance of fishery-related benefits, in this section we first briefly describe the methodology used for valuing "use" values before describing in some detail the method used for non-use values, which are based on a 1999 household mail survey. We then offer several critiques of this study and its application to the IP, arguing that the Four Accounts results are likely to be biased upward. We also provide some sensitivity analysis around the issue of non-IP related fish increases in the period 1998-2012. Because the 1999 study continues to be the best available information on how households in Washington state value increases in migratory fish, we also use this data source in our analysis.

a. *Use vs. non-use values*

Use values from harvesting adult fish are calculated using widely-accepted techniques. Values for five types of fish (coho, spring chinook, fall chinook, steelhead and sockeye) are calculated in six harvest categories (ocean commercial and sport, lower Columbia commercial and sport, Columbia tribal commercial and Yakima sport). Commercial values follow from the observed market price per fish and assume 80% of that price is profit. The analysis reasonably assumes that the increasing abundance of fish following implementation of the IP will not decrease the global market price of these fish. Recreational values, which are higher than commercial values per fish, are based on the amount of money fishermen spend to fish (e.g. equipment, licenses, travel expenses), as well as the non-financial value of the time spent traveling to site and fishing. Since many fishermen would likely spend even more to fish than they currently do, the report includes their consumer surplus, or the area under an estimated demand curve for recreational fishing. The report does not attempt to value tribal harvest for subsistence or ceremonial uses, which are described as "incalculable". These values are enumerated, though not valued economically, in Montag et al (2014).

Because "passive" uses do not reveal any behavior that can be observed through price-mediated markets, they are commonly estimated with the use of surveys. These surveys – which have been widely used and accepted in federal investment analyses for over three decades - typically present randomly-selected respondents with a hypothetical scenario where the level of some public good or service may be improved through some private cost to the respondent (e.g. higher taxes, electricity bills, water bills, or other payment vehicles). Often the respondent is told that the scenario would be implemented if a majority of respondents "vote" yes on the hypothetical referendum. Rather than observing "revealed" preferences on how salmon consumers value fish through the price they are willing to pay in the market, the survey instead observes "stated" preferences, where the values are contingent on the scenario that was presented to the respondent.

b. *The Layton, Brown and Plummer (LBP) 1999 study*

The Four Accounts analysis relies on a stated preference study conducted in 1998 for the Department of Ecology. The study was conducted by David Layton, Gardner Brown, and Mark Plummer (1999), henceforth "LBP". Although the report itself was not published in a peer-reviewed journal, results from a closely-related article relying on a subset of the data are reported in a highly-regarded, peer-reviewed economics journal (D. F. Layton 2001). The mail survey presented respondents in Washington state with four scenarios that increased populations of three groups of fish (saltwater species, freshwater species and migratory species) in two locations ("Western Washington and Puget Sound" and "Eastern Washington and the Columbia River"). Because Ecology hoped to use the survey results to evaluate the economic benefits of a wide range of programs that might improve fish populations, the survey did not provide a specific management plan for *how* the improvements might be achieved. Instead the survey said:

"The State of Washington is considering a variety of ways for improving fish populations, ranging from reductions in toxic contamination of water bodies to improvements in river flows and fish habitat. As mentioned earlier, fish populations are affected by a number of factors, including urban development, agricultural practices, timber harvesting, pollution, and hydroelectric dams. A new state program might affect some of these more than others. And in some cases, a new program would affect one region of the state differently from another, or would affect one species differently from others."

To describe the costs of the new programs, respondents are told that "new programs may directly or indirectly cost you and your household money....We want to find out more about how your household might respond to added costs such as these." Respondents were told to imagine the added costs of the program would show up as a "surcharge on your water bill (or other utility bill if you have no water bill)". It emphasized that the monthly costs would accrue each month for the next twenty years.

The survey varied the baseline "status quo" situation if no new programs were implemented. In one version, respondents were told that although fish populations had declined over the prior 20 years, they were expected to stabilize and would not decline further in the next 20 years. In a second version, the survey said that experts predicted that fish populations would decline further over the next 20 years. Respondents were given only one of these two versions. They were then asked to rank four new programs (one version shown in Figure 13) compared to the option of "no new programs". By observing these rankings, the authors statistically recover a willingness-to-pay (WTP) function for percentage improvements in each of the fish populations for the next 20 years. Importantly, this WTP function is estimated as a non-linear function such that the marginal value of improving fish populations from 2 million to 2.1 million is higher than the value of improving them from 2.5 million to 2.6 million. Specifically, the function relating annual household WTP for each of

Four Possible New Programs

	No New Programs	Fish Populations in 20 Years			
		New Programs (% increase over situation with no new programs)			
		Program 1	Program 2	Program 3	Program 4
Western Washington & Puget Sound					
Freshwater Fish	53 million	60 million (+15%)	70 million (+33%)	53 million (+0%)	55 million (+5%)
Saltwater Fish	54 million	62 million (+15%)	72 million (+33%)	108 million (+100%)	54 million (+0%)
Migratory Fish	2.5 million	2.88 million (+15%)	3.33 million (+33%)	5 million (+100%)	2.5 million (+0%)
Eastern Washington & Columbia River System					
Freshwater Fish	75 million	75 million (+0%)	79 million (+5%)	100 million (+33%)	120 million (+60%)
Migratory Fish	0.5 million	0.5 million (+0%)	0.53 million (+5%)	0.67 million (+33%)	0.9 million (+80%)
Additional Cost of Program (Monthly for 20 years)	$0	$25	$45	$4	$8

Figure 13: Four scenarios shown to respondents in one survey version of the LBP survey (replication from survey).

the 20 years and the percentage improvement (x) in migratory fish populations in "eastern Washington and the Columbia River" is[19]:

$$Annual\ WTP(2012\$) = \begin{cases} 12 * 1.377 * 2.53 * \ln(x) = 41.81 * \ln(x)\ for\ x > 5\% \\ 12 * 1.377 * 0.813 * x = 13.457x\ for\ x \le 5\% \end{cases}$$

Applying this function to the Four Accounts-estimated increases in fish, the aggregate value of fish benefits in the Four Accounts analysis implies that the average value of one fish ranges from approximately $27,000 (for low-end fish population increase of 181,650 fish) to $15,700 (for high-end fish population increase of 472,450). These values have garnered significant attention and skepticism because they seem at first wildly implausible given that the commercial market value of one fish is on the order of $50. It is important to recognize, however, that these estimates include non-use value that is *non-rival*. That is, many people can enjoy the benefit from the good at the same

[19] See Appendix IX.F for a more detailed explanation of how this function is derived from the LBP study. To calculate percentage improvements, one needs a baseline, and the Four Accounts assumes fish populations have not increased between 1998 and 2012, remaining constant at 2 million. This function adjusts for inflation between the survey year of 1999 and 2012, and represents the "stable" baseline treatment. The WTP function for respondents who were told that populations would continue to decline in the absence of new programs would have different parameters. This equation has a slightly different functional form for the linear portion of the function than the Four Accounts analysis, though this equation replicates their results. Again, see the appendix for more detail.

time without diminishing the benefit received by others. Rival goods, in contrast, can only be used by one person; only the person who buys the fish can eat it (a rival, "use" value). For non-rival goods, total willingness to pay increases in relation to the size of the population that values the good. These large fish value estimates stem primarily from the fact that having healthy anadromous fish populations are valued by millions of households, each of which are not directly impacting the value accrued by others. For example, assuming a population of 4.2 million households in Washington and Oregon (including projected population growth over the next 20 years), the value per fish (low end) works out to $27,000 / 4.2 million households = $0.0064 per fish per household.

Whether the LBP study is the correct benefit valuation study to use is a matter of professional judgment, and the Four Accounts analysis justifies this "benefits transfer" choice at length (see pages 12-16 of the Four Accounts report). We agree with the Four Accounts analysts that the LBP study is methodologically sound and generally consistent with modern non-market valuation approaches. The LBP study is one of several stated preference surveys valuing salmon in the Pacific Northwest (see Appendix VII.F for a survey of the existing literature), and we agree that the context and geographical scope of the LBP is the most similar to the IP. We also demonstrate in Appendix VII.F that the fish marginal value results in the study fall within the range of estimates published in the broader non-market valuation literature, although this literature focuses primarily on threatened and endangered fish. Finally, we find the application of the LBP approach to the IP in the Yakima basin via the benefits transfer methodology described in the Four Accounts analysis for the most part methodologically defensible given the available data, and consistent in general with modern non-market valuation methods.

However, we do have concerns about a) the LBP study itself and its valuation function relating fish improvements and household willingness-to-pay, and b) the way in which it is applied to the IP. These are discussed in the next section. Most of the concerns imply that the Four Accounts analysis overestimates the value of improved fish populations attributable to the IP to Washington households.

c. *Critique of the LBP study and its application to the IP*

We identify six reasons that suggest that the fish marginal value estimates as used in the Four Accounts analysis may be biased upward. In Appendix VII.F we provide more detail on each critique and our methodology in calculating the sensitivity analysis results described below.

1) Context matters in stated preference surveys eliciting non-market values. As described above, the LBP management plan for achieving fish improvements is deliberately vague. If respondents had been given the specific elements of the IP, however, it is likely that households would have reported lower average household willingness-to-pay for fish increases. In particular, we suspect that some fraction of Washington state households would object to new dams or reservoir expansions as part of the management plan given dams' controversial history and historically harmful effects on fish populations.
2) Estimates of willingness-to-pay depend critically on whether the baseline population trends are declining, flat, or increasing, and incorrect assumptions lead to a misapplication of the

LBP valuation function. Because of the nonlinear form of the LBP value function, the marginal value for a given increase in fish populations decreases as the "baseline" increases. Suppose there are two programs – A and B – and each is expected to increase fish populations by 150,000 fish per year. If only Program A is implemented, the economic value to households of having a population of 2.15 million fish would be $84.23 per year per household[20]. The same value holds if only Program B is implemented. However, suppose Program A is implemented first and increases populations to 2.15 million, and Program B is implemented fifteen years after, increasing the total population to 2.3 million fish. This new population level (a 15% increase in total) would be valued by households at $113.22 per year. According to the methodology of the LBP study, we would attribute $84.23 per household to Program A because its effects were felt first, and only $28.99 ($113.22 - $84.23) per household to Program B.

However, returning fish counts fluctuate significantly from year-to-year, and fishery scientists may not be able to estimate precisely the increase in fish populations attributable to specific programs. An analyst on Program A might reasonably ignore the effects of any prior programs (because they are lost in year-to-year noise) and assume a population of 2 million. An analyst on Program B, implemented fifteen years after Program A, might similarly ignore the observed or expected effects of Program A, and continue to assume a population of 2 million. They each conclude that benefits to the State will be $84.23 per household per year, or $168.46 combined. But the LBP study reported households are only willing to pay $113.22 per year for the combined effects of the program, so benefits would be overstated. Returning to the IP, the Four Accounts analysis assumes that the total number of returning migratory fish in the Columbia is the same 2 million that was used in the LBP study in 1998. If other fishery or habitat programs implemented in the intervening 16 years (the equivalent of Program A above) increased fish populations or can *reasonably be expected* to increase those populations, then the baseline fish population before the IP takes effect would increase from 2 million, and the corresponding economic value attributable to the IP would decline just as Program B's value declined above. These non-IP fisheries programs include the Redden Court's spill decision, ongoing water market purchases for improving instream flow, and the numerous habitat and flow improvements tallied in the PNSHP database described above. It should also be emphasized that programs implemented since 1998 *outside* the Yakima Basin count, given that LBP respondents were valuing improvements in "migratory fish" in "Eastern Washington and the Columbia River", not just yet the Yakima Basin.

To illustrate the importance of this assumption, we calculate the sensitivity of total economic benefits to Washington and Oregon households of the IP. Using a mid-range estimate of fish improvements attributable to the IP by 2042 of 200,000 fish per year, we find the total

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[20] An increase of 150,000 fish represents a 7.5% increase on a base of 2 million, so the annual household WTP using the LBP formula above is 41.81*ln(7.5) = $84.23.

benefits drop from $5,243 million to $4,602 million if we assume that all other programs implemented since 1998 have increased, or will increase, fish populations in "eastern Washington and the Columbia River" by just 25,000 fish per year, a 12% drop. If non-IP programs improve populations by 50,000 fish per year, the benefits from 200,000 fish per year increase from the IP drop to $3,912 million, a 25% decline. If non-IP program increase fish by 100,000, IP benefits fall 54%. Appendix VII.E provides more detail on these calculations and present similar sensitivity calculations for a wide range of expected fish impacts of the IP[21].

3) The methods used in the LBP study to elicit fish values do not directly address the substantial uncertainty related to the potential fish impacts discussed in Appendix VII.F. Although the LBP approach is consistent with most professional stated preference surveys, a better accounting for this uncertainty in valuation methods may lead to lower valuation estimates.
4) There is no distinction in the LBP study between hatchery and wild fish. It is reasonable to assume that a substantive component of the passive-use valuation of salmon and threatened or endangered species is a conservation value, so it is likely that hatchery fish may be valued differently --- and more likely lower --- than wild populations. This issue becomes particularly important given our assessment of the need for hatchery fish to support the growth rates presumed in the Four Accounts analysis (see Section VII.F). Furthermore, the costs of the IP do not include hatchery management.
5) The Four Accounts estimates include benefits that would accrue to people outside of the State of Washington. This is entirely valid when assessing the full benefits of an investment in general. However, to the extent that the State of Washington fiscally supports the IP infrastructure investments, the benefits to Washington State residents may be of particular relevance for a comparison with the costs accrued by the State.
6) The length of the hypothetical repayment period (20 years) is long relative to standard stated preference studies, and this is likely to lead to higher stated WTP estimates than if the hypothetical repayment period were shorter.
7) The Four Accounts does not delay the onset of fish-related benefits; they begin accruing in 2012.[22] One could argue that this is not unreasonable because LBP respondents were given a patient, 20-yr timeframe to see the promised results. We adopt this assumption to be consistent with the Four Accounts.

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[21] The corresponding values for the "high-end" estimates of 472,450 fish, which we argue are implausible, are as follows: with non-IP increases of 25,000 fish per year, the benefits of the IP drop from $7,387 million to $6,543 million. With increases of 50,000 fish, benefits drop to $5,690 million; and drop to $3,957 million with non-IP increases of 100,000. If total IP costs are $4,400 million and high-end estimates hold, the project as a whole passes only if non-IP programs increased or will increase populations by 87,303 or less. If low-end IP fish increases hold, this breakeven is 24,812 fish.

[22] As discussed in the following section, we account for the construction time by assuming agricultural and municipal benefits from water storage do not begin to accrue until infrastructure construction is complete so that all projects are completed and benefits start accruing 4 years in the future.

E. Project costs

IP project costs are documented in a variety of IP-related documents, namely:

- Costs of the Integrated Water Resource Management Plan Technical Memorandum (HDR Engineering Inc. and Anchor QEA 2011)
- Cost Risk Assessment of Six Projects from the Proposed Integrated Water Resource Management Plan Technical Memorandum (HDR Engineering 2012)
- Preliminary Cost Allocation of the Proposed Integrated Water Resource Management Plan Technical Memorandum (HDR Engineering, Inc. 2012)

In many cases, multiple alternatives for a given project have been proposed, with differing costs. Our first-order criterion for defining the version of an IP project to include is its implementation in YAKRW. Because YAKRW is the basis for much of the benefits related to water distribution, we select cost estimates that pertain to projects as implemented in YAKRW. Secondly, in cases where the above documents present different cost estimates, we rely on the most recently completed estimates: those presented in the Preliminary Cost Allocation Technical Memorandum, published in October 2012. In some cases revised cost estimates have been updated for individual project components in response to the evolving nature of individual projects. Cost categories include construction; interest accrued during construction (IDC); and operation, maintenance, and replacement costs (OMR). Total costs reflect net present value over the period 2012 – 2111 unless noted otherwise. Following the Preliminary Cost Allocation Technical Memorandum (HDR Engineering, Inc. 2012, 7–8), all amounts are in millions of 2012 dollars and were calculated with a 4% discount rate. Mid-range cost estimates are used where planning documents provide a range of cost estimates, (HDR Engineering 2012), and construction costs include land acquisition costs (HDR Engineering, Inc. 2012). While cost estimates reflect the most recent estimates available, they may differ slightly for two reasons: (1) future, parcel-specific negotiations concerning land acquisition costs and (2) slight adjustments to project scope and timelines. Unless noted otherwise, estimated completion dates correspond to those from the Integrated Plan (HDR Engineering Inc. et al. 2011, 61). Cost estimates do not reflect joint costs previously identified under the AJE accounting method (HDR Engineering, Inc. 2012).

Cost estimates for some of the project components warrant elaboration. Since late 2012 revised construction cost estimates have been developed for the Keechelus to Kachess conveyance (HDR Engineering, Inc. and Anchor QEA 2013), the drought relief pumping plant (U.S. Bureau of Reclamation and prepared by HDR Engineering Inc 2013), and Wymer (HDR Engineering Inc. 2014). This analysis does not use the revised Wymer cost estimates for two reasons. First, revisions result in only minor changes in undiscounted construction costs ($2.9 M). Second, the analysis refers to previous analyses for detailed cost estimates (HDR Engineering Inc. 2014). We do not use updated cost estimates for K2K and KDRPP revisions in order to be consistent across projects. Revised estimates present net present values for construction costs, only, and do not reflect changes to interest payments during construction (IDC) or operation, maintenance and replacement costs (OM&R).

Table 7: Project cost[1] estimates and sources

Category	Project	Construction	IDC	OMR	Total	Construction duration (years)[2]
Habitat	Tributary / mainstem fish habitat enhancement	337.9	0.0	0.0	337.9	18
	Wymer 1 (adjacent intake)	1,151.2	71.5	108.5	1,331.2	4
Reservoir Storage	Kachess Drought Relief Pumping Plant (KDRPP)[3]	177.9	11.1	6.8	195.8	3
	Bumping	409.5	25.4	17.4	452.3	4
	Cle Elum Pool raise (CEPR)	15.5	0.7	0.1	16.3	3
Ground-water Storage	Shallow Recharge (Thorp/ WIP) ASR	84.0	4.3	43.0	131.3	3
	Yakima Municipal ASR[4]	3.0	0.0	3.6	6.6	-
Fish Passage	Keechelus	71.1	3.3	5.5	79.9	3
	Tieton	71.1	3.3	5.5	79.9	3
	Clear Lake	2.6	0.0	1.5	4.1	3
	Kachess	71.1	3.3	5.5	79.9	3
	Bumping	20.0	0.9	5.4	26.3	3
	Box Canyon Creek	0.8	0.0	0.5	1.3	-
	Cle Elum	71.5	3.3	6.7	81.5	3
Operations	Kacheelus to Kachess Conveyance (KKC)	125.6	7.8	4.8	138.2	4
	Power subordination[5]	13.1	0.0	0.0	13.1	0
Conservation	Agricultural Conservation	300.3	0.0	0.0	300.3	18
	Municipal Conservation	0.0	0.0	15.9	15.9	18
Marketing	Marketing	1.9	0.0	0.5	2.4	8

[1] Source: Tables 2-4 of the Preliminary Cost Allocation Technical Memorandum (HDR Engineering, Inc. 2012)
[2](HDR Engineering et al. 2012, p. 14)
[3]KDRPP. Revised cost estimates (more recent than that provided here reflect two alternatives under consideration and may vary from $154 million to $185 million ($2012) in net present value (U.S. Bureau of Reclamation and prepared by HDR Engineering Inc 2013) . We retain the earlier estimate.
[4]The Yakima Municipal, or Ahtanum Valley ASR (Golder Associates 2014) is implemented in YAKRW but as part of the Municipal demand component of YAKRW in a way that cannot be easily separated out, so our analysis is conditional on its implementation but does not consider its economic efficacy.
[5]Power subordination costs listed in the construction column represent the foregone cost of electricity sales from annual decreases hydropower production over the months of April – June (U.S. Bureau of Reclamation 2011d). Please refer to the Power Subordination appendix for further details.

Construction costs of power subordination reflect the opportunity cost of foregone power consumption in the form of decreased electricity sales. The cost estimates are based on subordination levels of 25,000 MWH annually (U.S. Bureau of Reclamation 2011d) and 2009 power rates (Bonneville Power Administration 2010) that are assumed to be fixed in real terms over the 100 year valuation period. As further described in the Power Subordination Appendix VII.G, the present value of total costs from power subordination are estimated as $13.1 million as noted in the column for "construction costs" in the above table. We estimate this value by multiplying the total amount of power subordinated by month (in MWh) by mid-range, monthly electricity rates ($/MWh). We then discount the annual cost of foregone electricity sales and sum across years. For consistency with the YAKRW model, the enhanced agricultural conservation component does not include KRD and Wapatox canal improvements (HDR Engineering, Inc. and Anchor QEA 2011; HDR Engineering, Inc. 2014) that are identified as separate line items in previous planning documents (HDR Engineering, Inc. 2012). Costs of fish passage projects at Kachess, Keechelus and Tieton were evenly distributed where planning documents presented aggregate estimates (HDR Engineering, Inc. 2012). Detailed cost estimates of fish passage at these sites has not been conducted (HDR Engineering Inc. and Anchor QEA 2011).

1. *Discounting for consistency with benefit estimates*

All present value benefit estimates presented in Sections IV.D and IV.G are based on accruals beginning immediately. The costs presented in Table 7 are based on the beginning of construction as the initial time point (HDR Engineering 2012). For consistency in comparing the costs and benefits, the completion date of projects and the advent of benefits from that project must coincide mathematically in present value calculations.

The estimated completion times for water storage projects are all either three or four years (HDR Engineering et al. 2012, p. 14). Consider two projects. One takes three years to complete, with present value of costs at beginning of construction of PVC_3 and present value of benefits of PVB_3 beginning at completion time (three years after start). The other takes four years to complete with PVC_4 at beginning of construction and PVB_4, beginning at the end of construction. To make these benefits and costs comparable from the perspective of the beginning of construction, we can either discount benefits with reference to the beginning of construction compare PVC_3 with $PVB_3(1.04^{-3})$ and PVC_4 with $PVB_4(1.04^{-4})$ (assuming an interest rate of 4%). Or, we can inflate costs so as to reference the beginning of benefits, comparing $PVB_3$and PVB_4 with $PVC_3(1.04^3)$ and $B_4(1.04^4)$, respectively.

Comparing the costs against benefits for a suite of projects with different construction times is slightly more cumbersome. Because costs are in all cases separable across projects but benefits from all projects in a scenario simulated in YAKRW begin simultaneously, it is most direct to inflate costs for projects independently and compare the following two aggregate amounts:

$$PVC = PVC_3(1.04)^3 + PVC_4(1.04)^4, \text{ and } PVB = PVB_{3+4},$$

where PVB_{3+4} are the sum of the present value of benefits from projects 3 and 4. To change the reference to the beginning of construction of the most lengthy construction process (four years), the present value of both benefits and costs can be discounted by T periods, which may be four years from beginning of construction (T=4), or some other time-point of interest in the future:

$$PVC = 1.04^{-T}(PVC_3(1.04)^3 + PVC_4(1.04)^4), \text{ and } PVB = 1.04^{-T}(PVB_3 + PVB_4).$$

This sets the reference point for the benefits and costs at the beginning of the longest construction project and all projects are completed at the same time. These conventions allow a temporally consistent method for comparing benefits and costs for one or more projects, and allow direct comparison across projects, regardless of the actual start times, which may vary. Specifically beginning in Section IV.D, discounting is applied such that benefits begin contemporaneous with the end of construction of all projects, four years in the future, which is the presumed duration of the longest construction projects.

Agricultural conservation and Tributary / mainstem fish habitat enhancement are slated to take place over 18 years instead of three or four. The consequence of this is that the benefits do not accrue until projects are implemented, so benefits ramp up over this time period also. YAKRW implements these benefits, as with the others, as if they begin to accrue immediately upon project completion. However, because conservation activities as described make up a series of projects, their benefits accrue over the course of this time frame as well, not just at the final conclusion of construction. If we assume that these accrue evenly over the 18 years, it can be shown that their respective present values will be discounted to 72.6% of the value if accrual began immediately.

For the YAKRW runs that correspond to the IP as a whole, other than the agricultural conservation component, the projects all have duration of three or four years. We therefore, again, solely for comparison purposes, we assume that the IP would take four years to complete, and therefore discount IP benefits by four years relative to costs.

2. *Cost uncertainty*

This report largely takes previously estimated costs as given. Further, due to the complex interactions between the benefits that we examine in this report, we have opted to not systematically consider uncertainty and variance in projects costs for any specific projects. For further background on cost uncertainties, the Four Accounts analysis (end of Appendix D) provides a very general breakdown of estimated cost variance (in terms of percentiles) for the IP as a whole. It reports, for example that given their probability distribution over costs, their 10th percentile estimate for the costs of the full IP is \$2.7 billion, the median cost (50th percentile) is \$3.3 billion, and the 90th percentile estimate is \$4.4 billion. Thus, the 10th percentile estimate is 81% of the median, and the 90th percentile is 133% of the median. This general rule could be applied to generate a rough estimate of the cost distribution for individual projects. However, the Cost Risk Analysis (HDR Engineering Inc. and Anchor QEA 2011) provides cost risk assessment for six potential IP project alternatives, and the Costs of the Integrated Water Resource Management Plan Technical Memorandum (HDR Engineering Inc. and Anchor QEA 2011) provides additional details as well.

IV. Results

The results of our analysis are presented in several stages in approximately the same order that methods are discussed in Section III. We begin with selected results from the hydrologic modeling. The economic benefits of water storage projects for agriculture (Section IV.D.B) and for municipalities (Section IV.D.C) are then examined, followed by an analysis of the net benefits of water storage projects of out-of-stream uses and the implications in terms of the opportunity cost of instream flows (Section IV.D). Results pertaining to the benefits of fish passage and restoration follow in Section IV.E. A discussion of some unquantified economic impacts is discussed in Section IV.F, and individual IP project summaries are presented in Section IV.G.

A. Hydrologic modeling summary

As described in Section III.B, we use the hydrologic model YAKRW to simulate basin-wide curtailment rates for each IP scenario and climate regime. Table 8 provides summary statistics for the mean curtailment, the probability of curtailment, and the mean non-zero curtailment given the baseline IP scenario and the different climate regimes.

Table 8: Mean curtailment, probability of curtailment, and mean nonzero curtailment for the different climate regimes considered.

	Mean c (%)	Probability c>0	Average c given c>0	Probability c ≥ 70
Historical, Baseline	11.1	0.39	28.6	0.02
CGCM, Baseline	16.0 (p=0.063)	0.66	24.2	0.01
HADCM, Baseline	31.3 (p=0.000)	0.85	36.8	0.13
HADGEM, Baseline	56.4 (p=0.000)	1.00	56.4	0.39
Historical, Full IP	10.0	0.44	23.0	0.00
CGCM, Full IP	**13.1** (p=0.098)	0.67	19.6	0.00
HADCM, Full IP	**28.3** (p=0.000)	0.87	32.7	0.04
HADGEM, Full IP	**48.8** (p=0.000)	1.00	48.8	0.28

p-values are the probability of the mean being equal to the historical mean against the alternative that the future climate mean curtailment is larger.

The mean annual curtailment under the baseline historical climate regime is 11.1%; the probability of curtailment (proration <1) is 39%, and the mean curtailment rate given curtailment greater than zero is 28.58.[23] The intermediate climate change regime (HADCM) induces a mean curtailment rate of 31.38%, a probability of curtailment of 85%, and mean curtailment rates when positive of 36.76%. Under the most adverse climate scenario, the mean curtailment under the baseline (no IP) scenario is 56.4% and the probability of curtailment is 100%. Thus, these simulations suggest that adverse climate change has the capacity to increase the rate and magnitude of curtailments in the Yakima Basin. Figure 14 shows the curtailment sequence for the historical climate regime (black dots) and the most adverse climate regime that we simulate (HADGEM1), with means for the other two climate regimes shown as dotted lines.

Our data span 1925-2009 for historical data, and 1925 to 2006 for the future climate regimes. There have been no curtailments since 2005, so were these data included, the mean curtailment rates for the historical data would be lower if more recent data were available. Further, because the future

[23] YAKRW provides close estimates of mean annual curtailments, it tends to simulate small positive curtailments that are not actually implemented. Which is to say that when YAKRW curtailments are positive by small (i.e. less than about 10%, actual basin-wide curtailments tended not to be implemented. The implication is that the simulated probability of curtailment is higher than the actual probability of curtailment.

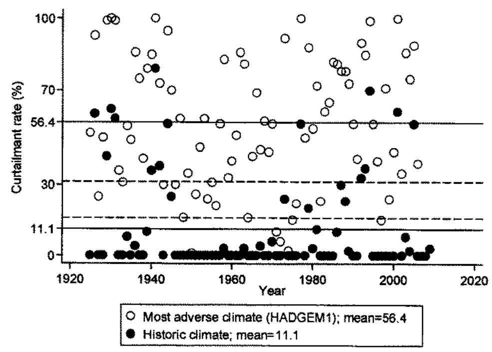

Figure 14: A comparison of historical and most adverse climate scenarios (HADGEM1), Baseline (no IP).

climate scenarios are basically "shifted" historical data based on CMIP 3 climate models, mean curtailments would be lower for these regimes as well if more recent data were available.

A comparison with the Four Accounts assumptions regarding the probability of severe curtailments will be useful for interpreting results later, especially because there is some ambiguity over the probability of a severe drought as described in the Four Accounts analysis. Table 12 in the Four Accounts Analysis describes their basis for calculating a probability of curtailment as "severe, 1-year droughts would occur every 5 years. A severe, 3-year drought would occur every 20 years" (ECONorthwest, Natural Resources Economics, and ESA Adolfson 2012). This statement is ambiguous in the sense that it can imply at least three different curtailment probabilities: 0.30, 0.32, and 0.35.

But there is also another way of calculating the implied probability of drought using their numbers. In the Four Accounts analysis, they find a benefit of $150 million in net farm earnings per year of severe drought. They conclude also that the expected net present value of this $150 million annuity over 100 years with a 4% discount rate is $0.8 billion ($800 million), which implies a definitive probability of drought since they assume only one type of drought (a severe one). Based on the standard annuity formula described below, this implies a probability of severe drought of 0.2176.[24]

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[24] The value of any (constant) annuity X received over 100 years with a 4% interest rate is $X \times d$, where

$$d = \frac{1 - 1.04^{(-100)}}{0.04} = 24.505.$$

The expected value of the integrated plan in any year is the probability of a drought times the benefits given a drought, so Table 13 and the associated description in the Four accounts analysis implies $d \times (\pi \times 150) = 800$, which implies that π, the probability of a curtailment, is calculated as $\pi = \frac{800}{d \times 150}$=0.2176.

Table 8 shows that curtailment of 70% or more happens about 2% of the time (0.02), and is higher than 0.2176 only under the most adverse climate regime. The implicit probability of curtailment that we calculate as 0.2176 is most likely driven by a combination of discounting and delayed implementation. It follows also that given their definition of a severe drought as 30% proration (70% curtailment) with no IP and that there is no curtailment with no drought, the average curtailment rate with no IP is $0.2176 \times 70\% = 15.232\%$.

Table 9 provides a comparison of mean curtailment rates between the baseline (no IP) and the full IP under the four climate scenarios. The difference in curtailment between the two IP scenarios increases in magnitude and (with one exception) statistical significance with increasingly adverse climate.

Table 9: Mean curtailment rates under baseline and Full IP, four climate scenarios

	Mean curtailment, Baseline	Mean curtailment, Full IP	Difference	Probability that mean c is lower with the IP than without (p-value)
Historical	11.09	10.00	1.09	0.3495
CGCM	15.96	13.15	2.82	0.1586
HADCM	31.38	28.27	3.11	0.2194
HADGEM	56.40	48.83	7.57	0.0384

Using the full available history of curtailments from 1925 to 2009, the mean annual curtailment under the baseline scenario is 11.09%, but under full IP implementation, the mean curtailment is 10.00%, for a difference of 1.09%.

Recall from above that the mean annual curtailment in the Four Accounts analysis for the No IP case is 15.232%. The analogous mean curtailment rate with the full IP is $0.2176 \times 30\% = 6.528\%$. The difference in the mean curtailment rate with the IP versus without is therefore $15.232 - 6.528 = 8.7\%$ based on the Four Accounts method. This difference is eight times the difference indicated by the HDR implementation of YAKRW over the full historical sample of 1925-2009, and more in line with the 7.57% difference under the most adverse climate regime. This will prove to be important factor in the estimated impacts of IP project.

B. Benefits to agriculture

To provide context for the reported individual project benefits, we begin by examining the relationship between curtailment and the net value of agricultural production. Because the benefits of individual components of the IP are dependent on implementation of other components of the plan, we provide an array of simulation results, including overall benefit estimates, individual-project benefit estimates, water market development impacts, and estimates of the opportunity cost of proposed changes in instream flows under the IP, all for various climate regimes.

1. Relationship between curtailment, trade, and production value

In the results that follow, we provide a battery of estimated benefits to agriculture for various IP scenarios, conditional on different climate regimes and different market regimes. As discussed in Section III.C.2, our working definitions of *no trading*, *intra-district trading*, and *inter-district trading* are designed to represent hypothetical bounds of complex processes, and are defined as follows:

1) *No trade* is implemented as proportional curtailment of crops in each district as a function of the districts curtailment rate, regardless of crop type.
2) *Intra-district trade* allows frictionless trading within districts.
3) *Full trade* allows frictionless trade across districts with some restrictions.

For most IP/climate scenarios, results for all three market outcomes are presented. In general, the results for "No trade" and "Full trade" represent hypothetical outer bounds for the continuum of results. Intra-district trade represents an intermediate outcome between No Trade and Full Trade assuming frictionless intra-district trading. While even the intermediate case of intra-district trade corresponds to a hypothetical frictionless trading scenario within districts, our results show that not only is it a useful intermediate benchmark for assessing IP scenario outcomes, but it helps illustrate the potential of intra- and inter-district trading for mitigating curtailment impacts. Given the reality of institutional constraints and market frictions, however, these frictionless outcomes are not in general achievable, but instead should be interpreted as they are --- benchmarks for the range of possibilities.

Figure 15 provides two perspectives on the value of water as a function of water available for irrigation. The left panel of Figure 15 shows the net value of agricultural production as a function of curtailment under the three market scenarios. The value of production corresponding to zero curtailment is on the left of the graph, and is equal across trading regimes. The flat region of the curves on the left results from irrigation districts not currently using their full water entitlement in an typical non-curtailment year. As the curtailment rate increases beyond this region, the value of

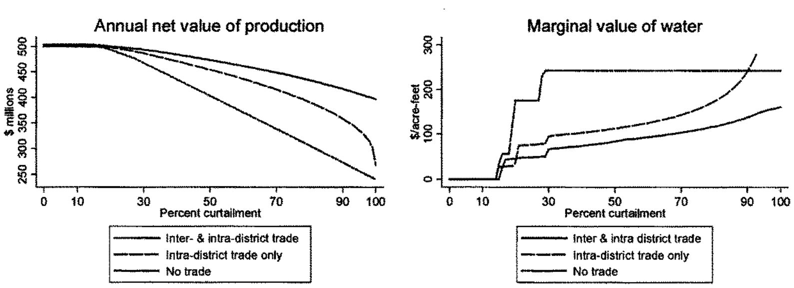

Figure 15: The net present value of agricultural production and the marginal value of water, aggregate over all districts.

production declines. However, it declines fastest for the "no trade" (proportional curtailment) scenario. Allowing for selective fallowing across crops within districts is equivalent to allowing intra-district trade, and this mitigates the losses in production that result from curtailment, represented by the middle line in the left hand graph. Allowing for both intra- and inter-district trading alleviates the impact of curtailment even further. None of these curves drop to zero because of districts' non-proratable water rights.

The right panel of Figure 15 shows the marginal value of water --- the value of one af/year given the curtailment rate, which is equivalent to the marginal cost of curtailment in terms of lost production value. In general, the marginal value of water increases as curtailment increases. The distinct steps in these functions between curtailment of 10% and 30% correspond to the curtailment rates at which districts begin to be water constrained (recall that they do not use their full entitlement in an typical non-drought year). The "no trade" case assumes that all crops are fallowed proportionally regardless of the marginal productivity of water, so the marginal value of water to a district is equal to the acreage-weighted mean value of productivity lost per af of curtailment across all crops in the district. Because high-value crops and low-value crops are curtailed by the same proportion, the cost of curtailment, and therefore the marginal value of water, is high but constant in a district once curtailment becomes binding. Intra-district trade allows selective fallowing such that crops with low marginal water value are fallowed first, which reduces losses due at low levels of curtailment. As the curtailment rate increases, increasingly high-value crops are fallowed, leading to an upward sloping marginal water value function. The highest valued crops are fallowed at very high level of curtailments, at at this point the marginal value of water is at its maximum. When intra- and inter-district trading is allowed flexibility for selective fallowing is maximized, so the cost of curtailment (and the marginal value of water) is lowest.

Table 10 provides some specific values corresponding to Figure 15 around which the proposed IP is designed, and the Four Accounts analysis is based. A stated goal for the IP is to guarantee a proration rate of not less than 70% (ECONorthwest, Natural Resources Economics, and ESA Adolfson 2012), which corresponds to a curtailment rate of 30%. With no trade (proportional fallowing), a curtailment rate of 30% result in a loss of $32.8 million. With frictionless intra-district trade, these losses are reduced to $14.4 million, and with robust intra- and inter-district trading, the simulated loss would be $9.5 million.

Table 10: Impact of 30% and 70% curtailments on aggregate annual production value ($millions).

Curtailment %	No trade	Intra-district only	Full trade
30	32.8	14.4	9.5
70	162.9	85.5	54.8

To assess the value of the IP, the Four Accounts Analysis relies on assumed distributions of a "severe drought", which they define as a drought for which the proration rate is 30% (curtailment of 70%). They estimate that given no intra-district trading and 30,000 af of inter-district trading (which we will refer to as "limited-trading"), the cost to agriculture of a proration rate of 30% is $163 million (ECONorthwest, Natural Resources Economics, and ESA Adolfson 2012, 39). Table 10 indicates an almost identical loss of $162.9 million for the four districts assuming no intra- or inter-district trading. (This excludes YTID which is not included in the Four Accounts losses; there are also no losses from senior KSR rights).

Based on relatively restrictive assumptions, the Four Accounts analysis suggests that IP market improvements could reduce drought-year losses by $40 million (U.S. Bureau of Reclamation, ECONorthwest, and State of Washington Department of Ecology 2011, Table 1). Our results show that the loss in annual net value under a 70% curtailment with efficient intra-district trading is $85.5 million, a reduction of about $77 million and less than half of the No Trade impact. With full intra- and inter-district trading the loss is $54.8 million, which is 34% of the losses under no trade. While the full-trade results should be interpreted as an outer bound on impacts, they do suggest that there is a large potential for gains from trade during drought years. Further, a review of the IP by Normandeau Associates et al. (2014) estimates a difference between the baseline evaluated at 70% curtailment and 30% curtailment at $77.2 million. Our estimate of this difference is $85.5-$14.4=$71.1 million. Thus, these estimates are very close to each other.

The left panel of Figure 15 shows that the value of production declines fastest with proportional curtailment, and slowest with full intra-and inter-district trading. With intra-district trading alone, the costs of curtailment are reduced within a district fallowing crops with the lowest marginal water value first, and move alone the district's inverse demand curves from right to left as water is curtailed. Inter-district trading scenarios allow water to move from one district to another. Figure 16 shows how water moves from one district to another in simulation as curtailment increases from zero to 100. No trading occurs up to the point where curtailment is a binding constraint to one or more districts (at a curtailment rate of approximately 20%). At this point, the simulation shows that Roza begins to buy water and continues to do so, while Kittitas Senior (KSR) sells water throughout.

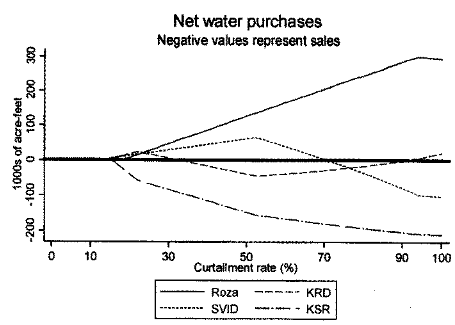

Figure 16: inter-district trade outcomes among trading districts.

SVID buys water at first, but at higher curtailment rates switches to become a net buyer, and KRD tends to sell at low curtailment rates, but buys at the highest curtailment rates.[25]

2. *Agricultural benefits of the IP*

Table 11 compares outcomes under no inter-district trading with outcomes with frictionless intra- and inter-district trading. The table has two data columns, one that corresponds to the baseline for evaluating the IP (HDR scenario 7.1) and one corresponding to the full implementation of the IP (HDR scenario 7.8).

Table 11: Agricultural benefits from IP with intra- and inter-district trade, $ millions. Historical climate regime.

Row	Value	Baseline (HDR 7.1)	Full IP (HDR 7.8)
1	Expected annual ag value, no trade	482.2	488.5
2	Expected annual ag value, intra-district trade only	492.1	495.6
3	Expected annual ag value, Full trade	497.8	500.0
4	Difference from baseline (HDR 7.1), no trade	--	6.3
5	Difference from baseline (HDR 7.1), intra-district trade only	--	3.4
6	Difference from baseline (HDR 7.1), Full trade	--	2.2
7	Present value of ag production, no trade	11,818	11,972
8	Present value of ag production, intra-district trade only	12,060	12,144
9	Present value of ag value, Full trade	12,198	12,252
10	Difference from baseline (HDR 7.1) no trade	--	154.0
11	Difference from baseline (HDR 7.1), intra-district trade	--	84.3
12	Difference from baseline, Full trade	--	53.4
13	Present value of intra-district gains from trade	242.3	172.6
14	Present value of inter-district gains from trade	138.6	107.7
15	Present value of gains from Full trade	380.9	280.3

The first three rows of data provide the annual expected value of agricultural production given the three trading regimes, respectively, based on the historical distribution of curtailment from 1935-2009 along with current crop acreage allocations. Rows 4-6 provide the difference in these annual expected values from the baseline case (HDR 7.1) for the trading regimes and IP cases. Depending on the trading regime, the IP as a whole provides average annual benefits to agriculture of $6.3 to $2.2 million/year. This illustrates that markets attenuate the value of additional water storage because they reduce the impacts of curtailment.

Rows 7-9 provide the expected net present value of agricultural production for each trade regime calculated as the sum of the present value of the annual expected value for each of 100 years given a

[25] KRD and KSR are relatively high in the basin. Third-party effects might preclude KRD from buying from SVID (at the high curtailment rates, above 90% for example), however, these trading results are consistent with KRD buying from KSR, which would be less likely to impose third-party effects and therefore less likely to be restricted from trade.

4% discount rate for a given trading regime. Rows 10-12 provide the expected present value of benefits from the IP, ranging from $154 million in agricultural benefits over the baseline assuming no trade, $84.3 million with intra-district trade, and $53.4 million with full trade.

Our largest estimate for the present value of benefits to agriculture of the integrated plan of $154 million is only 19.3% (about one fifth) of the estimated benefits presented in the Four Accounts Analysis of $800 million (ECONorthwest, Natural Resources Economics, and ESA Adolfson 2012, 39), despite the fact that both analyses use the same crop production model. The primary reason for this is the difference between the assumed frequency and magnitude of curtailments used in the Four Accounts analysis, the mean of which is eight times larger than the mean curtailment for the historical climate regime as illustrated in Table 9, Section IV.A. Assumptions about climate and curtailment are clearly crucial in estimating the value of the IP and its water storage projects.

Data rows 13 through 15 in Table 11 provide the present value of gains from trade. Relative to proportional curtailment, the present value of agricultural production is higher with intra-district trade, with inter-district trade, and with full trade, providing $242.3 million, $138.6 million, and $380.9 million, respectively under the baseline of no IP. Were the IP implemented, the gains from intra-district trade, inter-district trade, and full trade are $172.6, $107.7, and $280.3 million, respectively. These present values are based on a 4% interest rate. If the current Federally-set interest rate of 3.5% is used, these values are $194.7, $121.6, and $316.3 million respectively (about 13% higher). The Full IP provides the lower risk of curtailment to irrigation, both in terms of the frequency and the depth of curtailment, and the value of water markets is lower. In contrast, the gains from trade are highest when curtailments are highest, as under the baseline case (no IP projects) in the table.

The Market-Based Reallocation of Water Resources Technical Memorandum (U.S. Bureau of Reclamation, ECONorthwest, and State of Washington Department of Ecology 2011) provides estimates of the value of market development against which to compare these values. That analysis reports potential gains from trade of $40 million in a given year facing 40% proration (60% curtailment). Assuming a 24.5% probability of such a curtailment implied by Four Accounts assumptions, the expected value of trade would be about $10 million/year. Assuming the historical climate regime under the no IP scenario with only intra-district trade, the implied annual expected value of trade is $8.9 million (this is the annual value corresponding to the net present value over 100 years of $218.6 million in the table). Thus, while the assumptions underlying the Water Resources Technical Memorandum are different than our assumption of efficient intra-district trade only, the results are comparable. For our full-trade scenario, the net present value of $281.3 million presented in Table 11 correspond to expected annual gains from trade of about $11.48 million, which is about 1.8 times higher still, suggesting the potential for additional gains.

3. Individual project benefits

Table 12 provides the benefits of one project at a time relative to baseline ("HDR 7.1+1), and the benefits of adding a project as the final component of the full IP ("HDR 7.8-1"), for each trading scenario under the historic climate regime. Because of diminishing returns to storage, the "7.1+1" provides the upper bound on a project's value, and the "7.8-1" scenario provides the lower bound on project-specific value. For example, were Wymer Reservoir created on its own with intra-district trading but no inter-district trading, it would provide an estimated $86.7 Million in agricultural net benefits over 100 years, but if it were part of a full IP implementation, it would provide about 45% of that, or $39.4 million. This difference again illustrates the diminishing returns to additional water storage. These numbers for Wymer can be compared to the agricultural benefits estimated in a previous report (U.S. Bureau of Reclamation 2008b), in which agricultural benefits are estimated to be $26.5 million, which is less than half of all estimates for Wymer alone presented here.

Table 12: Expected net present value of agricultural benefits of individual projects under historical climate; baseline (HDR 7.1) plus one project at a time, and IP (HDR 7.8) minus one ($ millions)

	No trade		Intra-district only		Full trade	
	One only (Base+1)	all but one (IP-1)	One only (Base+1)	all but one (IP-1)	One only (Base+1)	all but one (IP-1)
KKC	1.9	8.8	1.0	3.9	0.6	2.8
KDRPP	139.3	73.3	78.0	45.2	49.8	28.0
KKC+KDRPP	138.2	79.8	77.9	49.1	49.7	30.2
CEPR	6.6	5.7	3.6	3.0	2.3	1.9
ASR	28.2	24.3	15.4	12.4	9.6	8.2
Conservation	67.0	54.2	35.7	27.4	22.9	19.0
Bumping	111.7	53.5	59.9	29.0	38.5	18.3
Wymer	158.1	71.1	86.7	39.4	55.5	25.3

It is important to note that the baseline case against which the "only one" cases are compared assumes that the proposed IP instream flows are not implemented, while the full IP against which the "all but" comparisons are made assumes that the proposed IP instream flows are implemented, which reduces the amount of water diverted to out-of-stream uses for any given storage scenario.

There is a general pattern evident in Table 12 that each project provides higher benefits when implemented alone than when implemented as part of the IP, with the exception of KKC. KKC does not provide additional reservoir storage capacity, but instead provides benefits through allowing more flexibility to fill Kachess reservoir, and is designed to work in coordination with KDRPP. The higher simulated value of KKC benefits under the full IP may have to do with the fact that KDRPP is implemented (along with KKC) in the full IP.

4. HDR Sequenced scenarios

"HDR Sequenced scenarios" in Table 13 are scenarios corresponding to the proposed sequenced development of the Integrated Plan developed by HDR. These are sequences of the IP with additional project(s) implemented sequentially as the scenario increases (see Table 1 for scenario descriptions).

These results are provided primarily for reference to ongoing proposed IP planning. However, the impact of diminishing returns to storage can be discerned from this table. For example, HDR 7.5

implements KKC, KDRPP, and the Cle Elum pool raise. HDR 7.6 is the same as 7.5 except with the addition of Wymer. As such, the difference in present value represents the value of adding Wymer conditional on implementation of these other three storage projects. For example, assuming intra-district trading only, the value of Wymer is 140.4-87.7 = $52.7 million, which is (as expected) below its value if implemented alone ($86.7 million as shown in Table 12). It is also above its value if implemented as part of the full IP and $39.4 million (Table 12), though this difference is confounded by the fact that IP instream flows are also implemented in this case.

Table 13: HDR sequenced scenarios. HDR 7.1, baseline (historical) sample ($ millions)

	Net expected present value of production/year			Present value of difference from baseline (HDR 7.1)		
HDR run	No trade	Intra-district only	Full trade	No trade	Intra-district only	Full trade
7.1 (Baseline)	11,818	12,060	12,198	--	--	--
7.2	11,902	12,105	12,227	84.7	45.2	28.8
7.3	11,902	12,105	12,227	84.7	45.1	28.6
7.4	11,967	12,143	12,252	149.6	83.2	53.1
7.5	11,977	12,147	12,254	159.1	87.7	55.9
7.6	12,082	12,200	12,288	264.1	140.4	89.2
7.7	12,117	12,216	12,298	299.5	156.6	99.5
7.8 (Full IP)	11,972	12,144	12,252	154.0	84.3	53.4

5. *Climate change scenarios*

Under the most adverse climate regime examined (HADGEM), the average curtailment rate is 56.4% (hollow circles). The two intermediate regimes, CGCM and HADCM, lead to mean curtailment rates of 15.96 and 31.38, respectively (see Section IV.A). The increase in curtailment rates under CGCM occur despite the fact that precipitation is predicted to increase by 13.4% over baseline, though this change would be accompanied by an increase in the proportion of precipitation in the form of rain instead of snow.

Table 14 provides results for a series of climate forecasts, as well as additional comparisons to illustrate the potential benefits from trade. The first corresponds to the full IP assuming the historical climate regime. With no trade, the present value of benefits is $154 million. The net benefits to agriculture under the full IP drop by 45% to $84.3 million with efficient intra-district trading, and to about $41 million with both intra- and inter-district trading. This is because effective trade alleviates the impacts of curtailment for any given water storage scenario, and therefore attenuates the benefits of adding storage.

As might be expected, the agricultural benefits of the IP as a whole increase with increasingly adverse climate scenarios. Given no trade (proportional fallowing), the benefits of full IP climb as the climate scenario becomes more adverse, by about 39% (from $84.3 to $116.9 million), by 192% (to $246.6 million) and about 355% (to $383.9 million) for the increasingly adverse climate regimes, respectively.

Table 14: Expected net present value of agricultural benefits of the IP under different regimes. Baseline=HDR 7.1 ($ millions)

Climate Scenario	No trade	Intra-district trade	Full trade
IP (HDR 7.8), historical climate	154.0	84.3	53.4
IP, least adverse climate regime (CGCM)	214.0	116.9	74.0
IP, moderately adverse climate (HADCM)	390.9	246.6	142.0
IP, most adverse climate (HADGEM)	649.2	383.9	235.8

In Section IV.A, we estimate that under our interpretation of the Four Accounts assumptions, the implied mean curtailment rate with no IP (baseline case) is 15.23%. The climate regime that provides the closest approximation to this mean curtailment rate is the CGCM regime, which induces an mean curtailment rate of 15.96% under the baseline scenario (HDR 7.1). We therefore provide in Table 15 the results of "one only" and "all but one" project implementations for comparison.

Table 15: Expected net present value of agricultural benefits of individual projects; CGCM climate scenario baseline (HDR 7.1) plus one project at a time, and IP (HDR 7.8) minus one ($ millions).

CGCM	No trade		Intra-district only		Full trade	
	One only (Base+1)	all but one (IP-1)	One only (Base+1)	all but one (IP-1)	One only (Base+1)	all but one (IP-1)
KKC	12.1	1.6	6.1	1.2	4.1	0.9
KDRPP	134.2	64.3	77.3	35.3	48.3	21.8
KKC+KDRPP	157.0	60.3	88.0	33.2	56.5	20.8
CEPR	6.6	9.1	3.3	4.1	2.5	2.9
ASR	48.4	30.2	25.2	14.3	15.9	10.4
Conservation	21.8	1.1	12.5	0.8	8.1	0.4
Bumping	124.0	68.0	67.9	33.1	43.3	21.3
Wymer	194.4	87.5	107.1	46.4	68.6	29.2

A comparison of Table 15 and Table 12 shows that the value of water storage projects is in general higher under CGCM, as would be expected under a more adverse climate regime. However, there are some anomalies in this pattern for KKC and agricultural conservation, which are the two projects that do not provide additional storage. Conservation in particular shows substantially lower value under CGCM (Table 15) than under the historical climate regime (Table 12). It is not clear why this might be the case. However, we will consider these issues again later when we summarize the results for these individual projects in Section IV.G.

Table 16 provides agricultural benefit estimates of individual projects for Base+1 and IP-1, assuming the most adverse climate scenario (HADGEM). The HADGEM Base+1 results provide the highest estimated benefits for all storage projects under more adverse climate regimes (all else constant), and therefore these estimates represent the largest benefit estimates that we report. As illustrated in Table 12 the contribution of individual projects will tend to decline if more than one project is implemented.

Table 16: Net present value of agricultural benefits under the most adverse climate scenario (HADGEM). $ millions.

HADGEM	No trade		Intra-district only		Full trade	
	One only (Base+1)	all but one (IP-1)	One only (Base+1)	all but one (IP-1)	One only (Base+1)	all but one (IP-1)
KKC	58.0	106.8	29.2	75.4	17.8	41.1
KDRPP	265.0	198.5	182.5	149.6	110.4	85.0
KKC+KDRPP	570.5	213.0	370.2	162.8	219.7	90.9
CEPR	35.6	0.4	16.7	-1.0	10.6	-0.5
ASR	178.4	129.7	104.5	121.7	65.4	53.0
Conservation	-0.1	10.1	-12.8	16.2	-1.8	4.6
Bumping	518.1	183.2	316.2	115.2	188.8	66.7
Wymer	867.0	328.4	585.6	256.8	337.0	133.6

Consistent with previous patterns, each storage project provides highest benefits with No Trade, and lower benefits with Full Trade. However, again, Conservation provides negative benefits under the full IP, and now CEPR provides negative benefits under the intermediate and full trade scenarios. Further, KKC and Conservation alone again provide higher benefits under the full IP than when implemented alone. The latter we have already discussed in the context of the CGCM results in Table 15 and so we will not revisit this issue.

The negative results for Conservation and CEPR occur only when the change in expected curtailment is exceptionally small. The base case for the expected curtailment under the Full IP minus CEPR is E(c)= 48.890, and the base case for comparison is the Full IP (7.8, HADGEM) is E(c)= 48.829, for a difference of only 0.061%. For agricultural Conservation, the baseline (HDR 7.1) expected curtailment is 56.402 and the expected curtailment is 56.378, a difference of only 0.02%. These small differences in curtailment lead to what amounts to rounding and simulation error. The benefits should be interpreted as zero in these cases. the Agricultural Water Conservation Technical Memorandum (U.S. Bureau of Reclamation, Washington State Department of Ecology, and Prepared by Anchor QEA 2011) states "In addition, these water savings are estimated for years when water users have a full water supply. Therefore, in drought years the water savings would be reduced because less water would be conveyed through irrigation systems and applied to farms, which, in turn, reduces seepage and other losses and results in less return flow. (p. 3)" Curtailment happens in every year under this scenario, which is likely to be the reason for these YAKRW results. See HDR Engineering, Inc. and Anchor QEA (2011) for more detail on YAKRW hydrologic modeling and results.

6. *Supporting evidence of the value of low curtailment risk: evidence from land sales*

While the above analysis relies on YAKRW simulation and estimates of water value conditional on current, static irrigated crop acreage allocations in the irrigation districts, there is additional empirical evidence that can corroborate, to a limited extent, the magnitudes of the simulated effects presented above. We provide some supporting evidence for the order of magnitude difference in the results we are reporting.

The market value of a property and an associated water right reflects the sum of benefits received from that land and water right. As such, an examination of irrigated land transactions provides an alternative method to estimate the effect of water supply volatility and incorporates the potential for a landowner to adapt to changing economic and environmental conditions. Brent (2014) estimates a hedonic price model to quantify the premium associated with a senior water right on agricultural land in the Yakima River Basin. Senior water rights are defined either as the percentage of senior rights held by an irrigation district or an indicator variable if the district holds more than 50% senior rights, which has been found to sufficiently insulate districts from droughts. The results indicate that on average additional water security associated with senior water rights is not capitalized into farm values.

This result relies on variation in water rights at the irrigation district level, which constitute the majority of water rights in the Yakima Basin. It is difficult to assess the role of water rights in driving variation in farm values across districts relative to other unobserved factors specific to the irrigation district. In particular the Wapato Irrigation Project constitutes 19% of all junior sales and lies within the Yakima Nation Reservation making it challenging to disentangle whether lower property values are due to less secure water rights or the factors associated with the reservation. Omitting an indicator variable for the Yakima Nation reservation results in a statistically significant senior premium of approximately 11%. One method to test the effect specific to irrigation districts is to examine all sales on either side of a border between a junior and senior district. A boundary discontinuity analysis (Black 1999) indicates that even without controlling for the reservation there is no premium for senior rights when restricting the sample to land near the border of senior and junior districts.

Despite the lack of a premium at the basin level, Brent (2014) shows that there is heterogeneity across counties, as Kittitas County exhibits a positive and significant premium of 24% (Brent 2014), for further information see Brent (2014). One explanation for the lack of a premium is that there are relatively low-cost mechanisms to cope with water supply volatility. There is evidence that supplemental water rights mitigate the effects of water volatility since private rights strongly capitalize into farm values in junior districts, but not in senior districts. Using the relative premium for farmland with senior rights provides an alternative to the production function approach applied by the USBR.

Table 17 presents the estimates from Brent (2014) for the benefits to the agricultural sector from storage enhancement in the Integrated Plan for three econometric modeling scenarios. Estimates for the gains to agricultural production are calculated by multiplying the per-acre premium for land with senior water rights by the irrigable acres of land with junior rights. The analysis is restricted to land served by the Yakima Project since data are readily available, making the results an effective lower bound on the benefits for the whole basin. Using the hedonic approach, the point estimates of benefits for increasing water supply security range from $28 million to $92 million depending on whether the parameters stem from the BMA, the base results, or the county level regressions.

Table 17: Estimates for Benefits from Increased Water Security in Yakima Basin

	Mean	Lower 95%	Upper 95%
Aggregate (BMA)	$27,789,981	-$125,859,536	$181,439,499
Aggregate (Base)	$54,395,045	-$63,328,439	$179,228,339
By county	$91,819,156	-$76,533,776	$133,431,079

Notes: The estimates are derived from parameters of the posterior distribution for the senior water right dummy variable. Estimates are scaled by using acreage of agricultural land with junior water rights in the Yakima Basin and the mean real price of agricultural land in 2008 dollars.

Examining the 95% confidence intervals reveals that the all the estimates include zero. This shows that the statistical results are relatively imprecise, and it means that we cannot (based on conventional confidence levels) reject the hypothesis the water security premium is zero. Nonetheless, none of the upper bounds are close to the $400 million estimate in the Four Accounts analysis. Indeed, the highest upper bound is $181 million.

Recall from Table 11 that our estimates of the benefits of the Full IP relying on the historical climate regime is $154 million, $84.3 million, and $53.4 million with no trade, intra-district-only trade, and full trade, respectively. The estimates made by Brent (2014) of $92, $54, and $27 million are similar to this range. While an exact comparison of these two estimates is not the goal of this analysis, these findings are important because they corroborate our findings in order of magnitude.

7. *Summary of agricultural benefits from IP projects*

The results presented in this section consistently illustrate (a) diminishing marginal economic returns to water storage, (b) more robust trade reduces the impacts of curtailments for a given amount of storage, and (c) more robust trade reduces the economic returns to new water storage in the basin, and (d) more adverse climate regimes increase the economic value of water storage.

C. Benefits to municipalities and domestic users

Following the approach in the Four Accounts analysis and our methodological approach developed in Section III.C.3, we report benefit estimates for the IP relating to two sources of demand: benefits that follow from avoided costs to municipalities of having to purchase water for new growth, and benefits to existing users of the IP plans to improve water market mechanisms.

1. *Water security*

In the water security component of the Four Accounts municipal/domestic analysis, the price of $2,500 is used to represent municipal/domestic willingness-to-pay for senior water rights, but it is applied as if it were an annual lease, not a permanent purchase. This has substantial consequences for the estimated impacts. As mentioned in Section III.3, the Four Accounts analysis assumes a marginal value of $1,000 for a senior(in this case non-proratable) right for agricultural irrigation such that the net value (gains from trade) are $1,500. However, by their own description, this value represents the net value of the transfer of a permanent right, which is equivalent in present value terms to a perpetual annuity of $1,500×0.04=$60/af/year where 0.04 represents a 4% discount rate. We show in Appendix Section VII.D.2 that the value of a senior water right for agricultural irrigation in an irrigation district with a mix of proratable and non-proratable rights ranges between

$286 and $864 with no IP and historical climate, while we would expect sale prices to be higher than this due in part to transaction costs, it suggests that $1,000/af is in the ballpark. Under a more adverse climate regime, the value of a non-proratable irrigation water right ranges from $1,206 to $3,665. Thus, under more adverse climate regimes, we would expect higher sales prices.

The use of $1,500 as an annually applied water price as a lease price is not supported empirically nor is it consistent with the justification given for using it.[26] Two appropriate uses of these numbers are (a) the sale price of $1,500/af for a permanent transfer is charged only once as a once-and-for-all purchase of a perpetual water right, or (b) the implied annuity value of $60/af/year is charged every year as if it were a recurring lease. Case (a) provides a simple illustration. Suppose the IP market infrastructure immediately provided the basis for trades. Municipalities could purchase 10,500 af of permanent rights at $2,500/af at a total cost of $26.25 million. The opportunity cost (foregone agricultural production value) of that water is $1,000*10,500= $10.5 million for net gains from trade of $1,500/af, or $15.75 million.[27] Discounting as they did in the Four Accounts analysis, which assumed delays in market development, provide a present value of gains from trade of just over $11 million, which is less than one twentieth of the analogous Four Accounts estimate of $280 million.[28] Applying Case (b) and discounting as in the Four Accounts analysis also provides an estimate of $11 million.[29] Appendix VII.D provides the calculations for this number and an approximation of the Four Accounts calculations.

There is another issue for the water security calculations that relates to existing junior water rights. The analysis estimates a willingness-to-pay for secure (senior) water rights for current municipal and domestic water users, but it implicitly assumes that their existing junior groundwater rights are of no value. To the contrary, existing junior groundwater rights are curtailed in low-water years, but provide value when not curtailed. Indeed, rather than assuming the purchase of permanent rights, a reasonable approach to incorporate this value would be to simulate long-term contingent contracts or options contracts (R. E. Howitt 1998; Michelsen and Young 1993; Whittlesey and Huffaker 1995) for water leases such that junior water rights holders can purchase senior water rights for low water years when they face curtailment. Under the historical hydrologic sample, YAKRW simulations suggest that under the full IP curtailment of proratable water rights to any level (that is, a

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26 We believe this error in calculation may simply have been a mistake. It is noteworthy that Normandeau Associates et al. (2014) independently arrived at the same conclusion.

27 This number ignores transaction costs associated with these transactions. Transaction costs can in some cases be substantial depending on the specifics of transactions, but tend to be larger per af for smaller water amounts (Colby 1990b). These costs would rightly be subtracted from gains from trade.

28 The same value for municipal benefits ($280 million) was used for Wymer reservoir in a previous economic analysis of this project (U.S. Bureau of Reclamation 2008b). This estimate was based on an analysis with similar, but not identical, methods and assumptions.

29 Although not supportable on the basis of being wholesale prices, if instead the larger value of $258/af/year (found in the new demand component of the municipal/domestic analysis) is used instead of $60, the present value of the savings is $48 million.

proration rate less than 1) would occur 44% of the time.[30] Because groundwater rights tend to be junior to proratable water rights, we that junior groundwater rights are curtailed to zero about 44% of years, and municipalities would purchase senior water rights on a spot lease market or contingent contract. The statistical expected value of the costs of these purchases can be calculated as 0.44 × \$11 million = 4.84, or about **\$5** million. Thus, if markets are assumed to be effective at allowing municipalities to cover their groundwater curtailments as described in the Four Accounts analysis, the expected net benefits to municipalities of doing so while making use of their existing groundwater rights is about one fiftieth of the Four Accounts analysis estimate of \$280 million.[31]

With that in mind, there are countervailing reasons as to why the \$5 million calculated above might over- or underestimate potential gains from trade. As noted in Section III.C.3 the \$2,500/af market price for ag-to-muni trades is a representative of a negotiated price that in each transaction falls between a seller's willingness-to-accept and a buyer's willingness-to-pay. The implication is that even if a municipality were to negotiate a \$2,500/af price, their marginal willingness to pay might be higher. For example, if the agricultural producer's opportunity cost is \$1,000/af, and the municipality's willingness-to-pay is \$10,000/af, they may negotiate a price of \$2,500, which would provide \$9,000 in total gains of which \$1,500 would go to the seller and \$7,500 to the buyers. There is a great deal of leeway in the negotiated price in this example (anywhere between \$1,000 and \$10,000), and the price actually negotiated will depend on the relative bargaining position of the two parties. The take-home message of this discussion is that even if the market price of \$2,500/af were a reasonable representation of a market equilibrium, to use \$1,500 --- the difference between the representative equilibrium price of \$2,500 and the opportunity cost of water to agriculture, assumed to be \$1,000 here --- would likely underestimate the gains from trade.[32] On the other hand, the discussion of water markets (Section IV.B.2) suggests that transaction costs, especially in the case of inter-sectoral transfers such as these, might amount to as much as one-third of the gains from trade.

Importantly, none of these water security benefits come from any IP water storage project, but only from the assumption that water markets will become more available as a result of IP activities to facilitate markets. However, to the extent that IP water storage reduces water scarcity in a drought of any given severity (or even in a non-drought year), it will also reduce water market prices, which in turn will benefit municipalities (though with countervailing reductions in agricultural benefits due to the price reductions). This price change is not accounted for in this analysis.

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[30] Note that many of these are small curtailments of less than 5% as YAKRW output, and are often not implemented in actuality. Nonetheless, the point here, in the spirit of the Four Accounts analysis, is that they represent relative drought years and may be the basis for curtailing even more junior groundwater use by municipalities. Therefore, we use this inflated curtailment probability to be relatively conservative.

[31] It might be argued that spot-lease prices will tend to be higher during more severe curtailments, when leasing is most likely. While this is true, a market-based \$1,500/af sale price (corresponding to a \$60/af/year annual lease) in principle accounts for expectations on both the supply and demand side of future curtailments, and so would account for such effects to the extent that they are incorporated into expectations.

[32] In reference to the section that follows: this distinction between market price and buyer willingness to pay is not germane to the discussion of water purchases for new demand that follows.

2. Benefits for new growth

There are two accounting issues to address in the Four Accounts analysis in regards to the value of acquiring new water for growth through IP implementation. The first is whether to use $60/af/year or $258/af/year as the marginal water value/cost. The Four Accounts analysis relies on a wholesale water price of $258. Wholesale water rates are generally defined as the rate that one utility charges another utility for water service. Wholesale water is generally priced to cover pre-transfer water treatment, and any transport and administrative costs borne by the seller. Given that these costs would be incurred for municipal water (either directly or through the price of purchase) regardless of whether acquired through the IP or not, it is inappropriate to include these costs when estimating the value of the IP. As such, a wholesale price would be biased upward for the purposes of this analysis. Further, utility-to-utility water prices even net of these costs tend to be higher than irrigation-to-utility transfer prices (Libecap 2010; Brewer et al. 2007), in part because the opportunity cost to utilities is often higher. Thus, given that water sales are likely to come from the agricultural sector, we argue that it is more reasonable to use the value of $60/af/year (instead of $258), which represents the gains from trade of a lease and supports a net present value of gains from trade used in the Four Accounts analysis of $1,500/af (an assumed purchase price of $2,500 minus the opportunity cost to irrigation of $1,000).

Either $60 for annual gains from trade or its corresponding net value of $1,500 the net value of permanent sale could be used to calculate the net present value of market transactions to municipalities. It is useful to begin by supposing that all 10,900 af of water were purchased outright immediately to cover the forecasted growth to 2060. This would lead to gains from trade of 41 [years]X $1,500 X 1193 [af] = $73,369,500. Assume as in the Four Accounts analysis that municipal purchases occur at 1193 acre feet per year as demand increases (all else constant) provides an estimate of **$27 million**, which is less than a quarter of the estimate provided in the Four Accounts analysis.[33] Calculations are provided in Appendix VII.D Table 44, including an approximate recreation of Four Accounts Analysis calculations.

While we have gone to some effort to justify the use of $1,000 as an opportunity cost of irrigation water and $2,500/af to represent an equilibrium agriculture-to-urban trade, there many macroeconomic, environmental, and local factors that can affect equilibrium market prices for water that are subject to uncertainty. In Appendix VII.D we provide a brief and simple explanation of the theory behind the market conditions and prices being used. We also perform some robustness analysis in Section IV.D.2 by examining the impact of differences in the value of a senior water right for agriculture, and by doubling the ag-to-urban sale price.

Another convenient benchmark is to assume that growth continues at the same rate for 100 years, which is the planning horizon for the IP projects rather than increasing demand horizon ending at

[33] Whether treated (appropriately) as a permanent sale or a recurring lease, using a lease price of $258 or its corresponding permanent sale price of $6,450 provides a net present value of $115 million as reported in the Four Accounts Analysis.

2060. If municipal demand growth continues at an additional 1193 af/year until 2112, the net present value of this the incurred costs would be about $33 million rather than $27 million.

Additionally, the Four Accounts analysis ignores existing inchoate water rights held by municipalities. Based on data from the Washington State Department of Ecology Water Resources Explorer database, the municipalities included in the Four Accounts analysis hold more than enough inchoate rights to cover the forecasted water demand growth to 2060 (State of Washington Department of Ecology 2014b). It is possible that some of these inchoate rights will not be fully available to municipalities to cover future demand growth for a variety of reasons (e.g. court-imposed mitigation requirements for future groundwater use as has occurred in the upper Kittitas for domestic groundwater use), but to the extent these inchoate rights will be available, municipalities will be delayed beyond 2060, or more precisely beyond the point where their current inchoate rights will support them (which is generally beyond 2060 by our understanding of the municipal water rights in the basin).[34]

Finally, because the Four Accounts analysis was published in 2012, plans continue to be developed for the Ahtanum Valley Aquifer Storage and Recovery project (Golder Associates 2014). This ASR project is not addressed in the Four Accounts analysis, but it is integrated in the YAKRW simulations developed by HDR as a source of water for municipalities outside of IP development. In other words, the demand growth assumed in the Four Accounts analysis is partially mitigated by the estimated 6,000 af provided by this ASR. The ASR would capture and store additional later summer water, which in turn would reduce the benefits of the IP to municipalities, regardless of whether this water is used directly for municipal and domestic purposes or diverted for other uses. While we do not incorporate this development explicitly in any analyses, accounting for it would further reduce, perhaps substantially, the estimated benefits to municipalities of the IP.

3. Benefits due to individual projects

As described in the Four Accounts analysis, the water security benefits are claimed to result from the improvements in markets that are attributed to the IP. As such, these benefits do not follow from any infrastructure development.

Our approach for allocating these benefits of the estimated $27 million in benefits from support of new municipal and domestic water demand across projects is to allocate them in proportion to each

[34] Another point relates to the exact status of new municipal rights provided by the IP. While the new municipal rights would in principle be junior water rights (relative to all previously acquired water rights), the Four Accounts analysis implicitly assumes that these would be uninterruptible rights. This makes some sense in that municipalities generally must rely on uninterruptible rights for planning purposes, but we have not found any explicit statement in any descriptions of the IP, including the FPEIS, that states that these municipal rights would hold uninterruptible status. If they are interruptible rights, their value would have to be discounted by the expected frequency of interruption. As discussed in the water security section above, if junior water rights are curtailed in 44% of years (assuming the historical climate regime), the expected value net present value of the IP-provided junior water rights would be 66% of the $27 million (senior water rights would need to be leased in the 44% of years in which they would be curtailed). Thus, an estimate of the expected net present value of benefit to municipalities of junior water rights from the IP are 0.66*$27 million = $17.8 million.

project's contribution to water storage. Table 18 provides these contributions.[35] Each of the storage projects, except the Cle Elum pool raise, has the capacity to provide the entire estimated increases in municipal/domestic demand up until 2060.[36] If only one water storage project is implemented in a scenario, it accrues (provides) 100% of the estimated benefits to municipalities/domestic users, with the exception of the Cle Elum pool raise. This proposed project would provide 14,600 af of new water storage, which is only 30% of the estimated 48,900 af of new water demand. Therefore, if the Cle Elum pool raise were implemented alone, the municipal benefits would be 0.30*17.8 =$5.34 million. If two projects are implemented, one providing 100,000 af and the other providing 200,000 af, the smaller of these will be credited with 1/3, and the second with 2/3 of the municipal benefits (totaling an estimated $27 million). Thus, the average benefits to municipalities will tend to decline as the number of implemented projects increases.

Table 18: Municipal net benefits distributed among contributing storage projects.

Project	New storage (acre-feet)	Fraction of new IP storage	Benefits ($millions)
ASR	100,000	0.16	4.26
Bumping	156,300	0.25	6.66
CEPR	14,600	0.02	0.62
Conservation*	0	0.00	0.00
KKC+KDRPP**	200,000	0.32	8.53
Wymer	162,500	0.26	6.93
Total	633,400	1.00	27.0

Conservation investments do not increase storage, but primarily affect water distribution over time and space.
**KKC does not add to total storage capacity, but instead augments inflows into Kachess. Strictly speaking, then the contribution of KKC to new storage is zero.

To assess the value of individual projects we focus in Sections IV.D and IV.G on two bookend cases: the benefits of a project when it is the sole storage project implemented, and the benefits of the project when all other storage projects are also implemented. As noted above, for single-project implementation, the $27 million is credited to the benefits of the sole project. When all projects are implemented, the municipal benefit attributed to a project is in proportion to its share of storage provided by it.

The Four Accounts analysis estimates the benefits of the IP at about $400 million ($0.4 billion). Our revision, based on their methodological approach suggests benefits of the IP to municipalities and domestic users of around $32 million or lower in expected net present value terms; $27 million

[35] Note that this allocation of water across projects applies only to new water, not the market security benefits.
[36] In fact, the RiverWare YAKRW model is parameterized to allow an approximation of this demand growth, though this affects agricultural curtailment frequency and magnitude through its effect on water supply available for irrigation. It allows a setting such that municipal water demand for 2040 is fully provided as a component of any IP scenario including the base (no IP projects) case, et of water provided by the proposed Ahtanum ASR. 2040 is the midpoint of the time period (2020-2060) within which municipal/domestic benefits are accrued.

from avoided costs to accommodate new growth, and about $5 million to provide security for existing groundwater users.

We conclude this section with a few important points. First, water curtailments are always economically harmful, and can be especially harmful if they are imposed on municipalities, if for no other reason than that under current water entitlements, municipal and domestic water users often have a higher willingness-to-pay for water at the margin than is economical for irrigation users (Brewer et al. 2007). These estimates represent the cost to acquire uninterruptible water rights, and should not be confused with the economic impact of municipal water curtailments, which can have much larger impacts relative to the costs of water acquisition. Nonetheless, an avoidance cost approach as relied on here is appropriate given the legal requirements of municipalities to provide secure water for their populace, and an ability to do so.

D. Water storage projects and operations

Water storage projects provide benefits for both out-of-stream uses to agriculture and municipalities, and instream flows for the support of fish populations. We begin by reporting the net benefits of the water storage projects in terms of out-of-stream benefits. These net benefits provide information about the minimum value that instream flows would have to provide for the projects to break even. We then report results that show the opportunity cost of proposed IP instream flows in terms of foregone agricultural production value.

1. Net benefits for out-of-stream uses

Table 19 provides the estimated total benefits and net benefits of water storage to out-of-stream uses assuming implementation of all IP water storage projects. Costs account for all water storage projects: KKC, KDRPP, Cle Elum pool raise (CEPR), Ag Conservation, passive ASR, Bumping, and Wymer. All costs and benefits are discounted as described in Section III.E. Specifically discounting is applied such that benefits begin contemporaneous with the end of construction of all projects, four years in the future (the presumed duration of the longest construction projects).

Table 19: Net benefits of water storage for out-of-stream uses (present value at start of construction). $Millions.

		Total out-of-stream benefits			Net benefits		
run	Cost[1]	No trade	Intra-district	Full trade	No trade	Intra-district	Full trade
IP, historical climate	2,850	155	95	69	-2,695	-2,755	-2,781
IP, CGCM climate	2,850	206	123	86	-2,644	-2,727	-2,764
IP, HADCM climate	2,850	357	234	144	-2,493	-2,616	-2,706
IP, HADGEM climate	2,850	578	351	225	-2,272	-2,499	-2,626

[1]Projects included in these costs include KKC, KDRPP, Cle Elum pool raise, Ag Conservation, passive ASR, Bumping, and Wymer. Present values represent the start of construction, assuming simultaneous completion and the beginning of construction of four-year projects as described in Section III.E.

Specifically, the total cost of $2,850 million ($2.85 billion) represents the discounted sum of the costs of: KKC, KDRPP, Cle Elum pool raise, Ag Conservation, passive ASR, Bumping, and Wymer. Total benefits are equal to those provided in Table 19 of the agricultural irrigation benefits in Section IV.B plus the municipal and domestic benefits estimated in Section IV.C.

After discounting to the beginning of IP infrastructure construction, the total out-of-stream benefits (agriculture and municipal/domestic) range from $69 to $578 million depending on climate and market regime. All estimates are all substantially lower than the estimated $1.2 billion combined benefits from these two sectors estimated in the Four Accounts analysis. A large part of this difference results from the difference in municipal benefits, and some of the difference is due to differing base years.

Notice that the cost of IP storage net of out-of-stream benefits is negative, and ranges between -$2,272 and -$2,781 million depending on climate and trading regime.[37] Proposed IP instream flows are implemented in the full IP scenario, so these measures underestimate the total net benefit by the value of instream flows provided by the IP. B/C ratios can also be easily calculated as the total benefit divided by the total cost. For example, the B/C ratio for the case of intra-district trade (HADCM climate) is 234/2,850= 0.082. For CGCM climate, the B/C ratio is 0.043. Again, this B/C ratio does not account for any benefits accrued from instream flows, meaning these B/C ratios would be biased downward depending on the magnitude of instream flow benefits via provided by the IP.

If the federally-set interest rate for 2014 of 3.5% is used instead of 4% (which we used to be consistent with the Four Accounts analysis), net benefit estimates in Table 20 range from -$2,191 to -$2,777, a maximum of about 4% difference in net present value of benefits after accounting for costs, municipal, and agricultural value. While we do not report these comparisons in the remaining results below, the differences do not change the sign of B-C outcomes (or change B/C ratios from below to above 1) in any scenario considered for either individual projects or the IP as a whole, regardless of market or climate regime.

In the municipal benefits section we noted the potential for the long-run "settled" price of $2,500/af might be lower or higher, depending on multiple factors. If this ag-to municipal price were lower, then the municipal benefits would drop, suggesting that the net benefits of the IP in Table 20 would be even less than otherwise. However, net benefits would be higher (less negative) as municipal benefits increase. This would be the case for a municipality that would have to pay $5,000 instead of $2,500. Then the net benefits of not having to purchase IP water to cover growth would be about $72 million instead of $27 million. The range of net benefits from IP water storage would slightly less negative, ranging between -$ 2,234 million to -$ 2,743. These numbers are comparable to those

[37] Only one point estimate of costs is provided for each scenario to for parsimony. Section V.E suggests as a rough guide to generate a range of cost estimates to use the percentiles provided in Appendix D of the Four Accounts analysis. For example, an estimate of the 10th percentile would be 81% of the point estimate of $2,850 million, or $2,309 million, and an estimate of the 90th percentile cost would be $3,791 million. These can then be used to estimate a range of net benefits and B/C ratios for each scenario.

listed under "Net benefits" in Table 19. Municipal benefits are relatively small, and different assumptions on municipal value have relatively small impacts on outcomes when spread across all IP water storage projects.

Table 20 provides the total and net benefits of the individual components of the storage-related IP projects without the IP instream flows implemented, under the least and most adverse climate scenarios.[38] Under the individual scenarios (Base+1), IP instream flows are not implemented, so no additional fish benefits would accrue; these are therefore final net benefit estimates. Furthermore, given that these are "one at a time" implementations, municipal water benefits are fully credited to each "total benefit" estimate. This is in contrast to when the IP is implemented as a whole.

Table 20: Out-of-stream net benefits of individual water storage projects implemented alone (Base+1). $millions. Present value at start of construction.

	Project	Total benefits			Net benefits		
Run Base+[project]	Cost	No trade	Intra-district	Full trade	No trade	Intra-district	Full trade
CGCM climate scenario (least adverse future climate scenario)							
KKC	138.2	33.4	28.3	26.6	-104.8	-109.9	-111.6
KDRPP	195.8	137.8	89.1	64.3	-58.0	-106.7	-131.5
KKC+KDRPP	334.0	157.3	98.3	71.4	-176.7	-235.7	-262.6
CEPR	15.7	12.6	9.7	9.0	-3.1	-5.9	-6.7
ASR	126.3	64.5	44.7	36.6	-61.8	-81.6	-89.6
Conservation	256.7	18.6	10.7	6.9	-238.1	-246.0	-249.8
Bumping	452.3	129.1	81.1	60.1	-323.2	-371.2	-392.2
Wymer	1,331.2	189.3	114.7	81.7	-1,141.9	-1,216.5	-1,249.5
HADGEM climate scenario (most adverse)							
KKC	138.2	72.7	48.0	38.3	-65.5	-90.2	-99.9
KDRPP	195.8	249.6	179.1	117.5	53.8	-16.7	-78.3
KKC+KDRPP	334.0	510.8	339.5	210.8	176.8	5.5	-123.2
CEPR	15.7	37.4	21.1	16.0	21.7	5.5	0.3
ASR	126.3	175.6	112.4	79.0	49.3	-13.9	-47.3
Conservation	256.7	-0.1	-10.9	-1.5	-256.7	-267.6	-258.2
Bumping	452.3	466.0	293.4	184.4	13.7	-158.9	-267.9
Wymer	1,331.2	764.2	523.6	311.1	-567.0	-807.6	-1,020.1

As is apparent from the net benefits, individual storage projects provide positive net benefits only under the most adverse climate scenario (HADGEM). Under this climate scenario, KKC+KDRPP and CEPR provide positive net benefits of 5.5 million each (by coincidence) under the intermediate

[38] Recall that the CGCM climate regime approximates the average curtailment rates implied by the assumptions of the Four Accounts analysis, and shows higher benefits than the historical regime. The net benefits under the historical climate regime would be lower (more negative).

trade scenario Conservation benefits are again an anomaly for the HADGEM results in Table 20 as they were in Table 16. These values remain negative here because Conservation does not provide additional storage and so is not credited for municipal benefits.

If municipalities were given uninterruptible rights with implementation of individual projects, and this saved them from having to purchase at $5,000/af rather than $2,500/af, municipalities would save about $72 million rather than $27 million. If this amount is credited to one individual project (as assumed in Table 20), CEPR would provide positive net benefits ranging from $8.4 to $4.8 million depending on the trading regime under the moderate (CGCM) climate regime (not shown in Table 20). Under the most adverse climate regime (HADGEM), KKC+KDRPP, ASR, and Cle Elum would all provide positive net benefits for low and intermediate trading regimes. It is important to note again that the net benefits are affected more when municipal benefits are credited to one project only rather than across the full set of projects, and not even CEPR provides positive net benefits with the higher municipal benefit estimates when the full IP is implemented. In fact, the sum of net benefits for KKC+ KDRPP, ASR and CEPR are $85.6 million under the adverse climate scenario and intermediate trading. This value is larger than the assumed $72 million saved by municipalities, and so this limited group of IP projects would not jointly satisfy a B-C criterion for out-of-stream uses as a group under these assumptions.

Table 21: Benefit-Cost ratios assuming IP Instream flows are not implemented.

	CGCM climate			HADGEM climate		
Project (Base + 1)	No trade	Intra-district trade	Full trade	No trade	Intra-district trade	Full trade
KKC	0.24	0.20	0.19	0.53	0.35	0.28
KDRPP	0.70	0.46	0.33	1.28	0.92	0.60
KKC+KDRPP	0.47	0.29	0.21	1.53	1.02	0.63
CEPR	0.80	0.62	0.58	2.38	1.35	1.02
ASR	0.51	0.35	0.29	1.39	0.89	0.63
Conservation	0.07	0.04	0.03	0.00	0.00	0.00
Bumping	0.29	0.18	0.13	1.03	0.65	0.41
Wymer	0.14	0.09	0.06	0.57	0.39	0.23

Table 21 provides B/C ratios for the IP projects, assuming no IP instream flows based on the results presented in Table 20, for the least and most adverse future climate scenarios. For example, assuming intra-district trade and CGCM climate, Bumping Lake expansion has a B-C ratio of 81.1/452.3=0.18 (numbers taken from Table 20). None of the projects satisfy the B-C criterion of 1 or greater under the less adverse climate scenario. Under the intermediate trading regime and less adverse climate, Cle Elum Pool raise provides the highest B-C ratio of 0.62, implying that it provides out-of-stream benefits that are about 2/3 of its costs. Both CEPR and KKC+KDRPP provide B/C ratios above 1 under the most adverse climate scenario and moderate trade. CEPR provides the highest return of $1.35 per dollar of cost. In addition, CEPR also provides a B/C ratio above 1 for full trade.

Table 22: Out-of-stream net benefits ($millions) and B/C ratios for individual projects implemented as part of the full IP under the most adverse climate scenario (HADGEM).

	Net Benefits (B-C)			B/C ratios		
Project (Base + 1)	No trade	Intra-district	Full trade	No trade	Intra-district	Full trade
KKC	-46.9	-73.8	-103.1	0.66	0.47	0.25
KDRPP	-18.8	-60.6	-115.9	0.90	0.69	0.41
KKC+KDRPP	-144.6	-187.6	-249.1	0.57	0.44	0.25
CEPR	-14.8	-16.0	-15.6	0.06	0.00	0.01
ASR	-11.8	-18.5	-77.3	0.91	0.85	0.39
Conservation	-248.1	-242.8	-252.7	0.03	0.05	0.02
Bumping	-290.0	-348.1	-389.6	0.36	0.23	0.14
Wymer	-1,044.5	-1,105.8	-1,211.1	0.22	0.17	0.09

Table 21 provides estimates for individual projects implemented alone. Table 22 provides estimates of out-of-stream net benefits and B/C ratios for individual project when implemented as part of the full IP assuming the most adverse climate scenario (HADGEM). The table shows that no project provides positive net benefits under these conditions for any water market scenario.

2. *IP instream flows: Break-even values and opportunity costs*

Before examining the benefits of instream flows, we examine the costs of providing them. There are two relevant measures of costs of instream flows in the context of this analysis:

1) The cost of IP storage projects net of the out-of-stream benefits, when proposed IP instream flows are implemented ("net remaining costs").
2) The out-of-stream water use value lost when proposed IP instream flows are provided, with or without additional IP water storage ("opportunity costs").

The first measure is based on the cost of new infrastructure net of out-of-stream uses, which Interpreted another way represents the benefits that must accrue from instream flows for the IP storage projects to satisfy a benefit-cost criterion. The second is the opportunity cost of the instream flows in terms of foregone out-of-stream benefits, regardless of IP infrastructure investment (Grantham et al. 2014; Ward 1987). This measure can also be interpreted as the minimum payment required to purchase water rights to provide instream flows. In each case, the analysis relies at least in part on the results of the out-of-stream (agricultural and municipal) benefits.

Recall from Table 19 at the beginning of this section that the cost of IP storage net of out-of-stream benefits is negative, and ranges between -$2,272 and -$2,792 million depending on climate and trading regime. Proposed IP instream flows are implemented in the IP scenarios, so the (negative) net benefits represent the economic benefits that the IP instream flows would have to provide, primarily through fish-production benefits, for the IP water storage projects as a group to provide a non-negative net benefit, and a B/C ratio of one or greater. Thus, the cost of providing IP instream flows with IP infrastructure ranges between $2,272 and $2,792 million.

The negative net benefit values for individual projects presented in Table 20 analogously represent the instream flow benefits each project must provide for their net benefits to be non-negative, and B-C ratios to be 1 or greater.

Another way to "implement" IP instream flows is to simulate the purchase of out-of-stream water rights to provide IP instream flows without investing in IP infrastructure. Proposed IP instream flows are implemented in YAKRW are described in HDR Engineering, Inc. (2014), and can be implemented in YAKRW independently of other IP storage projects. Parameterizing YAKRW to implement IP instream flows but no storage project (that is, baseline + IP instream flows only) generally reduces water allocated to out-of-stream uses, and thus imposes an opportunity cost on them through reduced diversions and higher curtailment in drought years. This opportunity cost represents the minimum payment that irrigators might accept to relinquish water rights for instream flows. It should be noted immediately that the costs of acquiring rights from irrigation to augment instream flows are likely to be higher than these opportunity costs suggest due to transaction costs, relative bargaining position, and other factors.

Table 23 provides estimates of the opportunity cost of instream flows in terms of agricultural production. We focus primarily on the costs relative to the baseline case (HDR 7.1) for the different climate regimes. To make these comparable to the values in Table 19 and Table 20, these opportunity costs have been discounted by four years to represent a baseline of four years in the future to correspond to completion of water storage projects as described in Section III.E.[39]

Table 23: The cost of proposed IP instream flows in terms of agricultural production value. Present value, $ millions.

run	No trade	Intra-district trade only	Full trade	Reduction in diversions (af) due to IP instream flows
Base+Instream, historical climate	267.2	158.5	97.7	76,823
Base+Instream, CGCM climate	230.9	128.2	81.7	71,604
Base+Instream, HADCM climate	482.4	327.2	186.0	113,715
Base+Instream, HADGEM climate	546.3	489.5	236.5	114,043
IP-Instream, historical climate	155.9	76.1	48.3	51,847

As the table shows, given the historical climate regime the IP instream flow operations would lead to opportunity costs ranging from a high of $267.2 million given no trade, and a low of $97.7 million under full trade. Under the historical climate regime, implementing IP instream flows reduces mean irrigation water available to the districts by 76,823 af/year. To purchase instream flows in perpetuity

[39] To calculate present value with current year (beginning of construction) as the base year, multiply by $(1.04)^4$.

under the historic climate regime with intermediate trade would cost $2,063.2/af (corresponding to $84.2/af/year if it were an equivalent lease. Adding transaction costs of a third of this would imply a cost of $2,744/af for a purchase of instream flows. With full trade, the analogous numbers (opportunity cost plus transaction costs) would imply a purchase cost of $1,692/af.

This amount of water represents about 4% of the 2 million af of water rights held in the five major federal districts, and about 9% of non-proratable rights. This is not an inconsequential volume of water, and while we show it is likely the least costly method of providing the proposed instream flows among the options considered, transferring this amount of senior water rights out of irrigated agricultural production may have substantive local economic activity and public finance consequences.

Interestingly, the estimated cost of providing instream flows under the CGCM scenario is lower. This is ultimately related to the way in which the predicted increase in precipitation under CGCM interacts with the instream flow constraint specification. The moderate and adverse climate scenarios lead to higher costs of implementing the IP instream flows via purchase. With intra-district trading, for example, the opportunity cost of providing instream flows (with a purchase) under the most adverse climate scenario (HADGEM) is $2,877. With transaction costs, this amounts to $3,826.The scenario "IP-Instream, historical climate" represents the opportunity cost of instream flows given full IP implementation. It is included as a reference to illustrate the fact that the opportunity cost of IP instream flows is lower when the additional IP storage is available.

A comparison of Table 19 and Table 23 (adding transaction costs of 1/3 of each value) offer an important cost comparison for providing IP instream flows either with, or without, IP storage projects. Table 24 provides the ratio of the cost of providing IP instream flows with and without providing IP storage infrastructure for each climate and trade regime. For example, assuming intra-district trade and the CGCM climate regime, providing IP instream flows by building the IP storage projects costs about 25 times more (2,744/110.5=25) than relying on reducing existing out of stream agricultural uses to meet instream flow targets.

After netting out the out-of-stream benefits from the IP, the cost of providing instream flows via full IP implementation is between 3 and 25 times the opportunity cost of water without the IP, suggesting that the lower-cost approach for providing proposed instream flows would be to transfer water rights from out-of-stream uses to instream uses.

Table 24: Ratio of IP instream costs with and without IP storage

climate regime	no trade	Intra-district trade only	Full trade
Historical	8	13	21
CGCM	9	16	25
HADCM	4	6	11
HADGEM	3	4	8

The use of water banks and public purchase of water for instream flows has been developing in Washington State through various programs such as the Trust Water Rights Program and the

Washington Water Acquisition Program.[40] While these programs are relatively small in terms of water and transaction volume and have had mixed success across the state (Lovrich et al. 2004), they show promise for future development and may, with further development, to provide a basis for such transactions. As noted above, transferring this amount of senior water rights out of irrigated agricultural production may have substantive local economic activity and public finance consequences.

E. Fish passage and habitat restoration

As noted in Section III.D.1, actions to improve fish populations in the basin can be categorized as follows:

1) Fish passage for one or more existing dams in the basin
2) Operation changes to improve instream flow conditions for fish
3) Other fish habitat restoration

This section examines fish-related impacts from these three categories of IP management activities. The estimated benefits from fish are basically the product of two types of values: the estimated expected increase in fish abundance due to IP investments, and the marginal (individual) value of fish. The estimation methods used in the Four Accounts and supporting analysis as well as the FPEIS are described in Section III.D.

The Four Accounts analysis is again the foundation for our analysis. We use it as a starting point for assessing the relative contribution of fish passage, instream flows, and other restoration to the extent possible. We then reassess the estimated aggregate value of fish impacts, both in terms of fish abundance impacts and the valuation of abundance, and find that the Four Accounts analysis is overly optimistic both in terms of fish abundance impacts, the marginal value per fish in the current environment, and the aggregate value of the fish benefits provided by the IP. We then disaggregate this value to provide B-C metrics for each fish passage project, instream flows, and other restoration to the extent possible.

1. *Implications of the Four Accounts and other existing IP analyses*

We begin by distinguishing between sockeye and non-sockeye, and fish passage versus non-fish passage investments (instream-flows and other restoration activities).

Wild sockeye salmon principally use lake habitat for reproduction. Sockeye currently have no access to reservoirs in the Yakima Basin, and there exists no viable wild sockeye population. The five fish passage projects of the IP are designed to open up spawning habitat for sockeye. As described in Section III.D.1, the sockeye recruitment model that provides estimates for the Four Accounts analysis relies on spawning capacity of lakes, and does not condition sockeye recruitment on non-passage restoration activities, which is to say that non-passage restoration activities do not factor into estimates of sockeye success in the modeling framework used (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012; U.S. Bureau of

[40] See the department of Ecology Water Program website http://www.ecy.wa.gov/programs/wr/market/market.html.

Reclamation, HDR Engineering Inc., and Anchor QEA 2011). Assuming IP fish passage projects were implemented, sockeye salmon recruitment back to the Columbia River estuary attributable to IP fish passage is estimated at 170,000 to 380,000, which is 80 to 95 percent of the total low and high fish recruitment impacts of 181,650 to 472,450 for all species. These estimates are conditional on restoration activities being implemented. This means that sockeye accounts for between $4.6 and $6 billion of the total Four Accounts estimates of IP fish benefits, which ranges from $5 to $7.4 billion.[41]

Inferring from the Fish Benefits Analysis Technical Memorandum (U.S. Bureau of Reclamation, HDR Engineering Inc., and Anchor QEA 2011), 25% of the recruitment of chinook, steelhead and coho come from fish passage, and 75% come from restoration for both high and low estimates. Further, because sockeye modeling implicitly assume that non-passage restoration activities do not affect sockeye success, non-sockeye species convey 100% of the restoration benefits. From the above information, we can infer the implied breakdown of fish and economic benefits from sockeye versus non-sockeye, and from fish passage and non-passage investments, which is presented in Table 25.

Table 25: Implied breakdown of fish and economic benefits from sockeye versus non-sockeye, and from fish passage and non-passage investments based on Four Accounts estimates and modeling assumptions.

	Fish estimates		Percent (%)		Four Accounts $millions	
	low	high	low	high	low	high
Sockeye	170,000	380,000	93.6	80.4	4,679	5,952
Non-sockeye	11,650	92,450	6.4	19.6	321	1,448
Fish passage	172,913	403,113	95.2	85.3	4,759	6,314
Non-passage	8,738	69,338	4.8	14.7	241	1,086
total	181,650	472,450	100	100	5,000	7,400

In particular, Table 25 provides the share of benefits attributable to fish passage and non-fish passage. This is useful information for reassessing aggregate estimates of fish population impacts and fish value, as described in the next section.

2. *Reassessment of fish abundance impacts and economic benefits*

In Section III.D (Methods) we qualitatively characterize several reasons to conclude that abundance estimates and marginal fish values reported in the Four Accounts analysis are overly optimistic. While we cannot quantitatively address most of these concerns, we are able to examine two important assumptions that underlie their results by bringing to bear additional data: a) fish population growth rates, and b) baseline fish abundance. In this section we summarize our contention that the fish population growth rates implicit in the Four Accounts analysis are too

[41] Note also that these numbers imply an average value per sockeye of $27,529 at the low abundance end) to $16,711 at the high abundance end.

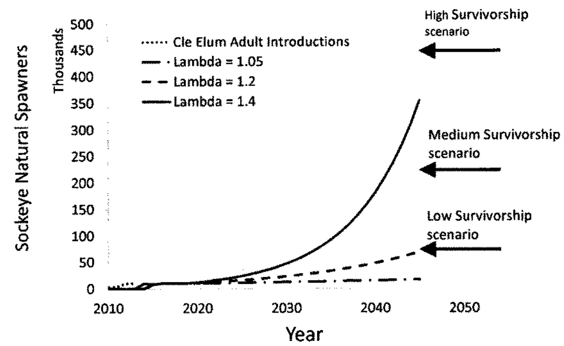

Figure 17: Projections of sockeye salmon abundance based on a range of population growth rates over the BIP planning horizon. These projections incorporate current reintroductions.

optimistic, and that baseline fish abundance in the Columbia River basin appear to have been increasing since 1998, which may have substantial impacts on the value of the additional fish from IP projects. More extensive methodological explanation is provided in Appendix section VII.E and VII.F.

Figure 18 illustrates various rates of population growth for sockeye as an example. At a population growth rate of λ[Lambda]=1.05 the current stock would grow to over 12,000 fish in the 10 year planning horizon, and 17,000 fish after 30 years.[42] If the long-term population growth rate is as high as λ=1.2, then abundances may exceed 16,000 after 10 years, and will enter the lowest YBIP forecasts after 30 years. Abundances reach the higher end of YBIP forecasts only if the population growth rate is set to an extraordinary high values (e.g. 1.4) and the planning horizon is 30 years.

Based on available monitoring data for sockeye abundance in the Yakima basin, population growth rates (λ) would have to exceed any known biologically realistic value to hit IP forecasts within near-term time horizons. Indeed, even if the time horizon were extended out to 2045, the necessary values of λ would have to exceed 10 to hit forecast targets. A biologically relevant range of λ for a growing population would be between 1.0 and 1.3, with very few Columbia River salmon populations exceeding 1.05 (McClure et al. 2003).[43] We can examine the impact of a more conservative and arguably more likely growth rate of λ=1.05 and 1.10 on the net present value of

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[42] The rate of population growth λ is defined in terms of the ratio of the population size at time t to the population size at time t+1. Thus, population growth in percentage terms is λ-1, so that λ =1.05 corresponds to a population growth rate of 5%/year.

[43] Of the 131 populations examined in 05 (McClure et al. 2003), only 18 (14%) have growth rates over 1.04.

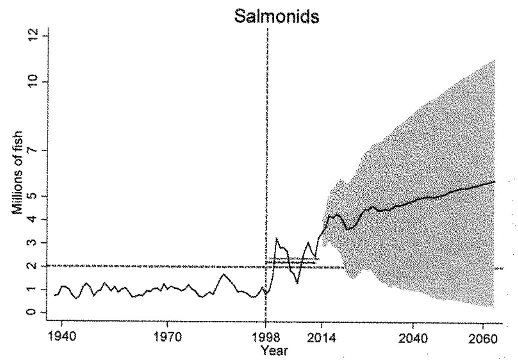

Figure 18. Salmonid counts at Bonneville Dam and Willamette fall. Forecasts and 95% confidence intervals (grey area) beyond 2014 generated using an AutoRegressive Integrated Moving Average (ARIMA) model of order (1,1,1), with a 3-year seasonal lag. The two short lines between 1998-2012 and 1999-2013 are means for that period.

implied fish numbers, using these growth rates until they reach the low and high estimates reported in the Four Accounts analysis.

The second issue we examine is that the Four Accounts analysis assumes a non-increasing fish population baseline of two million fish between 1998 and 2012. An examination of Figure 18 shows that fish counts until 1998 actually are lower than the two million assumed in the Four Accounts analysis, but then begin to increase in 1999, reaching a high of around 3.20-3.30 million fish in 2013. The mean fish count for 1998 to 2012 (which coincides with the range of time between the LBP analysis and the Four Accounts analysis) is about 2.21 million salmonids. Over this time period, the lowest value in this range was 845,939 in 1998, and the highest value of 3,291,654 in 2013 was omitted from this range. If 1998 were omitted and 2013 were included, the mean fish count for the period would be 2,369,867 (2 million plus almost 370,000 above baseline), so using the 1998-2012 range is conservative in this regard. The forecasted values from 2014 to 2060 have 95% credibility intervals that illustrate one component of uncertainty in these numbers, and is large due to their high variance, especially since 1998. Nonetheless, it seems reasonable based solely on the average fish counts that the baseline population is increasing.

Table 26 shows the sensitivity of results to both higher baseline fish populations and slower fish growth than is assumed in the Four Accounts analysis. These calculations rely on the high-end IP increase of 472,450 fish, which the Four Accounts estimated would produce $7,477 million in economic benefits. Incorporating 1998-2012 fish increases and delaying achievement of the IP fish targets required some modification of the Four Accounts/LBP approach. We describe these modifications in detail in the fish valuation appendix.

The table shows that fish values decline with lower fish population growth rates, and with higher baseline fish populations. It further shows that the results are much more sensitive to changes in baseline fish populations than delays in fish growth. For example, if the baseline is 2.2 million, which is 200,000 fish above the Four Accounts baseline and just below the mean Salmonid counts for 1998-2012, and growth rates are sufficiently large such that the low and high fish populations are reached by 2042 (30 years) the low and high fish benefits estimates drop to $1.4 billion and $2.7 billion (down from $5 and $7.4 billion with a two million fish baseline).

Table 26. Economic benefits (millions of 2012$) to Washington and Oregon households conditional on growth rates and baseline increases. Hi and Lo correspond to the High and Low Four Accounts estimates are 472,450 fish and 181,650 fish, respectively. Washington only benefits equal 63% of the estimates in the table.

	Non-IP related fish population increases 1998-2012							
Year that IP fish impacts stabilize	0		100,000		200,000		300,000	
	Low	High	Low	High	Low	High	Low	High
2042	5,003**	7,387	2,288**	3,957	1,402**	2,699	1,018**	2,081
2052	4,593	7,056**	2,120	3,717**	1,290	2,510**	934	1,926**
2062	4,147	6,670	1,927	3,440	1,159	2,292	834	1,745
2072	3,822*	6,348	1,780*	3,216	1,062*	2,120	762*	1,610
2082	3,523	6,025	1,635	3,005	967	1,960	691	1,476
2092	3,239	5,744*	1,518	2,825*	891	1,825*	634	1,367*

**Correspond to growth parameter λ=1.05.* ***Correspond to growth parameter λ=1.10*

There is an underlying fish growth rate implicit in the result for any given baseline, year to stabilization, and stabilized fish numbers (whether high or low), as discussed in the context of sockeye recovery in Appendix section VII.E.a. In that section it is noted, based on (McClure et al. 2003), that growth rates corresponding to growth parameter λ greater than 1.05 are very unusual, and would be considered very high growth rates relative to what is commonly observed. The Four Accounts analysis implicitly assumes growth rates associated with λ much higher than this --- as much as $\lambda=1.40$ to reach the high fish abundance estimates, which is larger than any recorded in McClure et al. (2003) and would probably require active hatchery or importation investments not included in the IP.

In Table 26, values with a single asterisk are associated with outcomes that most closely correspond to $\lambda=1.05$. At this growth rate, the low end increases in fish numbers are reached around 2072, and the high end fish increases are reached by 2092. If the Columbia River Baseline of 2.2 million fish is used as the mean baseline fish count for 1998 to 2012, the fish benefits amount to $1,062 million (about $1.1 billion) for the low-end fish estimate (of 181,650), and $1,825 million (**$**1.8 billion) for the high fish estimate (472,450 fish). The values with double asterisks correspond to a higher still growth rate with λ=1.10, though we contend that growth rates this high would be exceptionally unlikely.

In Section III.D.3.c on page 59 we note that the Four Accounts analysis assumes that fish benefits start to accrue immediately (in 2012), whereas it would be reasonable to "start" accrual of fish benefits after completion of the enabling infrastructure. However, given the survey language in the LBP study about how and when fish benefits are accrued in the future, either interpretation is consistent with the LBP approach. As a robustness check, we also consider the implications of pushing back the accrual of benefits 4 years (as if to 2016). If this delay were assumed in the Four Accounts analysis, the estimated benefits drop from about $5.0 billion to $3.8 billion on the low end and from about $7.4 billion to $5.5 billion. With our baseline (higher by 200,000 fish), the low end estimate is $870 million and the high end is $1,478 million; accounting for delay lowers the estimates in the previous paragraph by an additional 20%.[44]

In summary, if we account for the empirically observed increases in baseline fish numbers in the Columbia that are not accounted for in the Four Accounts analysis, and if we assume a positive growth rate that is relatively high but within observed and more credible ranges, we arrive at point estimates for **fish benefits around $1 and $2 billion** instead of the Four Accounts range of $5 to $7.4 billion in fish benefits. The differences in our revised benefit estimates compared to the Four Accounts estimates also do not account for other factors that we argued suggest lead to upward bias in the valuation estimates.

Relatively recent research by Montgomery and Helvoigt (2006) provides some interesting corroboration of a potential trend in attitudes and WTP for salmon recovery investments. Based on data collected in 2002 and 2006 in Oregon, they find a decline in WTP for salmon recovery efforts. While they find various socioeconomic factors account for some of this trend, they speculate that increases in fish counts during this period (as we illustrate in Figure 18) may lead to lower marginal WTP for fish restoration, which is exactly what is driving our lower benefit estimates in response to higher fish baselines.

The degree of uncertainty in these point estimates is very high. This uncertainty comes from various sources, including uncertainty about fish carrying capacity, growth rates, natural annual and spatial variation in fish abundance arising from both inside and outside the Yakima basin, as well as variance related to the marginal valuation of fish. It is worth noting however that all else equal, the variance of aggregate value will tend to be lower than the sum of the variance of fish abundance and their marginal value because they are negatively correlated (marginal value declines as fish abundance increases). Nonetheless, neither the Four Accounts estimates nor our revised estimates are *statistical*

[44] These calculations maintain the assumption that fish increases are achieved by 2042, as well as all other aspects of the Four Accounts valuation approach except that no household benefits accrue in 2012-2016. The differences observed are due to two effects: first, the elimination of four years of household payments in 2012-2016 that are not heavily discounted, and second, the assumption of linear fish population growth pushes more of the fish increase into the 2032 period, making the percentage increase in the first period smaller and therefore household WTP in all years in the period 2012-2031 smaller.

point estimates. The point estimates are based on simulation methods and summary data from various sources. We cannot therefore claim that there is any statistically-significant difference between the $1-$2 billion range and the range reported in the Four Accounts analysis. We do conclude, however, that this lower range is far more likely.

Given this revised range of total fish benefit numbers, the total contribution of sockeye, non-sockeye, fish passage, and non-fish passage are estimated and provided in Table 27 absent any assumptions that species-specific population growth rates are intrinsically different, and rounding revised aggregate low and high benefit estimates to $1 and $2 billion.[45] This table is the direct analogue of Table 25, except with the new aggregate fish numbers. Together, the estimate of aggregate fish passage benefits in these two tables can be used to the contribution of each fish passage project to the total.

Table 27: Estimated contribution of sockeye, non-sockeye, fish passage, and non-fish-passage to fish benefits given revised aggregate estimates. Percentages are taken from Table 25.

	Percentage of fish		$ millions	
	low	high	low	high
Sockeye	93.6	80.4	936	1,609
Non-sockeye	6.4	19.6	64	391
Fish passage	95.2	85.3	952	1,706
Non-passage	4.8	14.7	48	294
total	100	100	1,000	2,000

3. Fish passage

Table 28 uses the estimated total fish benefit along with relative contributions of each reservoir to adult survival and cost estimates of passage projects to develop benefit-cost estimates. Tables 2-4 and 2-5 in the Fish Benefits Technical Memorandum (U.S. Bureau of Reclamation, HDR Engineering Inc., and Anchor QEA 2011) provide high and low abundance impacts by reservoir for which fish passage is being proposed, used here to provide estimates of the relative contribution of each reservoir to sockeye recovery were passage implemented. The cost estimates are reported and described in Table 7 in Section III.E. The revised benefit estimate totals of $952 and $1,706 are taken from the fish-passage row of Table 27, and the individual reservoir contributions are then calculated as a fraction of these numbers according to their percent contribution to total abundance.

Table 28 shows that based on the revised fish value estimates, all fish passage projects satisfy the B-C criterion, with B/C ratios ranging from 1.43 to 11.68. The average B/C ratio for the low-end

[45] This is probably not a realistic assumption. Given that sockeye populations are very low relative to the predicted growth in them, it might be reasonable to think that growth rates would be higher for sockeye, especially during initial and intermediate establishment. Given that this is the case, the economic implications of the results will not change.

aggregate fish value estimate is 2.74, and 4.91 for the high estimate. As a group of projects, these are the strongest results presented in this report.[46]

The numbers for Bumping lake assume the Bumping lake expansion. Without it, the lake is 17% the size listed (33,700 af rather than 198,000 af (HDR Engineering, Inc 2011). It would therefore provide about 17% benefits, or $29 to $52 million. Assuming the same cost structure, it would provide B/C estimates ranging from 1.11 to 1.98, which at the low end just barely satisfies to B-C criterion.

Table 28: Contribution of reservoirs to fish passage benefits.

Reservoir	Contribution to total Abundance %		Cost[2] $mill.	Four Accounts Benefits $millions		revised benefit estimates $millions		B/C ratios for revised estimates	
	low	high		low	high	low	high	low	high
Keechelus	12	16	79.9	571	1,010	114	205	1.43	2.56
Kachess	29	31	79.9	1,380	1,957	276	495	3.46	6.19
Cle Elum	27	23	81.5	1,285	1,452	257	461	3.15	5.65
Tieton[3]	13	17	79.9	619	1,073	124	222	1.55	2.78
Bumping[4]	18	14	26.3	857	884	171	307	6.52	11.68
Total	100	100	347.5	4,759	6,314	952	1,706	2.74	4.91

[1]Adapted from Tables 2-4 and 2-5 in U.S. Bureau of Reclamation, HDR Engineering Inc., and Anchor QEA (U.S. Bureau of Reclamation, HDR Engineering Inc., and Anchor QEA 2011).
[2] Costs taken from Table 8 in Section III.E.
[3]If Clear Lake fish passage provides the same benefits per acre as Tieton, the B/C ratio would range from 26 to 52 given estimated costs of $4.1 million.
[4]These numbers assume the Bumping lake expansion and Cle Elum pool raise. Without it, Bumping Lake would provide B/C estimates ranging from 1.11 to 1.98 assuming the same costs. The effect of the Cle Elum pool raise would be very small because it adds only 3% of the volume and negligible additional habitat.

Another perspective on this result is to consider the minimum number of fish the passage projects must contribute to break even. This minimum contribution of fish passage to the IP is conditional on IP habitat restoration and instream flows being implemented. Table 25 shows that based on the Four Accounts distribution of fish benefits across fish passage and non-passage projects, non-passage projects contribute a low estimate of 8,738 fish and a high estimate of 69,338 fish. If non-passage projects were not implemented or provided no fish, the marginal value of each fish contributed by fish passage would be higher than if non-passage were productive. In particular, if the non-passage projects were not implemented and therefore provided no additional fish, then fish passage projects as a whole would need to contribute a minimum of 62,000 fish in the steady-state to cover their aggregate costs of about $350 million. If non-passage projects were implemented and provided the low estimate of 8,738 fish, the fish passage projects together would have to contribute

[46] Though not shown in the table, the B/C ratios for the Four Accounts estimates range from 7 to 33.

72,500 fish in steady state to cover their costs.[47] If the non-passage projects provided the high-end fish increases, the fish passage projects together would have to contribute 144,500 fish to cover their own costs. Even this largest number is lower than the estimated low and high estimated contributions shown in Table 25 of 172,913 and 403,113 fish, respectively, and so fish passage projects would on average pass the B-C test based on these estimates.

4. *Habitat restoration and instream flows*

The recruitment benefits to non-sockeye species focused on in the previous studies (chinook, steelhead, coho) comes primarily from habitat restoration and instream flow augmentation. The impact and net economic contribution of habitat restoration and instream flows for fish abundance in the Yakima Basin is less clear than that from fish passage. Not only are the EDT estimates questionable as per the discussion in the Appendix (VII.E), restoration and instream flow impacts are assessed together in the existing reports using EDT, and it is difficult to identify the relative contribution of flows versus other restoration. We therefore consider restoration and instream flows together first. Given the dearth of information to separate out the impact of instream flows from those of habitat restoration, we can provide very little useful information about these two categories separately.

Further, the analysis in the Fish Benefits Technical Memorandum (U.S. Bureau of Reclamation, HDR Engineering Inc., and Anchor QEA 2011) assumes that IP restoration is always implemented if fish passage projects are implemented (that is to say, fish passage is implemented conditional on restoration in every case). This assumption masks the potential contribution of restoration to fish passage productivity. We will examine the implications of this for interpreting restoration benefits as well.

a. *Net benefits of instream flows and restoration combined*

Table 25 shows that the Four Accounts implies that habitat restoration provides $241 to $1,086 million in benefits from non-passage restoration and instream flow benefit estimates in the Four Accounts analysis.[48] Our revised estimates shown in Table 27 suggest that non-passage projects would provide benefits ranging from $48 to $294 million.

Mainstem restoration costs are estimated to be $338 million, spread over about 18 years. Even if instream flows provide no fish benefits whatsoever, these restoration expenditures exceed the maximum non-passage benefits of $294 million inferred from the Four Accounts analysis and supporting documentation, and so would not appear to satisfy a B-C criterion based on our revised aggregate fish benefits estimates.

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47 New estimates for the Keechelus Reach would add about 750 and 1,500 steelhead and spring chinook, respectively (J. Hubble 2014). If these numbers are added to the low and high end non-passage estimates, fish passage would have to contribute 73,500 and 146,400 fish to break even. These are slightly higher than without these higher non-passage contributions, but it does not change any qualitative implications.

48 Again, new estimates for the Keechelus Reach would add about 750 and 1,500 steelhead and spring chinook, respectively (J. Hubble 2014). This will not substantively change our conclusions, so we retain the original numbers.

As discussed in Section IV.D.2, the estimated costs of providing proposed IP instream flows based on IP water storage projects range between about $2,200 and $2,800 million (Table 19 on page85), which is much higher than the estimated benefits of all non-passage restoration combined, even those implied by the Four Accounts analysis. However, if feasible, purchasing IP instream flows at their agricultural opportunity cost would cost around $100 to $150 million under moderate climate and market conditions. As reported in Table 7 in Section III.E, the tributary/mainstem fish habitat enhancement costs are estimated at $338 million. Adding instream flow purchase costs to the restoration costs provides total IP instream flow and restoration costs around $450 million. This is higher than the estimated benefits of IP instream flows and restoration ranging from $48 to $294 million.

b. *Conditional benefits of restoration and flows*

There are two ways in which fish passage and non-passage benefits interact. First, like water from storage, diminishing returns to fish according to the LBP valuation function means that greater fish abundance lowers the value of each additional fish. Second, there may be multiple technical complementarities in the production of fish passage and non-passage projects, which is to say that the technical effectiveness of fish passage may be dependent on whether or not restoration and/or proposed instream flows implemented, and vice-versa.

Unfortunately, these inter-relationships are difficult to assess given the existing information. The analysis in the Fish Benefits Technical Memorandum (U.S. Bureau of Reclamation, HDR Engineering Inc., and Anchor QEA 2011) assumes that IP restoration is always implemented if fish passage projects are implemented. This assumption masks the potential contribution of restoration to fish passage productivity.

Consider the implications of diminishing marginal returns first, and assume temporarily that there are no technical complementarities between fish passage and non-passage projects. Using the LBP valuation function and the conditions assumed for our revised estimates of aggregate benefits, we can show that if only non-passage projects were implemented, simulated fish increases range between 8,738 and 69,338. As shown in Table 25, the value of these benefits would range from $65 to $387 million, which is higher than the comparable values of $48 and $249 million with fish passage implemented. Again, this higher value of non-passage projects without fish is due to diminishing marginal value of fish for the same basic reason that water storage projects provide more benefits when implemented alone than as part of the IP as a whole. Nonetheless, the upper bound of $387 million still does not cover the estimated non-passage costs of about $450 million.

Now consider the possibility of technical complementarities between fish passage and non-passage. In the Four Accounts analysis, the sockeye population modeling comprised two basic components: lake area for spawning, and assumed survival rates. In the model, these survival rates are not explicitly dependent on whether or not habitat restoration was implemented, in part because it is assumed to occur if fish passage is implemented. Nonetheless, the effectiveness of fish passage may be dependent on whether restoration and IP instream flows are implemented. To the extent this is true, the difference between the productivity (and associated value) of fish passage with versus without restoration and instream flows can be credited as restoration benefits assuming fish passage is implemented. This may be the case for the Cle Elum fish passage project, which may function better and provide greater mobility for fish if Cle Elum reservoir and associated instream flows are managed with this in mind. Unfortunately, the existing analyses underlying the Four Accounts analysis and the FPEIS do not allow us to estimate the marginal contribution of restoration and instream flows to fish passage benefits.[49] As such, we can provide no additional quantitative analysis. However, we have found that if there are complementarities between restoration/instream flows and fish passage and fish passage is implemented, then the estimated benefits of $48 and $249 from restoration and instream flows are biased downward and instream flows and restoration may be cost effective.

c. *Contribution of instream flows versus other restoration activities*

As mentioned at the beginning of this section, the models used to estimate the impact of habitat restoration (EDT) and fish passage (Spawner per Hectare method) on fish abundance does not allow us to distinguish between the contributions of instream flows and other habitat restoration. As such, we cannot say much about the individual benefits of instream flows and other restoration activities. We can only discuss the net benefits of them together.

5. Summary of fish impacts and value

The analysis in this section suggests that the aggregate fish benefits from the IP are likely to be around $1 to $2 billion, which is lower than the four Accounts estimate range of $5 to $7.4 billion. The difference between these estimates stems solely from a difference in the assumed growth rate of salmonid populations and the assumed baseline salmonid fish populations in the Columbia River system, the choice of which we motivate with existing evidence and previous studies. There are other concerns that suggest that both the abundance measures and valuation metrics my still be biased upward, but data do not exist to test the sensitivity of results to these concerns.

Our results show that fish passage projects all satisfy a B-C criterion, with B/C ratio point estimates ranging from 1.3 to 11.68. Habitat restoration and instream flows combined are estimated to provide an high-end estimate of $249 million (with fish passage implemented) do not provide benefits that cover their costs of about $450 million (assuming instream flow purchases), but the benefits may be an underestimate if, in the aggregate, IP instream flow augmentation and habitat restoration are technical complements.

Finally, we cannot dissect the relative contribution of proposed IP instream flows and habitat restoration to their overall benefits. What is clearer is that instream flow benefits cannot (based on

[49] The technical, (physical) contribution of restoration to fish passage would be the difference in fish abundance with versus without restoration/flows, *conditional on fish passage being implemented.* This is the metric that we cannot estimate, and without this metric we cannot estimate the economic value of it. However, if there are net technical complementarities between these, its value would be positive in the sense that fish passage would be more effective with habitat/flow augmentation than without.

our estimates) be large enough to justify the shortfall in IP water storage benefits net of out-of-stream benefits.

F. Other considerations for IP project net benefit estimation

Other potentially important aspects of the valuation approach include impacts associated with reservoir expansion, reservoir drawdown, additional storage, and changes in instream flows.

1. Reservoir creation and expansion, pool raises and drawdowns

Completion of the IP's water storage and operational components would affect water levels at all reservoirs in the Yakima Basin. Natural resource economists have found that water level changes influence lakeshore property and other recreational values (Cordell and Bergstrom 1993; Lansford and Jones 1995). Some have also associated changes in reservoir levels with minor changes in the regional economy(Allen et al. 2010). Dickes et al. (2011) summarize the main findings from this literature:

"A common finding among these studies is that proximity to the water source and the size of lake (water) frontage increase property values. Lansford and Jones (1995) confirm that scenic view, waterfront location and water level are all statistically significant contributors to enhanced property values. While proximity to the lake makes the most substantial impact on housing prices, consumers do appear to exhibit a positive preference for higher water levels as capitalized in the value of homes" (Dickes et al. 2011, 2).

Lansford and Jones (1995) estimate recreational and aesthetic benefits to lakeshore property of $652 for a one-foot increase in long-term water level changes in North Texas. Eiswerth et al. (2000) estimate that a one-foot increase in water levels produce an additional $12-$18 in annual, per-person use values for fishermen on Lake Walker, Nevada. Studying near shore property sales at California's Lake Almanor from 1987 – 2001, Loomis and Feldman (2003) find that an additional foot of exposed shoreline decreases home sales price by $108 - $119. These effects are critically important in the baseline conditions however, so should be interpreted carefully. In many cases insufficient information limits the ability of researchers to accurately estimate the relationship between water-based recreation and lake level changes (Ward, Roach, and Henderson 1996). For this reason it is difficult to determine the aggregate effect of water level changes at individual reservoirs with the costs and benefits of the Integrated Plan.

2. Recreation and amenity values

This report focuses on the fish benefits of instream flows, but the uncertainty surrounding the productivity of instream flows for anadromous fish in the basin contribute to the uncertainty about the economic value of instream flows. Numerous studies have estimated the value of water for instream flows, but their results vary substantially depending on the uses of instream flows (e.g. whitewater boating, fishing, fish productivity more generally) (Johnson and Adams 1988; Duffield, Neher, and Brown 1992; Ward 1987; J. B. Loomis 1998; Grantham et al. 2014). Johnson and Adams (1988) examine the value of instream flows explicitly for steelhead benefits on the John-Day river, and find that the value of additional instream flows averages about $5/af in 2014 dollars ($2.40 in

1987) for recreational steelhead fishing value alone, though the value of consumptive use of instream flows can be ten times this amount, suggesting that the marginal value of instream flow consumptive use value can exceed $50/af when accounting for benefits to other valuable fish species as well. Ward (1987) finds recreation values from fishing and boating to range up to $2,300/af (in 2014 dollars). Again, context matters significantly for these estimates. The Four Accounts analysis of fish value in principle includes fish values associated with all uses, it does not directly account for additional recreation benefits that might accrue from other recreational activities. We do not consider these further.

3. Flood control

Flood control is one of the primary goals of the Yakima River Project (U.S. Bureau of Reclamation 2002). Additional storage is likely to provide additional flexibility for reservoir management when balancing irrigation, summer instream flow, and spring flood risk (HDR Engineering Inc. et al. 2011). However, we are not aware of any existing research that provides an assessment of the potential flood risk mitigation that the additional storage might provide, or any estimates of the benefits thereof. While engineering flood risk assessment would be a necessary component of an economic assessment of flood control benefits, performing an engineering assessment of the impacts of flood control capacity is beyond the scope of this project. We therefore do not consider it further.

Where applicable, we discuss additional potential impacts that we do not quantify for specific projects in their individual summaries in Section IV.G. Other existing studies, including the Four Accounts analysis (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012) as well as the FPEIS (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012) discuss additional non-quantified impacts to some degree for additional background.

G. Project and scenario results summary and discussion

This section summarizes the results for the individual IP projects. The summaries draw from the sections above, and add additional context and assessment where applicable. Water storage and conservation projects are summarized first, followed by operations and fish passage.

1. Water storage and conservation projects

Water storage and conservation projects primarily provide out-of-stream benefits, as well as instream flow benefits to fish. Because there are diminishing marginal returns to additional storage, the benefits from a project differ depending on whether they are implemented alone, or along with other water storage projects. Further, when more than one water storage project is implemented, we allocate municipal benefits according to relative contribution to storage. Although there is a great deal of uncertainty about the benefits of instream flows, what we have shown is that (a) the value of instream flows for the IP as a whole cannot be high enough for the IP storage projects to satisfy an B-C criterion, and (b) the cost of purchasing instream flows outright, if feasible, would likely be substantially lower than providing them by infrastructure development. Because of these two issues we do not include instream flow benefits in the numbers below. Benefits and costs, as described in Section III.E, have been discounted to represent a base year of the beginning of construction, assuming that benefits begin accruing at the end of construction.

a. *Proposed IP Instream flows and their implications for water storage projects*

As discussed in Section IV.E.4, our revised estimates of total non-passage restoration benefits conditional on implementation of fish passage projects range from $48 to $294 million. Only a portion of these benefits are presumably due to instream flows; the rest attributable to proposed tributary/mainstem fish habitat enhancement investments of about $340 million in present value. Given the methods used to estimate these values as discussed in Section IV.E, it is difficult to assess the relative contribution of instream flows versus habitat enhancement. Nonetheless, instream flows cannot provide the $2 to $2.5 billion in benefits to justify the full suite of water projects as shown in Table 19 on page 85. This also implies that individual projects cannot each provide instream flow benefits to cover their costs.

To make this point, the IP FPEIS states that half of Wymer's 162,500 ac-foot of new storage is to be allocated to IP instream flows: "On average 82,500 af of the storage capacity would be used annually to improve instream flows upstream and downstream of the reservoir." (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012)[50] Even if Wymer were credited with 100% of IP instream flow benefits it would not cover the net shortfall of Wymer implemented with the Full IP, because even under the most adverse climate and restrictive market conditions Wymer provides net out of stream benefits of -$567 (net benefits are more negative under more moderate climate and market assumptions (See Table 20). Nonetheless, if Wymer were credited with all IP instream flow benefits, then none could be credited to the other storage projects. The conclusion for Bumping lake is qualitatively the same as that for Wymer.

In contrast, the Cle Elum pool raise results in net out-of-stream benefits far more favorable than Wymer, ranging from $-3 million to -$7 million in net out-of-stream benefits (Table 20). It is conceivable, and perhaps likely, that under intermediate climate and markets conditions if Cle Elum were credited with as little as 25% of the low estimate and 4% of the high range of IP instream flow benefits (again, ranging $48 to $294 million *assuming no restoration benefits*), instream flows could justify the Cle Elum pool raise. KDRPP+KKC is intermediate case (net out-of-stream benefits ranging around -$136 to -$305 million), which would require it to be credited with higher proportions of IP instream flow benefits. Passive ASR is similar in this regard.

There are three important caveats to these quantitative conclusions about instream flow benefits attribution. First instream flow benefits would be lower than $48 to $294 million to the extent that habitat restoration (at a cost of $340 million) provides part of these benefits. Offsetting this, however, is the recognition that available data do not support estimates of the contribution of instream flows to the estimated fish passage benefits. As such, these combined flow/habitat

50 In addition, the YAKRW operating rules state that the scenarios considered by HDR Engineering Inc, implement IP instream flows only if Wymer is implemented (HDR Engineering, Inc. 2014).

estimates would be downward biased. But finally, our results (Section IV.D) suggest that the opportunity cost of providing IP instream flows are likely to be substantially lower than the cost of satisfying IP instream flows by building infrastructure, and suggests that it is more economically to provide IP instream flows by purchasing senior water rights than by building storage under the conditions considered if water market infrastructure is in place to do so.

b. *Habitat Restoration*

As noted above, we cannot separate the economic contributions of IP instream flow augmentation and other habitat restoration activities. However, the estimated cost of these restoration programs is $340 million, and the estimated benefits as just described range from $48 to $294 million. Based on these numbers, if (contrary to the discussion in the last section habitat restoration provided all of these benefits, it would provide B/C ratios ranging from 0.14 to 0.86, and so would not be justifiable based on these B/C ratios alone. To the extent that proposed IP instream flows provide some of these benefits, the B/C ratios would be lower. That said, habitat restoration may be a technical complement to fish passage (as instream flows might), because habitat restoration may improve the effectiveness of fish passage. As such, some fish passage benefits may be attributable to habitat restoration at the margin. However, we have no basis for assessing whether or to what extent this is the case.

The following subsection provides a summary of outcomes for each storage and conservation project. Note that the "With IP" numbers in these columns correspond to the marginal contribution of the project conditional on the rest being implemented, including IP instream flows. As such, the net benefits, when negative, can be interpreted to represent the shortfall that instream flows must cover for the project to satisfy a B-C criterion. The "Alone" results are the benefits assuming no other IP storage projects, and no IP instream flows. In these cases, the net benefit and B/C ratios are final in the sense that instream flow benefits are irrelevant because IP instream flows are not implemented.

c. *KKC and KDRPP*

KKC and KDRPP are considered together because of their close connection geographically and because in principle, KKC facilitates the use of KDRPP by allowing Lake Kachess to refill faster whether or not KDRPP is actually implemented. Results are shown in Table 29. An interesting pattern of effects is shown by KKC. Under moderate climate (CGCM), KKC provides very little benefits as part of the full IP. Implemented alone, it provides higher benefits, but still, its benefit-cost ratio ranges under 0.25. With adverse climate (HADGEM), KKC provides higher benefits as expected, but in this case, it is more effective with the full IP than without, perhaps because the high and more regular curtailment rates limit the degree to which it allows improved water allocation from Keechelus to Kachess (which is its sole function). KKC provides no additional reservoir capacity, so we credit municipal benefits to KDRPP. Benefit/Cost ratios range from zero to 0.66 under the most adverse climate and restrictive water market scenarios.

Table 29: KKC and KDRPP out of stream net benefits.

run	cost	No trade PB[1]	NB[2]	BC[3]	Intra-district trade PB	NB	BC	Full trade PB	NB	BC
						KKC				
With IP, CGCM	138	1	-137	0.01	0	-138	0.00	1	-137	0.01
Alone, CGCM	138	33	-105	0.24	28	-110	0.20	27	-112	0.19
With IP, HADGEM	138	91	-47	0.66	64	-74	0.47	35	-103	0.25
Alone, HADGEM	138	73	-66	0.53	48	-90	0.35	38	-100	0.28
						KDRPP				
With IP, CGCM	196	62	-134	0.32	38	-158	0.19	26	-170	0.13
Alone, CGCM	196	138	-58	0.70	89	-107	0.46	64	-132	0.33
With IP, HADGEM	196	177	-19	0.90	135	-61	0.69	80	-116	0.41
Alone, HADGEM	196	250	54	1.27	179	-17	0.91	118	-78	0.60
						KDRPP+KCC				
With IP, CGCM	334	59	-275	0.18	36	-298	0.11	25	-309	0.08
Alone, CGCM	334	157	-177	0.47	98	-236	0.29	71	-263	0.21
With IP, HADGEM	334	189	-145	0.57	146	-188	0.44	85	-249	0.25
Alone, HADGEM	334	511	177	1.53	340	6	1.02	211	-123	0.63

[1]PB=present value of benefits; [2]NB=Net benefit for out-of-stream uses, [3]BC=Benefit cost ratio for out-of-stream uses.

Results for KDRPP alone and as part of the Full IP follow typical patterns. It provides highest benefits and a B/C ratio of 1.27 when implemented alone, assuming no trade and the most adverse climate. B/C ratios for all other scenarios are less than 1, and as low as 0.10.

KKC+KDRPP provide the highest benefit cost ratio of the three scenarios at 1.53 under the most adverse climate and market restrictions. For intermediate climate and market conditions, it's B/C ratio is 0.29 if implemented alone (that is nothing else implemented but KKC+KDRPP, and 0.19 if implemented as part of the full IP.

There is at least one additional consideration for these projects. The KDRPP may lead to significant drawdowns in severe drought years. Recreation may be negatively impacted during these drawdowns, and if drawdowns occur with sufficient frequency and magnitude, decreases in near shore property values may result, the magnitude of which will depend on the frequency of use and extent of drawdowns. Even if a drought year drawdown is offset through refill in the following year, drought-year drawdowns impose recreational costs. In a 2006 – 2007 survey of Kachess Reservoir recreationists, 20% of respondents expressed satisfaction with May-June water levels but dissatisfaction with those in August-September. Thirty-five percent of respondents agree that higher water levels make boat launching easier, boating safer, scenery more enjoyable, and activities like kayaking, fishing, swimming and water-skiing better. Finally, 30% of respondents said low water levels had the opposite effect (Aukerman, Haas & Associates LLC 2008).

These additional potential property value and recreational costs would be highest if the KDRPP were to be implemented alone, because KKC would not provide additional water to Kachess, and because in the absence of other storage projects, KDRPP would be utilized the most. Thus, recreational and property value impacts would be the highest when the value KDRPP as a drought relief mechanism is at its highest, suggesting that the highest B/C ratios for KDRPP should lower than those in Table 29 especially if implemented alone and the curtailment distribution becomes more severe due to climate change.

d. *Bumping Lake Expansion*

Bumping Lake Expansion net benefits for out-of-stream uses are all negative except under the most adverse climate and trade conditions. B/C ratios range from 0.4 with the full IP implemented, full trade and a less adverse climate; to a high of 1.03 in the most adverse climate with no trade and implemented alone, though with only two values of 0.5 or above.

Table 30: Bumping Lake enlargement, out of stream net benefits.

		No trade			Intra-district trade			Full trade		
	cost	PB[1]	NB[2]	BC[3]	PB	NB	BC	PB	NB	BC
With IP, CGCM	452	64	-389	0.14	34	-418	0.08	24	-428	0.05
Alone, CGCM	452	129	-323	0.29	81	-371	0.18	60	-392	0.13
With IP, HADGEM	452	466	14	1.03	293	-159	0.65	184	-268	0.41
Alone, HADGEM	452	162	-290	0.36	104	-348	0.23	63	-390	0.14

[1]PB=present value of benefits; [2]NB=Net benefit for out-of stream uses, [3]BC=Benefit cost ratio for out of stream uses.

Like KDRPP, there are additional considerations for Bumping Lake Expansion, though different in their characteristics. The Bumping Reservoir expansion would flood a public campground and boat launch. It would also flood roads, hiking trails and a summer cabin and resort on land managed by the U.S. Forest Service (HDR Engineering, Inc 2011). One economic estimate of the value of these impacts is the costs required to relocate or replace these structures, neglecting changes in the quality of recreational amenities. Replacement costs are included as a subset of the cost estimates for the Bumping Reservoir Enlargement. (HDR Engineering Inc. and Anchor QEA 2011). Of the $3.5 million in Bumping project relocation costs, the IP identifies $1.2 million to relocate recreational facilities and $0.3 million for cabin siting and access road surveys (HDR Engineering, Inc. 2012, Appendix J). While not unimportant, these costs are small in proportion to total costs of the Bumping expansion.

There is also the potential for additional impacts with regard to the local environmental amenities given its location. A previous study of a plan for Bumping Lake enlargement provides detail on the potential impacts (United States Bureau of Reclamation 1979). There are several stated preference studies and "travel cost" studies that have estimated willingness-to-pay to protect old-growth forest, most commonly in the context of spotted owl habitat. The most relevant study surveyed households in California and New England on willingness-to-pay to protect old-growth spotted owl habitat from fire (J. Loomis and Gonzalez - Caban 1998). The authors estimated that median annual willingness-to-pay to protect 1000 acres (roughly the same amount flooded by Bumping Reservoir) is $20.12 (p. 321); converted to 2012 dollars, multiplied by the same number of WA households as used in the Four Accounts in 2012 and using the same 4% real discount rate and 100-yr timeframe produces an estimate of damages from lost old-growth forest of $1.85 billion. If this value were included as a cost of Bumping Lake expansion, which it arguably could be, it would provide B/C ratios ranging from 0.05 to 0.02.

e. *Wymer Dam and Reservoir*

An economic analysis of Wymer was conducted in 2008 (U.S. Bureau of Reclamation 2008b). The analysis estimated total benefits of $411.5 million ($439 inflated to 2012), which included $280 million in municipal benefits ($299 million in 2012 dollars), $26.5 million in agricultural benefits ($28.3 in 2012 dollars, and recreation benefits of $103.9 million ($110.8 in 2012 dollars). With estimated costs of $1,148 million ($1,225 in 2012 dollars), they report a "most probable" benefit/cost ratio of 0.36. The biggest difference between our results and these relate to the estimated municipal benefits, which we argue are overestimated by a factor of approximately 10 based on similar arguments provided in Section IV.C, though there were some differences that we would also argue unjustifiably inflate the estimate. In particular, in contrast to the Four Accounts analysis, this study did not adjust predicted costs of water for growth to account for the lower consumptive use of municipalities relative to agriculture. It is also noteworthy that our estimates of agricultural benefits are higher than in this previous study even in the most conservative scenarios the lowest of which is $68.6 million when implemented alone (Table 15, for agriculture only), instead of their $28.3 million (2012 dollars)).

Estimated out-of-stream uses for Wymer Dam are provided in Table 31. Our analysis suggests that for the intermediate market and climate scenario, the out-of-stream benefits fall short by about $1.3 billion if Wymer were to be implemented as part of the full IP.

Table 31: Wymer Dam and Reservoir out of stream net benefits.

		No trade			Intra-district trade			Full trade		
	cost	PB[1]	NB[2]	BC[3]	PB	NB	BC	PB	NB	BC
With IP, CGCM	1,331	81	-1,251	0.06	46	-1,286	0.03	31	-1,300	0.02
Alone, CGCM	1,331	189	-1,142	0.14	115	-1,217	0.09	82	-1,250	0.06
With IP, HADGEM	1,331	287	-1,045	0.22	225	-1,106	0.17	120	-1,211	0.09
Alone, HADGEM	1,331	764	-567	0.57	524	-808	0.39	311	-1,020	0.23

[1]PB=present value of benefits; [2]NB=Net benefit for out-of-stream uses, [3]BC=Benefit cost ratio for out-of-stream uses.

The scope of our mandate does not include estimation of recreation benefits. However, if the recreation benefits of $110.8 million for Wymer reported in U.S. Bureau of Reclamation (2008b) were taken as given and added to the benefits in Table 31, it would increase the net benefits and B/C ratios (see Table 32 for these results). For example, the B/C ratio for moderate trade and climate with Wymer implemented alone is 0.23 instead of 0.09 without accounting for recreation. Even with recreation benefits added, all B/C ratios are less than 1 and therefore do not satisfy the B-C criterion.

Table 32: Wymer net benefits and B/C ratios including estimated recreation benefits.

	No trade		Intra-district trade		Full trade	
	NB1	BC2	NB	BC	NB	BC
With IP, CGCM	-1,140	0.14	-1,175	0.12	-1,190	0.11
Alone, CGCM	-1,031	0.23	-1,106	0.17	-1,139	0.14
Alone, HADGEM	-456	0.66	-995	0.25	-1,100	0.17

[1]NB=Net benefit for out-of-stream uses, [2]BC=Benefit cost ratio for out-of-stream uses.

One further point should be made in regard to instream flow benefits. As noted above, the IP FPEIS states that half of Wymer's 162,500 af of new storage is to be allocated to IP instream flows (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012). Table 33 shows that Wymer provides positive total benefits under each trading regime when implemented alone, though net benefits are negative. When IP instream flows are implemented, it imposes costs to out-of-stream uses ranging from $244 to $75 million. When both Wymer and IP instream flows are implemented, the costs of the instream flows to out-of-stream uses outweighs the benefits of Wymer, leading to negative net out-of-stream benefits ranging from $111 to $25 million. As discussed in Section IV.E. even if all of the upper bound $1.05 billion in instream flow and restoration benefits implied by the Four Accounts analysis were credited as instream flows provided by Wymer (an untenable proposition), Wymer would still not break even, and we estimate the upper bound of restoration and instream flows together to be much lower, at $48 to $294 (see Section IV.E.4.a).

Table 33: Wymer and Instream flows. Historical climate regime.

run	cost	Total out-of-stream benefits			Net out-of-stream benefits		
		No Trade	Intra-district trade	Full Trade	No Trade	Intra-district trade	Full Trade
Wymer Only	1,331	158	97	71	-1,173	-1,234	-1,261
IP Instream flows only	--	-244	-135	-75	--	--	--
Wymer and IP Instream flows	1,331	-111	-55	-25	-1,442	-1,386	-1,356

f. *Cle Elum Pool Raise*

Cle Elum Pool raise is the least expensive project other than the Ahtanum (City of Yakima) ASR, and while its storage contribution is also relatively small (adding 14,600 af for a total storage capacity of 451,500 af, or roughly 3.3% of current storage capacity), it provides the highest set of B/C ratios of the water storage project. Under moderate climate outcomes, intermediate trade, and implemented alone, it provides a B/C ratio of 0.62. Implemented with the IP under these conditions it provides a B/C of 0.26. This is due to its limited contribution to total storage applicable to both agricultural diversions and municipal benefits.

However, under the most adverse climate scenario we consider it provides positive B/C ratios for out-of-stream use of any project when implemented alone. For the market conditions considered, ranging from 2.38 to 1.02. In contrast, when implemented as part of the full IP, it has very low B/C ratios, ranging from 0.06 to zero. This is likely because the its contribution is not large enough to cover the reduced diversions that follow from the IP instream flows that are implemented under the IP and are large under the HADGEM climate scenario (see Table 23).

Table 34: Cle Elum Pool raise out of stream net benefits.

		No trade			Intra-district trade			Full trade		
	cost	PB[1]	NB[2]	BC[3]	PB	NB	BC	PB	NB	BC
With IP, CGCM	16	8	-7	0.53	4	-12	0.26	3	-13	0.19
Alone, CGCM	16	13	-3	0.80	10	-6	0.62	9	-7	0.58
With IP, HADGEM	16	1	-15	0.06	0	-16	0.00	0	-16	0.00
Alone, HADGEM	16	37	22	2.38	21	5	1.35	16	0	1.02

[1]PB=present value of benefits; [2]NB=Net benefit for out-of stream uses, [3]BC=Benefit cost ratio for out of stream uses.

The draft environmental impact statement for Cle Elum pool raise considers several alternatives. One of these alternatives allows water use to be optimized for instream flows and reservoir water levels thereby optimizing for fish production and passage, or contributing also to water available for irrigation, though this latter alternative would require additional congressional authorization (U.S. Bureau of Reclamation and State of Washington Department of Ecology 2014). Thus, under current rules, the water would all be made available for instream flows. In any case, while the B/C ratio is only 0.26 based on out-of-stream benefits alone, the shortfall in net benefits is relatively small, and its contributions to instream-flow benefits (which contribute to our estimated benefits of $48 to $294 million for instream flows and restoration combined).

There is some concern that without the IP instream flow augmentation particularly for the Cle Elum River, and/or the Cle Elum pool raise itself, fish passage at Cle Elum would be less effective than otherwise, and that the Cle Elum pool raise is therefore important for the effectiveness of fish passage. While IP instream flow augmentation for the Cle Elum River is part of the proposed IP Instream Flows (HDR Engineering, Inc. 2014), and reservoir level management may affect fish passage effectiveness, this does not imply that the Cle Elum pool raise is necessary to operationally implement IP instream flows or maintain reservoir levels to facilitate passage. Although we argue that purchasing instream flows would likely be less costly than providing them on the basis of IP infrastructure, the potential contributions of the Cle Elum Pool raise to provide these benefits along with its relatively low cost make it the most likely project for satisfying a B-C criterion of any IP storage project.

The Cle Elum Pool Raise will permanently raise maximum water levels by three feet, and marginal water level increases have been shown to produce economic impacts including benefits in other studies. Lansford and Jones (1995) and Eiswerth et al. (2000) find that increased pool height may have a positive effects on property and recreation values, but these effects are likely to be context specific. It is not clear that property or recreational benefits would accrue beyond the costs incurred to landowners that are compensated for in the cost estimates for this project.

g. *Passive Aquifer Storage and Recovery (ASR) at Thorpe and WIP*

Passive aquifer storage and recovery, also called groundwater infiltration, would be applied to spreading areas like ponds and canals, each of which would be roughly 2-10 acres in size (2011). This infiltrated water would reduce the volume of water required from reservoir releases, supplementing the total water supply available (TWSA) and base flows in the Yakima River during low-water seasons (U.S. Bureau of Reclamation, Washington State Department of Ecology, and Prepared by Golder Associates, Inc and HDR Engineering, Inc 2011). Between 160 and 500 acres of infiltration area would be required to store 100,000 af (Golder Associates and Washington State Department of Ecology 2009), the mean annual volume that could be made available for other uses (Reclamation and Ecology 2011n).

Table 35: Passive ASR; out of stream net benefits.

		No trade			Intra-district trade			Full trade		
	cost	PB[1]	NB[2]	BC[3]	PB	NB	BC	PB	NB	BC
With IP, CGCM	126	29	-97	0.23	16	-110	0.13	13	-114	0.1
Alone, CGCM	126	64	-62	0.51	45	-82	0.35	37	-90	0.29
With IP, HADGEM	126	114	-12	0.91	108	-19	0.85	49	-77	0.39
Alone, HADGEM	126	176	49	1.39	112	-14	0.89	79	-47	0.63

[1]PB=present value of benefits; [2]NB=Net benefit for out-of stream uses, [3]BC=Benefit cost ratio for out of stream uses.

The results show negative net benefits under all but the most adverse climate and market conditions. Benefit cost ratios are below 0.5 in all but the HADGEM climate regime.

2. *Conservation*

The IP includes categories for both agricultural conservation and municipal conservation. We consider each in turn.

a. *Agricultural conservation*

Agricultural water conservation measures include lining or piping existing canals, automating canals, constructing re-regulating reservoirs on irrigation canals, improving water measurement and accounting systems, installing on-farm water conservation improvements, and other measures. These investments do not provide additional storage, but modify the spatial and temporal distribution of water in the Basin.

As discussed in Section IV.B.3 in relation to Table 12 through Table 15, the results for future climate scenarios are somewhat anomalous. Table 36 shows that, unlike any other IP project, the estimated benefits for agricultural conservation are highest under the historical climate regime. We therefore consider these scenarios here. In particular, B/C ratios for the historical climate regime range from 0.16 to 0.05, whereas the B/C ratios for the other climate regimes are at or below 0.05.

In the case of the most adverse climate scenario (HADGEM) the estimated present value of gross benefits is actually negative. As described earlier, this result should be interpreted as zero, and it follows from the fact that conservation measures, as parameterized in YAKRW, have essentially no effect on curtailment rates and therefore essentially no out-of-stream benefits under the most adverse climate regime. As noted previously, the Agricultural Water Conservation Technical Memorandum (U.S. Bureau of Reclamation, Washington State Department of Ecology, and Prepared by Anchor QEA 2011) states "In addition, these water savings are estimated for years when water users have a full water supply. Therefore, in drought years the water savings would be reduced because less water would be conveyed through irrigation systems and applied to farms, which, in turn, reduces seepage and other losses and results in less return flow. (p. 3)" Curtailment happens in every year under this scenario, which may be driving these YAKRW results. See HDR Engineering, Inc. and Anchor QEA (2011) for more detail on YAKRW hydrologic modeling and results.

These water conservation projects are scheduled to be implemented over about 18 years, rather than the three or four year time schedule of the rest of the projects (HDR Engineering et al. 2012). If benefits are assumed to ramp up evenly over this time period instead of accruing immediately as is implicitly assumed in the PB numbers in Table 36, it can be shown that the present value of benefits amount to 72.6% of reported present values, thus reducing net benefits and B/C ratios further.

Table 36: Agricultural water conservation for out-of-stream net benefits.

		No trade			Intra-district trade			Full trade		
	cost	PB[1]	NB[2]	BC[3]	PB	NB	BC	PB	NB	BC
With IP, historical	257	34	-223	0.13	17	-240	0.07	12	-245	0.05
Alone, historical	257	42	-215	0.16	22	-235	0.09	14	-243	0.06
With IP, CGCM	257	1	-256	0.00	0	-257	0.00	0	-256	0.00
Alone, CGCM	257	14	-243	0.05	8	-249	0.03	5	-252	0.02
With IP, HADGEM	257	6	-250	0.02	10	-247	0.04	3	-254	0.01
Alone, HADGEM	257	0	-257	0.00	-8	-265	-0.03	-1	-258	0.00

[1]PB=present value of benefits; [2]NB=Net benefit for out-of stream uses, [3]BC=Benefit cost ratio for out of stream uses.

As with the other water storage project results in this section, the "Alone" results in Table 36 are implemented without IP instream flows implemented. However, as mentioned in Section II, some of the estimated "conserved water" would be reserved for instream flows benefits. These specific instream flows are not implemented in YAKRW, and so in contrast to the other storage project, all rows in Table 36 should be interpreted with a recognition that they are underestimates of the benefits to the extent they contribute to instream flow benefits.

There is another reason to interpret the results for agricultural conservation carefully. Agricultural conservation does not provide more water storage capacity to hold water for the summer months, but instead by design reduce seepage from irrigation canals. These investments will allow some irrigation districts more control and effective use over their water entitlements, which will be beneficial to them. However, to the extent that the saved seepage is retained by the irrigation districts and used consumptively, return flows to the lower basin may decline, and may impact water users downstream. For example, Kennewick Irrigation District (KID) is not included in our market and impact analysis in part because they have historically not been subject to substantial curtailment because, despite the fact that they hold proratable rights, they are low in the basin and return flows contribute to their water availability. If upstream conservation practices reduce return flows available to KID, it may increase curtailment rates faced by KID. These potential losses are not accounted for in Table 36 but in principle should be. If these losses do accrue, net benefits of these conservation measures would be lower.[51]

The general point is that agricultural conservation will have *distributional* impacts on water availability and curtailments across irrigation districts, time, and space, but it is not clear what the benefits of the types of conservation practices would be in the aggregate. These aggregate results, therefore, have limited practical use for understanding these distributional impacts of conservation practices.

b. *Municipal conservation*

Under the IP municipal conservation program, educational measures and incentive-based actions to achieve municipal and domestic conservation estimates are set forth in the Integrated Plan (HDR Engineering Inc. et al. 2011, 58). Average municipal conservation savings under the Integrated Plan are estimated to be 7,600 af annually (HDR Engineering, Inc. 2011). Sixty percent of these annual savings are assumed to be accrued by 2030, and 100% by 2060. Costs for this basin-wide water conservation program are estimated to be between $0.5 and 1.5 million per year on an ongoing basis. Taking these details as given and assuming, as with municipal benefits in Section IV.C, that were it not for these water savings, municipalities would have to purchase additional water for growth at $1,500/af in terms of net value, the net present value of costs to 2060 ranges between $10.5 and $31.3 million, and the benefits are estimated at $6.36 million. This provides B/C ratios of 0.2 to 0.6, respectively. It should be noted that these costs and benefits were noted as preliminary in the supporting documentation, and we have not vetted the foundational assumptions.

3. Power subordination

Under the IP, instream flows would be augmented along the mainstem of the Yakima River by reducing diversions for electricity production the Roza and Chandler Power Plants. As a result of these reduced diversions, 14,000 fewer MWh would be produced over the months of April and May at Roza. At Chandler, 11,000 fewer MWh would be produced over the months of April, May and June (U.S. Bureau of Reclamation 2011d). Based in assumptions and calculations presented in Appendix VII.G, the annual value of foregone electricity production at Roza and Chandler combined is $534,500, for a present value of $13.1 million dollars.

Unfortunately, we do not have sufficient precision about the impacts of these instream flow augmentations on fish abundance in the basin to estimate the value of instream flows from Roza

[51] As noted in Section III.B.1, YAKRW focuses on surface water hydrology, and it deals with groundwater very simplistically. This is yet another reason to be skeptical of the aggregate numerical values presented for agricultural conservation.

and Chandler, except to say they must be lower than the combine total of $48 to $294 for IP instream flows and restoration combined. We therefore are unable to estimate the net benefits of the operations change.

4. Markets

One component part of the IP is to facilitate water market development. We consider the role of markets both within the agricultural sector and across sectors, between agriculture (as a potential seller of water) and both municipalities, for municipal water security, and the state (or other potential buyers) for instream flows.

c. *Water market gains from trade within Agriculture*

The gross potential gains from trade within and among irrigation districts can be interpreted as the increase in the value of production that is accrued relative to a more restrictive market setting. Table 37 provides the estimated gains from intra-district trade, the additional benefits from adding inter-district trade, and total gains from trade. These results are analogous to those presented in Table 11 (page 72) but are based on different climate regimes.

Table 37: Gains from trade for with and without the IP. $millions. Historical climate.

	annual gains from trade			present value of gains from trade			
run	intra-district trade	inter-district trade	Full trade	intra-district trade only	inter-district trade	Full trade	Net of Trans. Costs[1]
Baseline, CGCM climate	12	6	18	287	153	439	317
Full IP, CGCM climate	8	5	12	189	110	299	216
Baseline, HADGEM climate	49	32	82	1,212	787	1,999	1,436
Full IP, HADGEM climate	39	26	65	946	639	1,585	1,138

[1]Transaction costs are assumed to be 1/4 of gains from intra-district trade and 1/3 of gains from inter-district trade. No adjustment was made to account for reduced transactions due to transaction costs.

One factor leads to two persistent patterns in this table: water scarcity increases gains from trade. Water markets are more valuable without the IP, and with the more adverse climate scenario. Under the full IP and the less adverse climate, full trade would provide at most an estimated $12 million in gains from trade, for a present value of $299 not accounting for transaction costs, whereas without the IP under the most adverse climate scenario, the potential gains from trade reach a present value of up to $1.6 billion.

It bears reiterating that these are *potential* gains from trade in the sense that the results are based on a number of strong assumptions about market performance as outlined in Section III.C.d. In reality, market transactions for water can be costly in terms of both time/effort and financial resources beyond the per-af purchase price. As noted in Section III.C.2.d, several studies have estimated the transaction costs associated with water transaction. These costs vary depending on whether the transaction occurs within an irrigation district, across districts, or when one of the parties is a government entity. Transaction costs are also not based on the volume of water traded, but on a per-transaction basis, which makes estimation of transaction costs somewhat difficult. However, McCann et al. (2005) citing others find that transaction costs can amount to up to a quarter of the purchase price of water for typical water transactions, and anecdotal evidence from Kittitas county transactions suggest transaction costs of nearly one-third of the total purchase cost in legal and regulatory processing fees alone.

It is noteworthy also that intra-district gains from trade make up about 60 – 65% of total gains from trade in Table 37, and inter-district trades account for only 35-40%. Intra-district trades are likely to be associated with lower transaction costs in part because regulatory oversight is not required for intra-district transactions. This is not to say they are costless, however. For example, YTID charges $150 per transaction plus up to an additional $50 depending on additional factors.

The impacts of these fees and other less tangible costs of transactions are explained here. First, to the extent that these costs represent real resource and time costs, they should be subtracted from the aggregate benefits. A rough estimate of the gains from trade net of transaction costs are presented in the last column of Table 37, assuming that transaction costs amount to 25% of intra-district trades and 33% of inter-district trades. After netting out transaction costs, the potential gains from trade range from $317 million to about 1.1 billion.

The second effect of significant transaction costs is that it will limit the number of transactions that are worth carrying out. The Four Accounts restriction that trades only occur for crops with net revenues above $150 can be viewed as a way to impose a minimum "gap" in crop types that would be eligible for trades. Because transaction costs are likely to be lower for intra-district trades, the volume of transaction in a well-functioning intra-district market are likely to more closely approach the hypothetical bounds than inter-district trading.

Previous IP studies have reported estimates for IP market development, including capital costs of $2.1 million and annual O&M costs of $212,000 (HDR Engineering et al. 2012) --- for a present value of about $2.4 million. There is no detail in the IP regarding which actions are envisioned in the water marketing component, nor how proposed changes would differ from current market infrastructure and conditions. Presumably these are administrative costs for market development and operations. Our numbers above include administrative costs in the sense that the transaction costs discussed assume these costs are passed on to buyers and sellers as transaction fees. It is worth noting that the transaction costs implied by transaction costs of 25% and 33% of intra- and inter-district trades leads to aggregate transaction costs ranging from nearly $100,000 to nearly $500,000 (compared to $2.4 million reported in the previous study). These costs are not inconsequential, but they accompany larger net gains from trade.

One final point about transaction costs is that to some extent they are a function of the regulatory environment and infrastructure available to potential buyers and sellers, as well as and as such can be lowered by well-designed market structure.

d. *Water markets across sectors*

The Four Accounts analysis credits the IP with potential gains from trade from municipal purchase of senior water rights to increase water security for current municipal water users. We estimate potential gains from trade of about $5 million (Section IV.C), not accounting for transaction costs and assuming that municipalities address their risk through leasing during curtailment years. Any increases in this value would depend on the extent that the marginal value of water to municipalities is greater than the assumed $100/af/year as relied on in the Four Accounts analysis. This is probably likely in many cases where municipalities face curtailment risks.

As described in Section IV.D, it is likely that the instream flow augmentation proposed under the IP can be purchased at lower cost than if they were to be provided by IP water storage infrastructure. We estimate this value to be approximately $100 million (not accounting for transaction costs, and depending substantially on climate) based on water transfers upward of 75,000 af/year from agriculture to instream flow use assuming that these transactions are possible. There are undoubtedly barriers and costs to carrying out market transactions such as these. Some of the general barriers to trade have already been discussed in Section III.C.d but in the case of instream flow augmentation, the capacity of the Department of Ecology or other entities for funding and carrying out such transactions is probably insufficient without additional capacity. Among the institutional barriers that may exist is that change of use for federal project water --- which describes the water held by the large irrigation districts in the Yakima Basin --- may call for legislative action to facilitate, as was the case for California (e.g. the Central Valley Improvement Act, 1992. Sec 3405; http://www.usbr.gov/mp/cvpia/title_34/public_law_complete.html).

It is beyond the scope of this project to recommend alternatives to the proposed IP or for recommending strategies for water market development, and it should be noted that water market infrastructure has indeed been progressing, especially over the last 15 years or so. The Washington State Department of Ecology Water Resource Program website (http://www.ecy.wa.gov/programs/wr/wrhome.html) is but one illustration of these developments. However, it is likely that there are still substantial gains to be made to reduce transaction costs and willingness to participate in water markets through additional legal, regulatory, administrative, educational, and contractual avenues. Among the possibilities, there seems to be potential for stronger emphasis on developing long-term contractual solutions for water trading (such as contingent contracts) to prepare for drought, rather than having to pursue market options in emergency response to them.

5. Fish passage

A total of seven fish passage projects are proposed under the IP: one for Keechelus, Kachess, Cle Elum, Tieton, Clear Lake, and Bumping reservoirs. In addition, Fish Passage for Box Canyon Creek, which is a tributary into the Kachess reservoir, is proposed as part of the IP. We examine the first five, and then comment on the last two.

a. *Five major fish passage projects*

The summary results for the five major fish passage projects are listed in Table 38, the elements of which are taken from Table 28. In general, fish passage projects have the highest B/C ratios of any set of projects in the IP, providing B/C estimates ranging from 1.43 to 11.68.

Table 38: Benefits and costs of the five major fish passage projects. $millions. Taken from Table 28.

Reservoir	Contribution to total Abundance %		Cost[2] $mill.	revised benefit estimates $millions		B/C ratios for revised estimates	
	low	high		low	high	low	high
Keechelus	12	16	79.9	114	205	1.43	2.56
Kachess	29	31	79.9	276	495	3.46	6.19
Cle Elum	27	23	81.5	257	461	3.15	5.65
Tieton[3]	13	17	79.9	124	222	1.55	2.78
Bumping[4]	18	14	26.3	171	307	6.52	11.68
Total	100	100	347.5	952	1,706	2.74	4.91

The numbers for Bumping lake assume the Bumping lake expansion. Without it, the lake is 17% the size listed (33,700 af rather than 198,000 af (HDR Engineering, Inc 2011). It would therefore provide about 17% benefits, or $29 to $52 million. Assuming the same cost structure, it would provide B/C estimates ranging from 1.11 to 1.98, which at the low end just barely satisfies to B-C criterion.[52] The effect of the Cle Elum pool raise would be very small because it adds only 3% of the volume and negligible additional habitat.[53] Individual projects with the lowest estimated B/C ratios, such as Keechelus and Tieton would be the first to be called into question.

Section IVE.b4 discussed the potential impact of technical complementarities between and among projects, and as noted above in the discussion of the Cle Elum pool raise, concern related to such complementarities was voiced in a comment on a draft of this report. The concern is that without the IP instream flow augmentation particularly for the Cle Elum River, fish passage at Cle Elum would be less effective than otherwise, and that the Cle Elum pool raise is important for providing the proposed instream flow augmentation to support fish passage effectiveness. While IP instream flow augmentation for the Cle Elum River is part of the proposed IP Instream Flows and may increase the effectiveness of Cle Elum fish passage, this does not imply that the Cle Elum pool raise is necessary to operationally implement IP instream flows. The pool raise will increase storage capacity of the Cle Elum reservoir by about 3.3% by adding 14,600 af for a total storage capacity of

[52] The costs of Bumping Lake Fish passage are estimated to be approximately equal with the existing dam or with the new dam under the Bumping Lake Expansion (HDR Engineering Inc. and Anchor QEA 2011).
[53] The productivity of Clear Lake fish passage is dependent on fish passage at Tieton. Box Canyon fish passage impacts may also be dependent on fish passage at Kachess dam. More discussion of this is provided below.

451,500 af (U.S. Bureau of Reclamation and State of Washington Department of Ecology 2014).[54] This is not a large addition, especially in relation to current total water storage in the basin. The Cle Elum pool raise would not be necessary to meet proposed augmented instream flows in the Cle Elum River because releases from the all existing storage can be jointly managed to provide water for instream flows and irrigation. Water from Cle Elum reservoir can in principle be held in Cle Elum to augment instream flow needs in Cle Elum River with releases from additional reservoirs compensating for other uses as needed and perhaps requiring additional water rights to mitigate for these instream flows.

The point is that while instream flow augmentation may improve the effectiveness of fish passage at Cle Elum dam, the pool raise is not strictly necessary to provide these instream flows. If instream flow augmentation is not provided, then the net benefits, and the associated B/C ratio, may be lower. The same critique applies to other fish passage projects to the extent that the same type of complementarity exists between fish passage and instream flow at other dams. Granted, to the extent that additional storage is not developed, water rights may need to be acquired (purchased) to provide instream flow augmentation as discussed in Section IV.D.2.

b. *Additional passage: Box Canyon and Clear Lake*

Less information is available for two less expensive and more or less unrelated fish passage projects: Box Canyon and Clear Lake. While these two projects are not related infrastructurally, we group them together here to make only some indirect inferences about these two projects.

The Clear Lake dam is located upstream of Tieton Reservoir. The proposed fish passage improvements would overcome the limitations of the current fish ladders, promoting upstream fish migration and enhance the value of fish passage improvements at Tieton (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012). Presuming that Tieton Fish passage is completed, and assuming that the fish habitat quality in Clear Lake is equivalent to that in Tieton and the fish passage is as effective as lake dispersion, then we can estimate the additional benefits of adding passage to Clear Lake given their lake sizes and the low and high estimates of fish benefits from Tieton. Using these assumptions and data, Table 39 estimates B/C ratios of 5.2 and 9.3.

Table 39: Estimating potential benefits from Clear Lake Fish Passage.

		Benefits			B/C ratio	
	acres	Low	High	Cost	Low	High
Tieton	745	124	222[1]	79.9[1]	1.55	2.78
Clear Lake	127	21	38	4.1	5.2	9.3

[1]Taken from Table 28.

[54] Cle Elum Reservoir levels have fluctuated by as much as 120 feet (U.S. Bureau of Reclamation and State of Washington Department of Ecology 2014). In percentage terms, 3 additional feet of elevation in the Cle Elum pool is only 2.5% of this range.

The assumptions underlying these numbers are certainly strong, but the projected costs are relatively low compared to fish passage at Tieton.

Box Canyon Creek would expand the amount of accessible habitat as well as enhance the quality of existing shoreline habitat for fish; primarily bull trout (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012), at an estimated cost of $1.4 million. Even less informative quantitative data are available for Box Canyon in terms of benefits. However, the implementation and use of the Kachess Drought Relief Pumping Plant during drought years may negatively impact fish passage effectiveness of the Box Canyon fish passage improvements (U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012). To the extent that the benefits of Box Canyon fish passage provide its primary benefits during low-water conditions in Lake Kachess, the impact on the benefits of the Box Canyon Creek fish passage project may substantial.

V. Conclusion

The objective of this analysis is to perform benefit-cost analysss for the individual component projects of the integrated plan. This research is in response to Section 5057 of the State of Washington Capital Budget for 2013, which charges the State of Washington Water Research Center "to prepare separate benefit-cost analyses for each of the projects proposed in the 2012 Yakima river basin integrated water resources management plan (Yakima integrated plan)." Further, "[t]o the greatest extent possible, the center must use information from existing studies, supplemented by primary research, to measure and evaluate each project's benefits and costs." Finally, "The Center must measure and report the economic benefits of each project on a disaggregated basis, so that it is clear the extent to which an individual project is expected to result in increases in fish populations, increases in the reliability of irrigation water during severe drought years, and improvements in municipal and domestic water supply." This report is in response to this charge.

We present an expansive set of results that vary depending on different assumptions about climate and potential market water outcomes, and are conditional on various assumptions about IP implementation. Because each of the proposed IP projects would operate within the Yakima Basin hydrologic system, there are extensive interdependencies among projects such that the benefits of one project are often dependent on the implementation status of other projects. We show that the value of any given water storage projects is highest when no other water storage projects are implemented, and that because water markets act to reduce the economic impact of water curtailment, the extent of water market development also affects the value of water storage projects. The economic tradeoffs between instream flows for fish and out-of-stream water uses are also dependent on these factors. Selected specific results include the following:

- *A snapshot of IP benefit estimates for moderate climate, water market, and baseline fish scenarios.*
  - Agricultural irrigation benefits: $117 million.
  - Municipal and domestic benefits: $32 million.
  - Fish benefits: $1 to $2 billion.

- *When implemented together as part of the IP, the major water storage projects as a group do not pass a B-C test.* Net present value for out-of-stream benefits (NB) from the IP range from -$2.2 to -$2.7 billion (B/C ratios from 0.02 to 0.20) depending on market and climate assumptions. Estimated benefits of proposed instream flow increases cannot make up for this shortfall.
- *No individual water storage project provides positive net benefits for out-of-stream uses when implemented as part of the full IP, even under the most adverse climate and restrictive market conditions.*
- *Net benefits for out-of-stream use of individual water storage projects implemented with no other projects implemented are negative, with some exceptions under the most adverse climate and water market conditions.* Based on moderate climate and market outcomes, storage infrastructure projects implemented alone and without proposed IP instream flow augmentation result in the following estimated out-of-stream net present value and B/C ratios, none of which passes a B-C test:
  - Bumping Lake Expansion: NB=-$371 million; B/C ratio of 0.18.
  - Cle Elum Pool raise: NB= -$6 million; B/C ratio of 0.62. Under the most adverse climate scenario and moderate market conditions, NB=$5 million with a B/C ratio is 1.35. It is also the most likely of the storage projects to satisfy a B-C test under moderate climate based on the sum of out-of-stream and instream use value.
  - Keechelus to Kachess Conveyance: NB= -$110 million; B/C ratio of 0.20.
  - Kachess Drought Relief Pumping Plant: NB= -$107 million; B/C ratio of 0.46. Under the most adverse climate considered, Keechelus to Kachess Conveyance and Kachess Drought Relief Pumping Plant together provide net benefits of $6 million and a B/C ratio of 1.02.
  - Passive Aquifer Storage and Recovery: NB=-$82 million; B/C ratio of 0.35.
  - Wymer Dam and Reservoir: NB= -$1,217 million; B/C ratio of 0.09.
  - Due to diminishing economic returns to water in the basin, increasing the number of IP storage projects reduces the value of each water storage project implemented.
- *Instream flow benefits are insufficient to support the full suite of IP water storage projects given the net benefit shortfall in out-of-stream benefits, but proposed instream flows may be supportable through market purchases.*
  - Purchases of senior water rights to implement proposed IP instream flows would be less expensive than providing instream flows via IP storage infrastructure, with estimated costs ranging from $85 million to $500 million depending on water market and climate conditions.
  - Because of its low cost, Cle Elum pool raise is most likely to satisfy a B-C test under moderate climate based on the sum of estimated out-of-stream and instream benefits.
- *Reservoir fish passage projects are likely to provide positive net benefits through their pivotal role in supporting wild sockeye reintroduction into the basin.* Fish passage is estimated to provide benefits ranging from about $0.95 to $1.7 billion and cost a total of $0.35 billion for all fish passage projects, which provide B/C ratios ranging from 2.7 to 4.9 for the individual fish Passage projects.
- *Fish habitat restoration is unlikely to satisfy a B-C test.* Results for the net benefits of instream flow purchases and restoration investment together range from about $48 million to $294 million, which fall below their estimated combined costs of $450 million. IP restoration costs are estimated at $338 million, so our results suggest that restoration does not satisfy a B-C test. However, insufficient evidence exists to estimate the contribution of habitat restoration to fish passage productivity, which may affect the value of restoration.

- *Water markets show potential for reducing the impacts of basin-wide curtailment.* We estimate that potential net gains from trade net of estimated transaction costs range between $216 million and $1.4 billion depending on climate, the extent of market development, and the extent of IP development. We show that markets act as a substitute for IP water storage infrastructure in that more active markets reduce the value of IP water storage infrastructure.

This report is not intended to be a review of prior benefit-cost estimates of the IP, but does utilize and extend existing IP analyses, and sheds some light on the sources and accuracy of the estimated benefits in the Four Accounts analysis. The Four Accounts analysis estimates agricultural benefits of $0.8 billion, municipal benefits of $0.4 billion, fish benefits ranging from $4 to $7.4 billion, and costs ranging from $2.7 billion to $4.4 billion. These numbers for the IP as a whole indicate positive net benefits and B/C ratios of 1.4 and higher. Our estimated benefits as presented above are lower for each category for a host of reasons. Notably, the assumed climate regime has substantial consequences for agricultural benefit estimates and the assumed baseline salmonid abundance in the Columbia River Basin has important consequences for the valuation of fish benefits from the IP. The contribution of these and a host of other factors to the difference in overall estimates are described in detail in the report. Based on the engineering cost estimates used in the Four Accounts analysis and supporting reports, our benefit estimates suggest that the expected net present value of the IP is likely to be negative.

Despite the differences in results, there are important similarities in findings. Fish passage projects alone comprise a small percentage of median IP costs but provide about 75% to 80% of the estimated benefits of the IP. In contrast, IP investments for instream and out-of-stream uses account for about 66% of median costs but provide a small fraction of benefits. This distribution of costs and benefits drives the strong results for fish passage although it is not explicitly shown in the Four Accounts analysis.

In accordance to the legislative charge, this report focuses sharply on benefit-cost analysis to assess the economic efficacy of individual projects. It does not include an economic *impact analysis* to assess the indirect economic impact of IP investments on the local economy or the statewide impacts of the potential use of state funds to support the IP. Nor does this report cover costs and benefits from ongoing, non-IP programs within the basin whose outcomes may impact IP benefit metrics, such as fish translocation or hatchery operations.

Due to data limitations, the majority of the results are based on simulation methods rather than statistical analysis, though statistical analysis is provided when feasible and useful. The consequence is that although some robustness exercises are performed, the majority of our results do not lend themselves to statistical confidence assessment. Many necessary tradeoffs were made with respect to modeling approaches due to the scope of this research mandate.

Refinements are certainly possible and may be warranted for any given modeling approach relied upon in this analysis. First, despite the fact that we were not charged to examine climate impacts, potential climate change in the basin is an important determinant of outcomes in this report. To better address the effects of climate, the updated CMIP 5 climate scenarios should be used. Further, because the results of this study suggest that delaying, if not foregoing, investment in water storage infrastructure, more sophisticated modeling of the development of climate distributions over time would be useful in understanding the optimal timing of infrastructure construction.

The crop model used in this report was adapted from prior studies, and relies on several restrictive assumptions. First, it assumes that the impacts of irrigation curtailment last only one season, and have no multi-year impacts even on perennial crops such as hay and fruit trees. This simplification is likely to underestimate curtailment impacts. We also assume that fallowing is the only response to dealing with curtailment, which would lead to overestimation of impacts, whereas allowing deficit would mitigate this bias. The model also assumes static crop mix, whereas in the long run, irrigators are able to modify their crop mix in response to curtailment risk over time. In addition, we have not accounted for emergency groundwater pumping during droughts. This could mitigate drought impacts substantially for some irrigators depending on the distribution of emergency well rights.

Fish abundance impacts are very difficult to assess based on existing information. Among the most fundamental needs to assess the benefits of instream flow, restoration, and/or fish passage is better and more data that allow more precise estimation of impacts. This would be a substantial undertaking, but given the amount of resources being invested annual in fish restoration, data such as this would provide substantial benefits in understanding impacts.

Our fish valuation relies on the methods used in the Four Accounts analysis. While we hypothesize that the LBP study provides upwardly biased estimates of fish value in the context of the IP, we did not have the capacity to generate the data necessary to test this hypothesis. To do so, new survey work would be required with a focus on the Yakima Basin and the IP specifically. Further, it has become clear in our review of the literature that the development of new non-market valuation methods that better integrate the effect of outcome uncertainty on valuation would be well suited for the kinds of questions being asked about IP impacts. We do, however, demonstrate that incorporating any increases in fish populations between 1998 and 2012 resulting from any of the non-IP efforts in the Columbia Basin dramatically decreases the benefits attributable to the IP.

Several weaknesses of the municipal benefits analysis would also be useful to address. First, fully integrating municipal demand growth in an integrated model of water trading would allow for better estimates of equilibrium market outcomes (e.g. prices, quantities) and gains from trade. Second, a careful examination of the effect of large divergences between agricultural water value and municipal water value on water price volatility would be useful in understanding and predicting future market outcomes. Third, we relied entirely on the existing forecasts of population increases in relation to water rights, whereas updated analysis of these fundamentals is warranted.

Project-specific costs for most projects have been reported in existing reports. Where this is the case, we have taken these costs as given, in most cases without substantive assessment.

Finally, our market simulations rely fundamentally on frictionless intra- and inter-district trading to assess outer bounds on both infrastructure impacts and gains from trade. While we take considerable pains to recognize the impact of institutional constraints and market transaction costs on water trading, we integrate these factors into the market simulations only loosely. Much is still unknown about the reasons for persistently thin and inactive water markets and how to reduce transaction costs and facilitate transactions. However, the Yakima Basin is the beneficiary of the *Acquavella* general water rights adjudication, which is a crucial foundation for water market development in the basin. It seems clear that despite some substantial water market developments in the last couple of decades, opportunities still exist to further facilitate water market activity through additional legal, regulatory, administrative, educational, and contractual avenues.

VI. References

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VII. Appendix

A. Irrigation water value

As described in the body of this report the methodological approach used to estimate the benefits to agriculture from the individual YBIP projects builds on the approach used in the Four Accounts study, which was based on the spreadsheet model developed by Scott et al. (2004). A number of modeling capabilities were developed. In particular, we develop marginal value functions for water that allow us to compare the outcomes of three types of water market scenarios: a no trading scenario, an intra-district trading only scenario, and a full trading scenario with both intra- and inter-district trading. This appendix explains the relationship between crop production and water value by developing water value functions, also known as inverse demand functions for water. The next Appendix illustrates how these inverse demand functions are used to assess market outcomes.

Table 5 on page 32 of the report provides a breakdown of crop acreage allocation, water use, and value per acre, by irrigation district. The relationship between water availability and the marginal value of water implied in that table can be visualized for each district by ordering the crops from highest to lowest value ($/af) and placing them on an x and y-axis where the x-axis is af of water and the y-axis is $/af. This provides a step function representing the marginal value of water for crop production. Figure 19 illustrates the step function for the Roza district, conditional on that districts crop acreage allocation. The height of each step represents the value of water for a given crop and the length of each step is the amount of water used for that crop in a given district. Assuming that

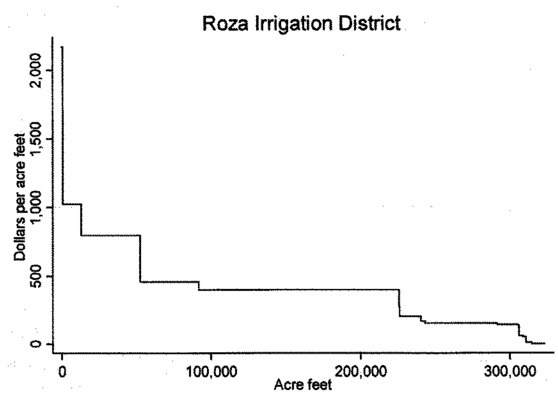

Figure 19: Illustration of marginal crop value as a function of water availability, arranged from highest to lowest value.

water is allocated to higher valued uses first, the total value of production for any given amount of water equals the area under the step function to the left of the amount of water available. For example, in Figure 19, the total value of production provided by 200,000 af of water as applied optimally across Roza crop acreage is the area under the step function to the left of 200,000 af.

The Scott model uses these step functions directly to implement the economic optimization model described above. To facilitate our market analysis, we approximate these step functions by fitting continuous and monotonically decreasing functions of the form

$$p = Bq^{\theta}e^{\varepsilon},$$

where p is the marginal value of water evaluated at quantity q, B and θ are parameters, e is the exponential function, and ε is a random disturbance with mean zero. Transforming both sides of the inverse demand equation provides $\ln p = \ln B + \theta \ln q + \varepsilon$, which permits the linear regression equation that can be estimated using ordinary least squares. This general procedure for estimating water demand curves from underlying step functions is described by Burt (1964). Regressions are run for each irrigation district, and each estimated regression is retransformed using the method described by (Duan 1983) to account for the fact that the expected value of the error term in the log-log model is not zero after retransformation (that is, $E[e^{\varepsilon}] \neq 0$) even though $E[\varepsilon] = 0$). Our estimated inverse demand curves can be defined in general as $\hat{p} = \hat{B}q^{\hat{\theta}}\hat{D}$,where $\hat{D}$ is Duan's smearing estimate of $E[e^{\varepsilon}]$.

The estimated inverse demand curves provide a close approximation to the step functions implied by Table 5 on 32, but the area under these functions, which represents the total value of production, are not guaranteed to match the area under the original step functions. Therefore, we calibrate our estimated inverse demand functions so that the area under the curves is equal to the total profit in a non-drought year for each district i. The calibration is based on the following equation that defines the area under an inverse demand curve for a given district:

$$\pi(\bar{Q}) \approx \int_{m}^{\bar{Q}} \hat{p}\, dq = \frac{DB}{1+\theta}\left(\bar{Q}^{1+\theta} - m^{1+\theta}\right)$$

Where $\hat{p}$ is the inverse demand function defined above, $\bar{Q}$ is the amount of water used during a non-drought year (which is typically less than a district's full entitlement), and m is the calibration instrument. The calibration involves changing the lower limit of integration to a value above zero when the area under the inverse demand function with a lower and upper limit of integration of 0 and the maximum water use in a non-drought year, respectively, is greater than the assumed value for total profit in a non-drought year. It is feasible for this area to be less than the assumed total profit in a non-drought year. Had this occurred the function could have been shifted upward but this was not the case for any of the irrigation districts. It is also possible to shift the entire function downward for cases where the total profit estimate was too high by multiplying by a constant less than 1. However, calibration through increasing the lower limit of integration provides a higher estimate of agricultural benefits for water storage projects and it was deemed preferable to err on the high rather than low side of agricultural benefits.

The total profit for SVID, Roza, KRD, and Wapato required calibration while Kittitas Sr. did not. The lower limits of integration along with the other relevant parameters are provided in Table 40.

Table 40 Estimated parameter and calibration instrument values for water inverse demand functions

	District				
Parameter	Roza	KRD	Wapato	SVID	Kittitas Sr.
B	13.03	10.35	16.42	13.79	9.37
θ	-0.63	-0.541	-0.943	-0.728	-0.484
m	4,000	3,500	5,000	5,000	0
D	1.21	1.282	1.655	1.192	1.16

Figure 20 shows the estimated functions and their corresponding step functions. These estimated inverse demand curves for water are used in two ways: first, they are used to estimate the aggregate

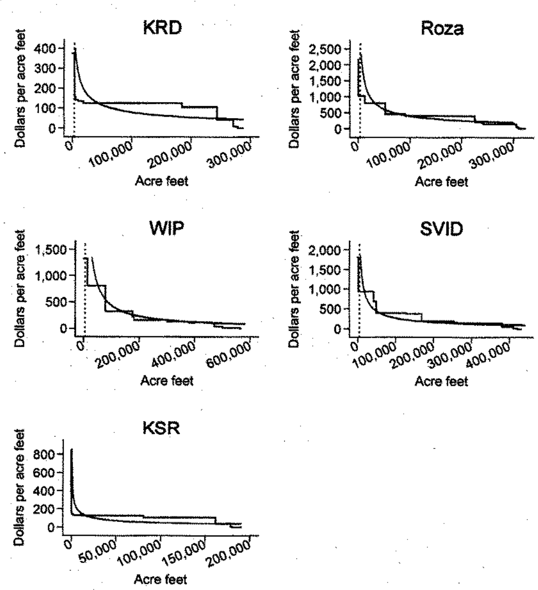

Figure 20: Calibrated Inverse demand functions for all districts. The vertical dotted lines represent the parameter *m*. The area under the fitted curve to the left of *m* is subtracted to ensure that the total value of production is the same under the step functions and fitted functions.

value of production given intra-district trade, and second, they are used to simulate inter-district trading. These processes are described in general in Section III.C.1 of the main body of the report, and in more detail in Appendix VII.B directly below.

B. Water markets

This appendix describes how the different market scenarios are implemented in this report. We begin by providing a comparison of our approach in relation to the Four Accounts analysis in general. We then provide a technical description of our assumptions and procedure for the three types of market outcomes shown in the body of the report.

1. Summary of Four Accounts analysis of market benefits

The Four Accounts analysis of water marketing activity relies on two important assumptions: (1) that irrigators growing higher-valued crops will lease water rights from irrigators growing lower-valued crops, but only where the buyers' crop earns $150 per af or more; and (2) that only 10% of an irrigation district's allocation can be leased outside the district (ECONorthwest, Natural Resources Economics, and ESA Adolfson 2012, 36). The supporting Technical Memorandum (U.S. Bureau of Reclamation, ECONorthwest, and State of Washington Department of Ecology 2011) uses a slightly different definition of "severe" drought (40% vs 30% in the Four Accounts) and relaxes several of these constraints. In general, we rely on the results from the Four Accounts analysis.

The water marketing component provides benefits by reducing drought year losses incurred by farmers. Water marketing benefits are measured relative to a baseline scenario where proratable irrigators receive 100% of their annual entitlements (U.S. Bureau of Reclamation, ECONorthwest, and State of Washington Department of Ecology 2011) and there is no water market activity within or between irrigation districts. A core "severe drought" scenario (without the IP) assumes that growers of crops with net revenue greater than $150 per af would lease water from farmers with crops with lower net revenues, such that 30,000 af of water would be traded between districts for crops. Without the IP, no trading would occur within districts., which implies proportional fallowing, discussed more below. In the Four Accounts analysis, with all elements of the IP implemented, the amount of inter-district trading remains 30,000 af, but intra-district trading increases from zero to 110,000 af. Similary, in the Technical Appendix where a severe drought represents 40% of water supply in a non-drought year, intra-district trading increases from zero to 130,000 af with only the market-based component of the IP. Under these same conditions, inter-district trading increases from 30,000 to 50,000 af. Allowing more than 10% of a district's water supply to leave the district, and allowing growers of crops with earnings less than $150/af allows the amount of water traded to increase. There is no discussion in the Four Accounts analysis or the Technical Appendix on exactly how the IP is expected to increase intra-district trading.

To estimate the benefits and costs of increased use of market-based re-allocation, we build on the marginal value functions described above for agricultural users, rather than use the Four Accounts' spreadsheet-based, step-wise value function approach. We do, however, compare our results with those in the Four Accounts and find relatively close agreement. We follow the Four Accounts in implicitly modeling leases only, rather than permanent sales. We use the terms "buyer" and "seller" below in place of the terms "lessor" and "lessee". These leases could be in the form of one-year leases that are negotiated in the midst of a drought year. Although not discussed in the Four Accounts, the leases could also be in the form of a pre-negotiated option contract (or "dry year option") that specifies in advance a) the amount of water to be transferred, b) the price that would be paid (the "strike" price), and c) the conditions that would trigger the option contract to take effect (i.e. the TWSA, or percent prorationing, on a certain date).

2. Modifications to the Four Accounts methods and assumptions

There are several important points of departure from the Four Accounts analysis. First, unlike the Four Accounts analysis, we examine IP outcomes for three different market scenarios. The three market regimes that we consider are:

- No water trading
- Intra-district water trading
- Full trading: both intra- and inter-district trading

The no trading regime imposes the restriction that when water is curtailed during a drought, all crops are curtailed in the same proportion. The intra-district trading regimes allows frictionless efficient water distribution within irrigation districts, but no trading across districts. Full trading allows both intra- and inter-district trading such that water is distributed efficiently to its highest valued uses across districts, with some cross-district trade limitations described below.

The assumption of (frictionless) intra-district trade is reasonable to the extent that a) landowners grow multiple crops on plots under their control and make profit-maximizing decisions about where to allocate scarce water and/or b) when irrigation districts have systems in place to allow customers to temporarily swap or lease water rights to other customers within the district. These trades have little or no impact on water users outside the district,they pose no legal problems and only need to be approved by the district's Board of Directors (RCW 90.03.383 sect 3). Intra-distict trades during the the 2001 and especially the 2005 severe drought years were apparently common in Sunnyside (SVID), Roza (RID), and Kittitas (KRD). Recall that the Four Accounts analysis implies *no* intra-district trading at all without the IP, and significant intra-district trading when the market-based component of the IP is implemented.

The Full trading market regime that allows both intra- and inter-district trade represent an outer bound on the impacts and benefits from increased markets. We rely on this approach and a frictionless market scenario because most, if not all, ad hoc limits on market transactions are relatively arbitrary especially in the long run and may eventually relax or disappear, including some legal barriers to trade. There is, however, at least one fundamental constraint on water markets that will almost certainly always remain, and that is that transactions may be limited in the case of potential for third-party harm. Nonetheless, water markets may be slow to develop, but there is a long history of market evolution and development in the face of scarcity.

A second point of departure is our inclusion of "senior" water rights holders (those dated before May 10 1905) in Kittitas County (Ecology subbasins 1-15), a group not modeled in the IP analysis.[55] These water rights holders have a potentially important role to play in water markets in the Yakima Basin because their position in the upper part of the Basin could in theory allow downstream transactions with few third-party effects or legal concerns. A number of these rights are already actively involved in water markets due to the requirement to mitigate formerly "exempt" groundwater wells. As of October 2014, there are 12 water rights being sub-divided as "water banks" and sold, mainly to domestic users. A total of 116 af have been sold in 269 transactions; a separate document detailing the amount available in these upper Kittitas banks via Ecology's website as well as the number and volume of individual transactions is available from the authors on request (see also (Robert Barwin 2013).

These Kittitas Senior rights represent a relatively large pool of water. Based on the Yakima Superior Court's Adjudication records, we calculate the total amount of water held in these rights to be 222,925 af. This estimate includes private irrigation companies and individual water rights holders, but excludes muncipalities, counties, the federal government, and timber companies. We subtract the 116 af that have been re-assigned to mitigate groundwater uses in the upper Kittitas as of October 2014. We assume that the fraction of these diversions that could be transferred is 72.6%, matching the consumptive use assumed for the Kittitas Reclamation District (HDR Engineering and Anchor QEA 2011). In total, this is 161,759 af of consumptive use. The adjudication record does not consistently report what beneficial uses (i.e. what crops) the water right is used for, so we rely on results from a mail survey in 2009 (Cook and Rabotyagov 2014) to estimate the crop mix. We pool these "senior" rights together and model them as if they were another irrigation district for computational simplicity only, fitting a marginal value function using the techniques described above.

C. Modeling details for market scenarios

An important assumption made in the Scott model that is typical in modeling drought impacts is to assume that a reduced water budget is met only through fallowing of acres (R. Howitt et al. 2014). This prohibits what is often referred to as deficit irrigation where an amount of water is applied that is less than the level associated with maximum yield. The result of this assumption is that water and land are used in a fixed proportion that is crop and location specific. This type of fixed proportions production relationship is often called a Leontief production function. This assumption is made in many economic impact studies based on input/output economic models (e.g. IMPLAN®) simplifies analysis because the production decision only depends on one variable rather than two. Choosing how many acres to fallow of each crop directly determines how much water is used for each crop.

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[55] The Technical Appendix on Market-Based Reallocation briefly mentions (footnote 4 on page 6) the potential for trading "outside the Yakima Project" and projects the amount of water traded for various purposes by 2040, though without a citation or documentation of how these amounts were arrived at. These water transfer amounts do not factor into their main analysis.

A graphical representation of the Leontief production function is shown in Figure 21. Isoquants map out all the combinations of land and water that produce the same amount of output. Isoquant 1 shows a lower level of production while Isoquant 2 shows a higher level of production. While each isoquant is a combination of a vertical and horizontal line the only relevant point for production is the vertex of these two lines. The shape of the isoquants follows from the fact that increasing one input without increasing the other does not increase production. This means that there is no benefit to moving away from the vertex of the isoquant. Following this logic, the possible production levels are combined in the dotted line that goes through the origin. The level of production that maximizes profit for the producer is determined by the land or the water constraint. The land constraint, represented by the vertical dashed line, is the limiting resource in a non-drought year because water law prohibits spreading. Diversion rights are not limiting in a non-drought year which is revealed by the fact that all irrigation districts use less than their entitlement in a non-drought year. In a drought year the water constraint, represented by the lower horizontal dashed line, becomes limiting so that production is limited to the blue isoquant.

This graphical examination only considered the production of one crop. When water becomes scarce the irrigators problem becomes one of how to allocate limited amount of water across crops. Assuming a Leontief production function restates the problem as *"how many acres of each crop should be fallowed?"* Our three trading scenarios differ inly in the degree of freedom that water owners have as a group to allocate water across corps within and across districts.

Four Accounts estimates the agricultural benefits in the baseline scenario to be $0.8 billion. Our attempt to replicate their results leads us to conclude that they arrived at this number by assuming proportional curtailment across crop acreage, rather than selective curtailment. This means that the marginal value of water is constant and does not depend on drought severity. Estimates of benefits using this approach are as follows. The cost of a drought is the curtailment measured in af multiplied by the value of water for each district (which is a constant). To summarize, the average value of water for each crop in a district is calculated by dividing profit per acre by water use per acre [($/acre)/(af/acre)]. Then, the value of water for each crop is multiplied by that crop's share of total

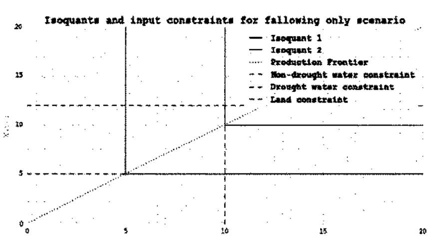

Figure 21. Fixed proportions isoquants and production frontiers with land and water constraints.

acreage in the district. For example, say a district has two crops where Crop A and Crop B have an implied value of water of $100/af and $200/af. If Crop A and Crop B constitute 3,000 and 1,000 acres, respectively, then the value of water for the district weighted by acreage is equal to $100/af*0.75+$200*0.25, which is equal to $125/af. The specific values used for each district which come directly from the Four Accounts report (they were not altered in any way for this study) are presented in Table 6 of this report.

The trading scenarios require accounting for differences in the value of water across crops and districts. The economic problem is classified as a constrained optimization problem where some representative decision maker allocates water across potential uses to maximize profit given access to a limited amount of water and land. This problem can be written in equation form as shown below. The crop production function assumes fixed proportions. *L* stands for the Lagrangian function which is used to find the profit maximizing water allocation by taking first-order conditions.

w_i : water applied to crop i
π_i : profit per acre
p_w : per unit water price
p_i : crop i price
g_i : water applied per acre for crop i
W : water constraint
L : land constraint
F : crop production function
$F_i(w_i, l_i) = w_i g_i^{-1}$

$$\max_{W_i} \sum_{i=1}^{n} \pi_i w_i g_i^{-1} - p_w \sum_{i=1}^{n} w_i$$

subject to

$$\sum_{i=1}^{n} w_i \leq W$$
$$\sum_{i=1}^{n} w_i g_i^{-1} \leq L$$

$$L = \sum_{i=1}^{n} \pi_i w_i g_i^{-1} - p_w \sum_{i=1}^{n} w_i + \lambda\left(W - \sum_{i=1}^{n} w_i\right) + \gamma\left(L - \sum_{i=1}^{n} w_i g_i^{-1}\right)$$

$$\frac{\partial L}{\partial w_i} = \pi_i g_i^{-1} - p_w - \lambda - \gamma g_i^{-1} = 0 \text{ for } i = 1,\ldots,n \text{ crops}$$

$$when\ \gamma = 0,\ \pi_1 g_1^{-1} = \ldots = \pi_n g_n^{-1} = p_w + \lambda$$

In a non-drought year the land constraint is binding and $\gamma>0$ and $\lambda=0$. In a drought year the opposite is true. This is the standard result that profit is maximized by equating the marginal value product of water across uses. Although not explicit in the equations above, the price of water in equilibrium depends on the total water supply available as well as other parameters in the model: $p_w = P_w(W,.)$.

The intra-district trading scenarios use the fitted inverse demand curves estimate drought impacts by calculating the area under each curve from m up to the amount of water available for each district based on the severity of the drought, each districts mix of proratable and non-proratable water rights, and their entitlement.

The Full Trading scenarios must account for differences in the value of water across districts. The constrained optimization problem is implemented by finding the allocation of water across districts that are assumed to be trading that maximizes the total profit of all the districts. For example, if Roza and SVID are the only trading districts, then the optimization problem finds the allocation of water across crops and maximizes profit for Roza and SVID combined. This depends both on the mix of crops and the percent of proratable rights.[56] Specifically, the constrained optimization problem consists of an objective function and a set of constraints. The objective function is the sum of profit for all trading districts. The constraints bound the amount of water a district can receive. The lower bound is zero, which is often referred to the non-negativity constraint, which is always present in this type of economic model. The upper bound is the maximum water used by each district in a non-drought year. The model is solved numerically using the sequential least squares quadratic programming (SLSQP) algorithm implemented in the Python package PyOpt. While the model described above shows that the optimal allocation of water is achieved where the marginal value of products are exactly equal to each other across uses this is not necessarily the result if corner solutions are possible due to the bounds.

We impose several constraints to inter-district trading. In the case of inter-district trading, we assume that WIP and YTID do not trade between districts. We impose this constraint on WIP because it retains institutional limitations that are likely to limit its market participation in the intermediate, and potentially even the long run (Ross 2014; U.S. General Accounting Office 1997). We preclude YTID from trading because it is relatively hydrologically isolated in such a way to limit water sales, and its crop values and non-proratable status limits it incentives to buy.

Another constraint the potential for third-party effects of transactions, especially in the case of transactions between downstream sellers and upstream buyers, which can negatively impact instream flows (and therefore also the diversion capacity of other water rights holders) between the transactants. In particular, we would be concerned about KRD buying from SVID or other downstream districts for this reason, but the crop mix and associated water value functions (and our assumption that WIP does not trade) essentially precludes such transactions from happening and so no explicit constraint is needed. Although our market model is not spatially explicit, Figure 16 shows that the simulated trading outcomes are such that the KRD does not buy from SVID in the sense that it only buys if curtailment reaches above 90%, at which point Kittitas Senior sells more than enough water to cover KRD purchases.

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[56] The model used in this study was implemented in the programming language Python (python.org).

D. Municipal and domestic water value

This appendix examines the pricing assumptions used in both the Four Accounts analysis and our own in regards to the municipal and domestic benefits of the IP. We first examine the marginal value of water to agriculture as the opportunity cost of a lease, then we examine the value of a senior water right for agricultural irrigation as the opportunity cost of the sale of a permanent senior water right. We also include in a final table the calculations for the benefits of municipal conservation, which we discuss in IV.G.b.

1. Empirical support for lease prices

Based on a dataset on western states water transfers (Libecap 2014), we find that water sale prices for agriculture to urban transactions averaged $612.25/af and lease prices average 79.38/af/year, the latter of which has a present value of $1,984.67 (these prices are inflated to 2012 dollars). Analogous averages for WA, OR, and ID tend to be lower, at $434.61/af for sales and 42.61/af/year (present value $1,061.72). There are many reasons why we would not expect the present value of market lease prices treated as a perpetual annuity to equal water sales prices, including the fact that transaction costs are different between the two, uncertainty about future water availability, and other factors will affect the outcomes. What is most pertinent here is that the range of these values are within the ballpark of the $1,000-$2,500 sale and purchase prices, as well as lease prices relied on in our analysis rather than prices in the range of the wholesale price used in one part of the Four Accounts analysis.

We can corroborate these values based on the agricultural water value simulations using YAKRW and the crop production value discussed in detail in Section IV.B. Table 41 includes simulated marginal water values under the baseline scenario (HDR 7.1) and the full IP, by climate regime, and by trading regime, *conditional on curtailment* (that is proration level less than full entitlement), under the assumption that municipalities will only lease water during curtailment years.

Table 41: Average marginal value of water conditional on curtailment, $.

run	No trade	Intra-district trade	Full trade
Baseline (HDR 71), historical climate	131	71	45
Baseline (HDR 71), CGCM climate	107	56	37
Baseline (HDR 71), HADCM climate	157	133	59
Baseline (HDR 71), HADGEM climate	215	290	90
IP (HDR 7.8), historical climate	125	61	39
IP (HDR 7.8), CGCM climate	112	52	33
IP (HDR 7.8), HADCM climate	180	101	59
IP (HDR 7.8), HADGEM climate	227	275	83

Under the historical climate regime and the baseline IP, the average marginal value of water *conditional on curtailment* is $131/af/year given no intra- or inter-district trading (that is, assuming proportional fallowing), $71 given intra-district trading only, and $45 given full trade. The analogous values under the full IP implementation are $125, $61, and $39. Both the "No trade" and "full trade" are extreme bounds on trading behavior, and so the "Intra-district trading" regime might be taken as a reasonable intermediate case. In any case, the marginal value of water for irrigation under the historical climate regime ($71 without the IP and $61 with the IP) are higher than assumed $40/af/year lease value (net present value of $1,000 at a 4% interest rate) used as the opportunity cost of water in the municipal demand analysis. It is noteworthy, that as the climate scenarios become more adverse, the marginal value of water under curtailment becomes higher. The only exception to this is that, somewhat surprisingly, the price drops between the historical climate regime and the CGCM regime. While not shown in the table, this is because the average curtailment rate conditional on curtailment (mean[c] | c>0) declines, even though both the probability of curtailment (Prob[c>0]) and the unconditional mean of curtailment (mean[c]) are both larger under CGCM than the historical regime.

The net benefits from the IP that accrue to municipalities as modeled in the Four Accounts analysis and here represent the avoided purchase costs net of the opportunity cost to the seller, presumed here to be irrigated agriculture. In the Four accounts analysis and ours, we assume this price to be $40/af/year (lease price) or $1,000/af as a sale price. If the opportunity cost is higher, as we find in for all cases except under the full IP and full trade (Table 41), then the net benefits of the IP for municipalities will be lower. For example the sale value equivalent to a $61/af/year and $71/af/year lease price are sales prices of $1,525/af and $1,775/af, ignoring transaction costs. If the purchase price municipalities face is $2,500/af as assumed in the Four Accounts analysis, the net gain to municipalities is $975/af and $725/af instead of the assumed gain of $1,500/af. If this is the case, municipal benefits reported in both the Four Accounts analysis and here assuming the $2,500 purchase price by municipalities is too high.

2. *Sale prices for senior water rights*

The opportunity cost of a permanent sale of a senior water right for irrigation requires a different estimation approach because it is based on the unconditional expectation of curtailments into the future. The value of water to senior agricultural irrigation water rights holders (irrigation districts in this case) depends on the reductions in agricultural production value that results from their sale, and this represents a lower bound in sale price. The Four Accounts analysis assumes that a senior water right is worth about $1,000 (p. 52), and we can examine the veracity of this value in terms of expected foregone agricultural production.

The minimum price a senior water right owner would likely to be willing to accept for the sale of a water right for an af of water is approximately equal to the expected marginal net present value of that water for irrigation. If $V(W)$ is the aggregate value of irrigated agricultural production and W is water applied to provide V, then $\partial V(W)/\partial W$ is the marginal value if water at any level of W.

However, irrigation districts in the Yakima Basin are prorated in a drought year based on the basin-wide proration rate and the share of proratable versus non-proratable water rights it holds in its portfolio, and the opportunity cost of selling water depends on the effective proration rate it faces. In a given curtailment year with basin-wide proration rate p, the effective proration rate for a district that has E_n af of non-proratable water rights and E_p af of proratable water rights, but sells S acre feet of nonproratable rights, the district's post-sale prorated water available is $W(S) = p_d E_s =$

$[(E_n - S) + pE_p]$, where $p_d = [(E_n - S) + pE_p]/[E_n + E_p - S\,]$ is the post-sale proration rate defined such that the amount of water received in a curtailment year given post-sale entitlements $E_s = E_n + E_p - S$ (which represents the total water entitlement after a sale that it would receive in a non-drought year). Note that if a district has no non-proratable rights E_n (and therefore none to sell), then $p_d = \frac{pE_p}{E_p} = p$. If a district has no proratable rights, then $p_d = \frac{E_n - S}{E_n - S} = 1$ regardless of the basinwide proration rate p and there is never any curtailment.

At proration rate p_d, the marginal opportunity cost of selling nonproratable water is $\left|\frac{\partial V(W(S))}{\partial(W(S))}\frac{\partial(W(S))}{\partial S}\right| = \frac{\partial V(W_s)}{\partial W_s}p_d \equiv M$, or the marginal value of water for agricultural production times the effective proration rate.

Given inverse demand functions for irrigation water for the districts and the effective proration rate for each district, M can be calculated for each district and year, or for the basin as a whole for each year; and the mean of this distribution of values over the history of curtailment, $\bar{M} = \sum_{t=1}^{N} M_t$, is an estimate of the statistical expectation of the marginal cost of selling a senior water right in any given year. Dividing this expectation through by the interest rate provides $PV_s = \bar{M}/r$, which is an estimate of the expected net present value of a senior water right in terms of agricultural production when a district faces curtailment of its proratable rights. It therefore represents the minimum price a senior water right holder would accept for its sale assuming that the rights holder expects to maintain this use if the water is not sold.

Based on the inverse demand functions described in Appendix VII.A , we generated an estimate for the marginal value of a senior water right using the shadow-price curves for the four districts and the effective curtailment rates for the four districts of WIP, Roza, SVID, and KRD, by aggregating production value and entitlements such that $p_d = W_a/E_a$ where E_a is the sum of all proratable and nonproratable entitlements in the four districts and W_a is the total water allocated to them in each year. Multiplying this by the marginal value of water for that year (given a basin-wide proration rate) provides M_t for year *t*. The average of these, $\bar{M}$, is the average estimated value of a senior water right over the sample years. We then used these to calculate the present value of a senior water right as a perpetual annuity at discount rate *r=0.04*. Table 42 provides results.

For the baseline and IP cases under the historical weather regime, the value of a senior water right ranges from \$35 to \$11 af/year, with present values ranging from \$864 to \$286. Note that the value of a senior water right tends to be higher under the IP, even though the marginal value of water for a lease would actually be lower at the (higher) average proration rate. This is because the higher expected proration rate under the IP more than offsets the lower marginal water price at these levels.

Table 42: Value of a non-proratable water right for irrigation under historical climate and adverse climate (HADGEM

			Average expected marginal value of water given trading regime			Expected net present value of non-proratable water ($/af).		
run	p	p_d	No trade	Intra-district only	Full trade	No trade	Intra-district only	Full trade
Baseline (HDR 7.1), historical	89	92	35	18	11	864	453	286
IP (HDR 7.8), historical climate	90	93	41	20	13	1,023	491	314
Baseline (HDR 7.1), HADGM	44	61	123	124	48	3,083	3,098	1,190
IP, (HDR 7.8), HADGM	51	66	147	124	48	3,665	3,096	1,206

It should be noted immediately that one would expect these marginal valuations in Table 42 to be lower than prices garnered in a market setting given that buyers tend to be those with relatively high-valued uses, and sellers tend to be able to negotiate to something other than their minimum willingness to accept. Indeed, given that municipalities often are willing to pay more than this given existing water entitlements, higher prices would tend to be negotiated for agriculture to municipal trades (Libecap 2010; Brewer et al. 2007; although see Brookshire et al. 2004 for a counterexample). Thus, this range of values can be compared to the $1,000/af noted in the Four Accounts Analysis (page 52) as the average value of ag-to-ag water sales, and thus supports our use of the $1,000 (sale) and $40 (lease) values to represent the opportunity cost of a senior water right to agriculture.

Table 42 also show, however, that the opportunity cost of a lease and sale are higher under the adverse climate regime, up to $3,098/af for the intra-district trade case with no IP. The consequence of higher opportunity costs in the event of this outcome is that the net benefits of trade for a given municipal valuation are lower, but that equilibrium market prices will likely be higher also.

3. *A descriptive model of Agriculture to urban trades*

Recent anecdotal data from the Yakima basin suggest substantial change and volatility of water prices, especially in inter-sectoral trades. A very simple model of a water market can help illustrate why high volatility can occur in inter-sectoral trade prices, and how we might expect prices to behave as water markets mature.

Figure 22 provides a standard supply and demand graph, where supply in this case is taken to be the opportunity cost to the agriculture sector of selling senior water rights, and demand is the marginal value of water (the inverse demand curve) for municipal water. A well-functioning, perfectly competitive market as illustrated in this graph will result in a an equilibrium quantity consumed by municipalities of W^*, and a price of $2,500/af. To coincide with the assumed long-run equilibrium market price assumed in the Four Accounts municipal analysis and adopted here. Given that existing senior water rights are generally held by agriculture and markets are not functioning well, we may instead be in a position like W^r, where municipalities value water at the margin much higher

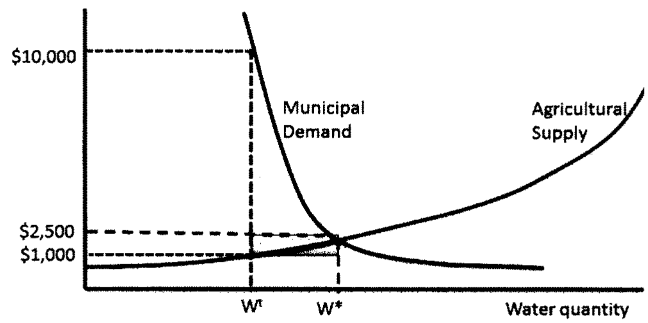

Figure 22: Water market price example.

than agriculture (and are willing to pay much more than agriculture is willing to accept, if they were to have to.

If a municipality starts with W^t and wants to buy an additional af of water starting at W^t, it the price of a mutually beneficial transaction could range anywhere from $1,000 (the opportunity cost to agriculture at W^{-t} and $10,000, the value that the municipality places on the water. Where in this range the price lands depends on the relative bargaining position of the two. If a municipality faces an emergency situation and an agricultural senior water right holder is in no particular hurry to sell (perhaps because of other potential buyers, the municipality may end up paying nearly $10,000, with the lion's share of the gains from trade going to the seller. In such a situation, even if water value and opportunity costs are not different across individual buyers and sellers we can see big variation in prices simply due to differences in bargaining positions. This type of variation will tend to diminish, though, as markets become closer to clearing.

In the Four Accounts analysis of the value to municipalities of being given uninterruptible rights via the IP, we use $2,500 as a long run, equilibrated price that the municipality would have to pay, and assume basically that the opportunity cost to agriculture remains unchanged, such that the net savings from the IP is equal to the red box. This is an overestimate of the savings to municipalities to the extent that the transactions that would occur without the IP would drive up the opportunity cost of water to agriculture.

4. *Review of municipal water use, conservation, and population growth forecasts*

Aspect Consulting, LLC (Aspect), under contract to WSU, reviewed the methodology and assumptions related to the non-economic portions of the Yakima River Basin Study related to municipal and domestic uses, as presented in the Water Needs for Out-of-Stream Technical Memorandum prepared by HDR Engineering, Inc and Anchor QEA (June 2011). The review involved a 4 step process including 1) verification of calculations, 2) verification of sources including variables and formulas, 3) researching potential alternative methodologies, studies or resources, and 4) assessment of impacts related to any significant findings of tests 1 through 3.

A key finding of the HDR / Anchor report is estimation of approximately 19,560 acre feet of increased net consumptive use (from 2010 to 2060) associated with out of stream municipal and domestic purposes such as residential, commercial, industrial, governmental, irrigation, and other demands. This value was derived generally using a 4-step process involving 1) estimating demand on a per system (large systems) or capita (smaller systems) basis, 2) estimating in-basin population including growth through the planning horizon (2060), 3) applying consumptive use factors, and 4) adjusting future demand based upon anticipated conservation and other factors.

Approximately 1/3 of the basin population resides within the 8-largest systems. Water system planning data was obtained by HDR / Anchor for these systems from comprehensive water system plans to determine total source production. In some cases, quantities associated with irrigation within municipal water system boundaries was included in the total (Yakima, Ellensburg). Aspect determined that residents other than Yakima and Ellensburg within this set of 8-systems receives additional irrigation water from local irrigation districts that was not accounted for; therefore, total municipal use as characterized under this heading may be understated. Demand for all other systems smaller than the largest 8 systems was estimated based upon population data multiplied by an estimated per capita water use of 250 gpcd, a value selected in part by engineering judgment. By examining water systems plans for the next 8 additional smaller systems, Aspect found that this value roughly corresponded to 250 gpcd. However, the reporting in these plans typically excluded separate irrigation. Therefore, this is a further indicator that 250 gpcd may understate the true out of stream demand of this subset of the population. The HDR / Anchor report acknowledged this fact and indicated that some of the irrigation demand in municipal / domestic settings is accounted for in the agricultural discussion of the report; however, the municipal portion of irrigation supply is not totaled separately. The review of this data suggests that the process used for estimating demand for large municipal systems and per capita demand for smaller systems is either adequate or possibly low. Improved accounting of irrigation practices within municipal and rural-residential settings would likely increase the estimated out of stream use.

Much of the population data was derived from the Washington State Office of Financial Management (OFM) Population Unit's, 5-year projections (2002 version). This forecast estimates population growth by County to the year 2025. Population estimates to the year 2060 were extrapolated using slightly reduced growth rates from historical to account for observable trends. While Aspect could not reproduce population estimates to the year 2060 exactly as the HDR / Anchor team had, the results were calculated to within reasonable level of error. Aspect further estimated population growth with newer OFM projection data (2007 version) which resulted in an increased estimated population (approximately 9,000 more individuals by 2060). If this population is used, this variance translates to approximately 1,000 acre-feet of additional consumptive use required by 2060 (approximately 5% more than currently estimated).

The consumptive use portion of out of stream demand is difficult to estimate and highly variable based upon development density and geographic location. In the HDR / Anchor study, 60% return flow for municipal purposes was selected and applied to determine consumptive portion of total municipal/domestic use. Aspect looked at various methods of verifying the appropriateness of this proportion including estimating based on typical indoor and outdoor consumptive use for lots of various size and geographic location. Aspect concluded that lots that are either high in the basin or have relatively small yards result in return flows at or above 60%, while lots that are low in the basin or are relatively large result in return flows below 60%. The net growth in total consumptive use (19,560 acre-feet) is highly sensitive to return flow factor selected, with 5% variation in return flow across the basin resulting in over 12% variation in net growth of consumptive use over the study period (from 2010 to 2060). However, given the uncertainty of how and where development will occur over time, the selection of a return flow factor at the lower end of a standard range as was done in the HDR / Anchor report is reasonable.

In aggregate, the methods and assumptions used in the HDR / Anchor estimation of increases demand associated with municipal / domestic uses are likely adequate. To the extent any alternative assumptions or methods may be adopted, the resulting net growth in consumptive use attributable to municipal and domestic demands would more likely increase rather than decrease primarily due to higher population estimates and better accounting of irrigation practices within municipal / domestic setting.

5. Data tables for present value calculations

Table 43: Water security benefits: comparison of Four Accounts revision

			Four Accounts Analysis		Revision: Annual leasing		Revision: purchase of perpetual right	
Year	t	water purchased (af/yr)	Current value ($1,500 X $583 X t)	Present value [(Current value)/(1.04^t)]	Current value ($60/af/yr)	Present value [(current value)/(1.04^t)]	Current value ($1,500/ af/yr)	Present value [(current value)/(1.04^t)]
2013	1	583	$874,500	$840,865	$34,980	$33,635	$874,500	$840,865
2014	2	1,166	$1,749,000	$1,617,049	$69,960	$64,682	$874,500	$808,524
2015	3	1,749	$2,623,500	$2,332,282	$104,940	$93,291	$874,500	$777,427
2016	4	2,332	$3,498,000	$2,990,105	$139,920	$119,604	$874,500	$747,526
2017	5	2,915	$4,372,500	$3,593,876	$174,900	$143,755	$874,500	$718,775
2018	6	3,498	$5,247,000	$4,146,780	$209,880	$165,871	$874,500	$691,130
2019	7	4,081	$6,121,500	$4,651,837	$244,860	$186,073	$874,500	$664,548
2020	8	4,664	$6,996,000	$5,111,909	$279,840	$204,476	$874,500	$638,989
2021	9	5,247	$7,870,500	$5,529,709	$314,820	$221,188	$874,500	$614,412
2022	10	5,830	$8,745,000	$5,907,809	$349,800	$236,312	$874,500	$590,781
2023	11	6,413	$9,619,500	$6,248,644	$384,780	$249,946	$874,500	$568,059
2024	12	6,996	$10,494,000	$6,554,521	$419,760	$262,181	$874,500	$546,210
2025	13	7,579	$11,368,500	$6,827,626	$454,740	$273,105	$874,500	$525,202
2026	14	8,162	$12,243,000	$7,070,027	$489,720	$282,801	$874,500	$505,002
2027	15	8,745	$13,117,500	$7,283,682	$524,700	$291,347	$874,500	$485,579
2028	16	9,328	$13,992,000	$7,470,443	$559,680	$298,818	$874,500	$466,903
2029	17	9,911	$14,866,500	$7,632,063	$594,660	$305,283	$874,500	$448,945
2030	18	10,494	$15,741,000	$7,770,200	$629,640	$310,808	$874,500	$431,678
2031	-	10,494	$15,741,000	$7,471,346	$629,640	$298,854	$0	$0
2032	-	10,494	$15,741,000	$7,183,987	$629,640	$287,359	$0	$0
2033	-	10,494	$15,741,000	$6,907,680	$629,640	$276,307	$0	$0
2034	-	10,494	$15,741,000	$6,642,000	$629,640	$265,680	$0	$0
2035	-	10,494	$15,741,000	$6,386,538	$629,640	$255,462	$0	$0
2036	-	10,494	$15,741,000	$6,140,902	$629,640	$245,636	$0	$0
2037	-	10,494	$15,741,000	$5,904,714	$629,640	$236,189	$0	$0
2038	-	10,494	$15,741,000	$5,677,609	$629,640	$227,104	$0	$0
2039	-	10,494	$15,741,000	$5,459,240	$629,640	$218,370	$0	$0
2040	-	10,494	$15,741,000	$5,249,269	$629,640	$209,971	$0	$0
2041	-	10,494	$15,741,000	$5,047,374	$629,640	$201,895	$0	$0
2042	-	10,494	$15,741,000	$4,853,244	$629,640	$194,130	$0	$0
2043	-	10,494	$15,741,000	$4,666,581	$629,640	$186,663	$0	$0
2044	-	10,494	$15,741,000	$4,487,097	$629,640	$179,484	$0	$0
2045	-	10,494	$15,741,000	$4,314,516	$629,640	$172,581	$0	$0
2046	-	10,494	$15,741,000	$4,148,573	$629,640	$165,943	$0	$0
2047	-	10,494	$15,741,000	$3,989,013	$629,640	$159,561	$0	$0
2048	-	10,494	$15,741,000	$3,835,589	$629,640	$153,424	$0	$0
2049	-	10,494	$15,741,000	$3,688,067	$629,640	$147,523	$0	$0
2050	-	10,494	$15,741,000	$3,546,218	$629,640	$141,849	$0	$0
2051	-	10,494	$15,741,000	$3,409,825	$629,640	$136,393	$0	$0
2052	-	10,494	$15,741,000	$3,278,678	$629,640	$131,147	$0	$0
2053	-	10,494	$15,741,000	$3,152,575	$629,640	$126,103	$0	$0
2054	-	10,494	$15,741,000	$3,031,322	$629,640	$121,253	$0	$0
2055	-	10,494	$15,741,000	$2,914,733	$629,640	$116,589	$0	$0
2056	-	10,494	$15,741,000	$2,802,628	$629,640	$112,105	$0	$0
2057	-	10,494	$15,741,000	$2,694,834	$629,640	$107,793	$0	$0
2058	-	10,494	$15,741,000	$2,591,187	$629,640	$103,647	$0	$0
2059	-	10,494	$15,741,000	$2,491,526	$629,640	$99,661	$0	$0

2060	-	10,494	$15,741,000	$2,395,698	$629,640	$95,828	$0	$0
2061	-	10,494	$15,741,000	$2,303,556	$629,640	$92,142	$0	$0
2062	-	10,494	$15,741,000	$2,214,957	$629,640	$88,598	$0	$0
2063	-	10,494	$15,741,000	$2,129,767	$629,640	$85,191	$0	$0
2064	-	10,494	$15,741,000	$2,047,853	$629,640	$81,914	$0	$0
2065	-	10,494	$15,741,000	$1,969,089	$629,640	$78,764	$0	$0
2066	-	10,494	$15,741,000	$1,893,355	$629,640	$75,734	$0	$0
2067	-	10,494	$15,741,000	$1,820,533	$629,640	$72,821	$0	$0
2068	-	10,494	$15,741,000	$1,750,513	$629,640	$70,021	$0	$0
2069	-	10,494	$15,741,000	$1,683,185	$629,640	$67,327	$0	$0
2070	-	10,494	$15,741,000	$1,618,448	$629,640	$64,738	$0	$0
2071	-	10,494	$15,741,000	$1,556,200	$629,640	$62,248	$0	$0
2072	-	10,494	$15,741,000	$1,496,346	$629,640	$59,854	$0	$0
2073	-	10,494	$15,741,000	$1,438,794	$629,640	$57,552	$0	$0
2074	-	10,494	$15,741,000	$1,383,456	$629,640	$55,338	$0	$0
2075	-	10,494	$15,741,000	$1,330,246	$629,640	$53,210	$0	$0
2076	-	10,494	$15,741,000	$1,279,083	$629,640	$51,163	$0	$0
2077	-	10,494	$15,741,000	$1,229,887	$629,640	$49,195	$0	$0
2078	-	10,494	$15,741,000	$1,182,584	$629,640	$47,303	$0	$0
2079	-	10,494	$15,741,000	$1,137,100	$629,640	$45,484	$0	$0
2080	-	10,494	$15,741,000	$1,093,365	$629,640	$43,735	$0	$0
2081	-	10,494	$15,741,000	$1,051,313	$629,640	$42,053	$0	$0
2082	-	10,494	$15,741,000	$1,010,878	$629,640	$40,435	$0	$0
2083	-	10,494	$15,741,000	$971,998	$629,640	$38,880	$0	$0
2084	-	10,494	$15,741,000	$934,613	$629,640	$37,385	$0	$0
2085	-	10,494	$15,741,000	$898,666	$629,640	$35,947	$0	$0
2086	-	10,494	$15,741,000	$864,102	$629,640	$34,564	$0	$0
2087	-	10,494	$15,741,000	$830,868	$629,640	$33,235	$0	$0
2088	-	10,494	$15,741,000	$798,911	$629,640	$31,956	$0	$0
2089	-	10,494	$15,741,000	$768,184	$629,640	$30,727	$0	$0
2090	-	10,494	$15,741,000	$738,638	$629,640	$29,546	$0	$0
2091	-	10,494	$15,741,000	$710,229	$629,640	$28,409	$0	$0
2092	-	10,494	$15,741,000	$682,913	$629,640	$27,317	$0	$0
2093	-	10,494	$15,741,000	$656,647	$629,640	$26,266	$0	$0
2094	-	10,494	$15,741,000	$631,391	$629,640	$25,256	$0	$0
2095	-	10,494	$15,741,000	$607,107	$629,640	$24,284	$0	$0
2096	-	10,494	$15,741,000	$583,757	$629,640	$23,350	$0	$0
2097	-	10,494	$15,741,000	$561,304	$629,640	$22,452	$0	$0
2098	-	10,494	$15,741,000	$539,716	$629,640	$21,589	$0	$0
2099	-	10,494	$15,741,000	$518,958	$629,640	$20,758	$0	$0
2100	-	10,494	$15,741,000	$498,998	$629,640	$19,960	$0	$0
2101	-	10,494	$15,741,000	$479,805	$629,640	$19,192	$0	$0
2102	-	10,494	$15,741,000	$461,351	$629,640	$18,454	$0	$0
2103	-	10,494	$15,741,000	$443,607	$629,640	$17,744	$0	$0
2104	-	10,494	$15,741,000	$426,545	$629,640	$17,062	$0	$0
2105	-	10,494	$15,741,000	$410,140	$629,640	$16,406	$0	$0
2106	-	10,494	$15,741,000	$394,365	$629,640	$15,775	$0	$0
2107	-	10,494	$15,741,000	$379,197	$629,640	$15,168	$0	$0
2108	-	10,494	$15,741,000	$364,613	$629,640	$14,585	$0	$0
2109	-	10,494	$15,741,000	$350,589	$629,640	$14,024	$0	$0
2110	-	10,494	$15,741,000	$337,105	$629,640	$13,484	$0	$0
2111	-	10,494	$15,741,000	$324,139	$629,640	$12,966	$0	$0
				$279,730,952		$11,189,238		$11,070,555

Table 44: Benefits for new growth.

year	t	Demand growth (1193 af/yr)	Four Accounts: Assumes purchase each year (lease-like)		Revision: Assumes purchase of perpetual right	
			Current lease value ($258 X af/yr)	Present value	Current sale value ($1,500 X 1193 af/yr)	Present value
2020	8	1,193	$307,794	$224,902	$1,789,500	$1,307,570
2021	9	2,386	$615,588	$432,504	$1,789,500	$1,257,279
2022	10	3,579	$923,382	$623,804	$1,789,500	$1,208,922
2023	11	4,772	$1,231,176	$799,748	$1,789,500	$1,162,425
2024	12	5,965	$1,538,970	$961,236	$1,789,500	$1,117,716
2025	13	7,158	$1,846,764	$1,109,119	$1,789,500	$1,074,727
2026	14	8,351	$2,154,558	$1,244,204	$1,789,500	$1,033,392
2027	15	9,544	$2,462,352	$1,367,257	$1,789,500	$993,646
2028	16	10,737	$2,770,146	$1,479,004	$1,789,500	$955,429
2029	17	11,930	$3,077,940	$1,580,132	$1,789,500	$918,681
2030	18	13,123	$3,385,734	$1,671,294	$1,789,500	$883,348
2031	19	14,316	$3,693,528	$1,753,105	$1,789,500	$849,373
2032	20	15,509	$4,001,322	$1,826,151	$1,789,500	$816,704
2033	21	16,702	$4,309,116	$1,890,985	$1,789,500	$785,293
2034	22	17,895	$4,616,910	$1,948,130	$1,789,500	$755,089
2035	23	19,088	$4,924,704	$1,998,082	$1,789,500	$726,047
2036	24	20,281	$5,232,498	$2,041,310	$1,789,500	$698,122
2037	25	21,474	$5,540,292	$2,078,257	$1,789,500	$671,272
2038	26	22,667	$5,848,086	$2,109,342	$1,789,500	$645,453
2039	27	23,860	$6,155,880	$2,134,961	$1,789,500	$620,628
2040	28	25,053	$6,463,674	$2,155,490	$1,789,500	$596,758
2041	29	26,246	$6,771,468	$2,171,281	$1,789,500	$573,806
2042	30	27,439	$7,079,262	$2,182,669	$1,789,500	$551,736
2043	31	28,632	$7,387,056	$2,189,969	$1,789,500	$530,516
2044	32	29,825	$7,694,850	$2,193,478	$1,789,500	$510,111
2045	33	31,018	$8,002,644	$2,193,478	$1,789,500	$490,492
2046	34	32,211	$8,310,438	$2,190,233	$1,789,500	$471,626
2047	35	33,404	$8,618,232	$2,183,993	$1,789,500	$453,487
2048	36	34,597	$8,926,026	$2,174,993	$1,789,500	$436,045
2049	37	35,790	$9,233,820	$2,163,455	$1,789,500	$419,274
2050	38	36,983	$9,541,614	$2,149,587	$1,789,500	$403,148
2051	39	38,176	$9,849,408	$2,133,585	$1,789,500	$387,643
2052	40	39,369	$10,157,202	$2,115,634	$1,789,500	$372,733
2053	41	40,562	$10,464,996	$2,095,908	$1,789,500	$358,397
2054	42	41,755	$10,772,790	$2,074,569	$1,789,500	$344,613
2055	43	42,948	$11,080,584	$2,051,772	$1,789,500	$331,358
2056	44	44,141	$11,388,378	$2,027,659	$1,789,500	$318,614
2057	45	45,334	$11,696,172	$2,002,366	$1,789,500	$306,360
2058	46	46,527	$12,003,966	$1,976,019	$1,789,500	$294,576
2059	47	47,720	$12,311,760	$1,948,737	$1,789,500	$283,247
2060	48	48,913	$12,311,760	$1,873,785	$1,789,500	$272,353
2061	49	0	$12,311,760	$1,801,717	$0	$0
2062	50	0	$12,311,760	$1,732,420	$0	$0
2063	51	0	$12,311,760	$1,665,788	$0	$0
2064	52	0	$12,311,760	$1,601,720	$0	$0
2065	53	0	$12,311,760	$1,540,115	$0	$0
2066	54	0	$12,311,760	$1,480,880	$0	$0
2067	55	0	$12,311,760	$1,423,923	$0	$0
2068	56	0	$12,311,760	$1,369,157	$0	$0
2069	57	0	$12,311,760	$1,316,497	$0	$0
2070	58	0	$12,311,760	$1,265,862	$0	$0

2071	59	0	$12,311,760	$1,217,175	$0	$0
2072	60	0	$12,311,760	$1,170,361	$0	$0
2073	61	0	$12,311,760	$1,125,347	$0	$0
2074	62	0	$12,311,760	$1,082,064	$0	$0
2075	63	0	$12,311,760	$1,040,447	$0	$0
2076	64	0	$12,311,760	$1,000,429	$0	$0
2077	65	0	$12,311,760	$961,951	$0	$0
2078	66	0	$12,311,760	$924,953	$0	$0
2079	67	0	$12,311,760	$889,378	$0	$0
2080	68	0	$12,311,760	$855,171	$0	$0
2081	69	0	$12,311,760	$822,280	$0	$0
2082	70	0	$12,311,760	$790,654	$0	$0
2083	71	0	$12,311,760	$760,244	$0	$0
2084	72	0	$12,311,760	$731,004	$0	$0
2085	73	0	$12,311,760	$702,888	$0	$0
2086	74	0	$12,311,760	$675,854	$0	$0
2087	75	0	$12,311,760	$649,860	$0	$0
2088	76	0	$12,311,760	$624,865	$0	$0
2089	77	0	$12,311,760	$600,832	$0	$0
2090	78	0	$12,311,760	$577,723	$0	$0
2091	79	0	$12,311,760	$555,503	$0	$0
2092	80	0	$12,311,760	$534,137	$0	$0
2093	81	0	$12,311,760	$513,594	$0	$0
2094	82	0	$12,311,760	$493,840	$0	$0
2095	83	0	$12,311,760	$474,846	$0	$0
2096	84	0	$12,311,760	$456,583	$0	$0
2097	85	0	$12,311,760	$439,022	$0	$0
2098	86	0	$12,311,760	$422,137	$0	$0
2099	87	0	$12,311,760	$405,901	$0	$0
2100	88	0	$12,311,760	$390,289	$0	$0
2101	89	0	$12,311,760	$375,278	$0	$0
2102	90	0	$12,311,760	$360,844	$0	$0
2103	91	0	$12,311,760	$346,965	$0	$0
2104	92	0	$12,311,760	$333,621	$0	$0
2105	93	0	$12,311,760	$320,789	$0	$0
2106	94	0	$12,311,760	$308,451	$0	$0
2107	95	0	$12,311,760	$296,588	$0	$0
2108	96	0	$12,311,760	$285,180	$0	$0
2109	97	0	$12,311,760	$274,212	$0	$0
2110	98	0	$12,311,760	$263,665	$0	$0
2111	99	0	$12,311,760	$253,524	$0	$0
		48,913		$114,028,713	$73,369,500	$27,188,010

Table 45: Municipal Conservation benefits and costs

Year	time period	annual cost ($millions)		Present value ($millions)		Cumulative water conservation	water saved per year	$/af	annual purchase ($millions)	Present value of purchase ($millions)
		low	high	low	high					
2015	1	0.5	1.5	0.48	1.44	285.0	285.0	$1,500	0.43	0.41
2016	2	0.5	1.5	0.46	1.39	570.0	285.0	$1,500	0.43	0.40
2017	3	0.5	1.5	0.44	1.33	855.0	285.0	$1,500	0.43	0.38
2018	4	0.5	1.5	0.43	1.28	1,140.0	285.0	$1,500	0.43	0.37
2019	5	0.5	1.5	0.41	1.23	1,425.0	285.0	$1,500	0.43	0.35
2020	6	0.5	1.5	0.40	1.19	1,710.0	285.0	$1,500	0.43	0.34
2021	7	0.5	1.5	0.38	1.14	1,995.0	285.0	$1,500	0.43	0.32
2022	8	0.5	1.5	0.37	1.10	2,280.0	285.0	$1,500	0.43	0.31
2023	9	0.5	1.5	0.35	1.05	2,565.0	285.0	$1,500	0.43	0.30
2024	10	0.5	1.5	0.34	1.01	2,850.0	285.0	$1,500	0.43	0.29
2025	11	0.5	1.5	0.32	0.97	3,135.0	285.0	$1,500	0.43	0.28
2026	12	0.5	1.5	0.31	0.94	3,420.0	285.0	$1,500	0.43	0.27
2027	13	0.5	1.5	0.30	0.90	3,705.0	285.0	$1,500	0.43	0.26
2028	14	0.5	1.5	0.29	0.87	3,990.0	285.0	$1,500	0.43	0.25
2029	15	0.5	1.5	0.28	0.83	4,275.0	285.0	$1,500	0.43	0.24
2030	16	0.5	1.5	0.27	0.80	4,560.0	285.0	$1,500	0.43	0.23
2031	17	0.5	1.5	0.26	0.77	4,661.3	101.3	$1,500	0.15	0.08
2032	18	0.5	1.5	0.25	0.74	4,762.7	101.3	$1,500	0.15	0.08
2033	19	0.5	1.5	0.24	0.71	4,864.0	101.3	$1,500	0.15	0.07
2034	20	0.5	1.5	0.23	0.68	4,965.3	101.3	$1,500	0.15	0.07
2035	21	0.5	1.5	0.22	0.66	5,066.7	101.3	$1,500	0.15	0.07
2036	22	0.5	1.5	0.21	0.63	5,168.0	101.3	$1,500	0.15	0.06
2037	23	0.5	1.5	0.20	0.61	5,269.3	101.3	$1,500	0.15	0.06
2038	24	0.5	1.5	0.20	0.59	5,370.7	101.3	$1,500	0.15	0.06
2039	25	0.5	1.5	0.19	0.56	5,472.0	101.3	$1,500	0.15	0.06
2040	26	0.5	1.5	0.18	0.54	5,573.3	101.3	$1,500	0.15	0.05
2041	27	0.5	1.5	0.17	0.52	5,674.7	101.3	$1,500	0.15	0.05
2042	28	0.5	1.5	0.17	0.50	5,776.0	101.3	$1,500	0.15	0.05
2043	29	0.5	1.5	0.16	0.48	5,877.3	101.3	$1,500	0.15	0.05
2044	30	0.5	1.5	0.15	0.46	5,978.7	101.3	$1,500	0.15	0.05
2045	31	0.5	1.5	0.15	0.44	6,080.0	101.3	$1,500	0.15	0.05
2046	32	0.5	1.5	0.14	0.43	6,181.3	101.3	$1,500	0.15	0.04
2047	33	0.5	1.5	0.14	0.41	6,282.7	101.3	$1,500	0.15	0.04
2048	34	0.5	1.5	0.13	0.40	6,384.0	101.3	$1,500	0.15	0.04
2049	35	0.5	1.5	0.13	0.38	6,485.3	101.3	$1,500	0.15	0.04
2050	36	0.5	1.5	0.12	0.37	6,586.7	101.3	$1,500	0.15	0.04
2051	37	0.5	1.5	0.12	0.35	6,688.0	101.3	$1,500	0.15	0.04
2052	38	0.5	1.5	0.11	0.34	6,789.3	101.3	$1,500	0.15	0.03
2053	39	0.5	1.5	0.11	0.32	6,890.7	101.3	$1,500	0.15	0.03
2054	40	0.5	1.5	0.10	0.31	6,992.0	101.3	$1,500	0.15	0.03
2055	41	0.5	1.5	0.10	0.30	7,093.3	101.3	$1,500	0.15	0.03
2056	42	0.5	1.5	0.10	0.29	7,194.7	101.3	$1,500	0.15	0.03
2057	43	0.5	1.5	0.09	0.28	7,296.0	101.3	$1,500	0.15	0.03
2058	44	0.5	1.5	0.09	0.27	7,397.3	101.3	$1,500	0.15	0.03
2059	45	0.5	1.5	0.09	0.26	7,498.7	101.3	$1,500	0.15	0.03
2060	46	0.5	1.5	0.08	0.25	7,600.0	101.3	$1,500	0.15	0.03
				$10.44	$31.33					$6.36

E. Fish productivity

In various places abundance is used to represent different characteristics of fish populations. Principally, there are important differences between recruitment and escapement as a measure of abundance of fish, and in different contexts these terms have been used. To prevent confusion we will try to provide a clear distinction.

In the Four Accounts Memorandum, recruitment is explicitly defined as fish mature enough to be exploitable from commercial, subsistence, or sport fisheries, or to spawn, minus the fish that die, prior to spawning, by non-human causes (ECONorthwest, Natural Resources Economics, and ESA 2012). Based on the usage in the Four Accounts Memorandum (U.S. Bureau of Reclamation, HDR Engineering Inc., and Anchor QEA 2011), this amounts to the adult fish arriving in the Columbia River Estuary that are potential spawners, but from which some in-river harvest and loss can occur. In the Four Accounts Memorandum adult fish represent recruitment. For this reason, where possible we have referred to abundance estimates as estimates of recruits.

Escapement is the number of fish that having recruited to the potentially breeding population, survive adult harvest and other in-river sources of mortality to arrive at the spawning grounds as potential spawners. These are the fish that actually arrive in the Yakima basin's spawning grounds to contribute to reproduction and population growth. They are also the property of the population that is estimated from in-basin monitoring programs using redd counts, carcass counts, weirs or other adult enumerations. Escapement is then calculated by expanding these observations often based on the fraction of the habitat sampled (for methodological review of expansions from monitoring data, see: Courbois et al. 2008).

Importantly, the data available on adults from which accessory analysis is performed, is for escapement rather than recruitment. Recruitment in this sense is not easily obtained for Yakima basin wild fish. Indeed, given the methods used in estimating Sockeye salmon abundance relied on the physical capacity of the reservoirs to support spawning adults, there was a conceptual reason to relate population growth to the abundance of fish that actually make it to the spawning grounds. Therefore, when comparing YBIP forecasts with available data on fish abundance we will generally use escapement unless it is specifically noted otherwise.

1. Assessment of existing fish impact estimates

As noted in Section III.D and IV.E the fish benefits of the IP and its component parts relates to the product of the contribution of IP projects to fish abundance and the value of those fish. The accuracy and precisions of the aggregate estimates depends on the accuracy of those population forecasts and value estimates. This section of the appendix focuses in fish population impact forecasts, and the next focuses in valuation.

Population forecasts rely on assumptions and are subject to considerable uncertainty, and in this case the forecasts for each species cover a wide range of values. So it is appropriate to review those forecasts to identify where uncertainties may exist and what relative likelihoods and/or reasonable expectations we may attach to the range of forecasts in the IP. We will consider the sockeye forecasts first and then evaluate the other anadromous salmonids second.

a. *Sockeye: Habitat capacity and historical abundance*

As mentioned above, forecasting the responses of sockeye salmon to the IP is complicated for several reasons. These include that the fish were extirpated from the basin in the early 20th century and the only sockeye currently observed in the basin are either the small numbers of fish that are presumably straying into the Yakima from other, adjacent sub-basins, or are introduced adult sockeye as part of the joint Yakima/Klickitat Fisheries project of the Yakima Tribe and WDFW, and thus not representative of habitat-based production. In addition, the majority of habitat that the IP now proposes to leverage to support a reintroduced sockeye population (i.e. the reservoirs behind the dams) did not exist when the sockeye were in the basin a century ago. Finally, given that sockeye production is estimated based on the capacity of the reservoirs in the basin, the forecasts are entirely dependent on the removal of passage barriers to those reservoirs, and so no other scenarios, such as habitat restoration by itself, were deemed relevant or considered.

The original estimates of sockeye abundance in the Fish Benefits memo (U.S. Bureau of Reclamation, HDR Engineering Inc., and Anchor QEA 2011) used a value of 30 spawners per hectare of lake surface area, and then applied some fixed values of egg-smolt and smolt to adult survival to estimate subsequent adult returns for each reservoir which were then summed. The low, medium and high production scenarios were differentiated by different estimates of reservoir level and different levels of smolt to adult survivorship. The range of forecasts for sockeye adult abundance in all reservoirs (escapement rather than recruitment) was 73,631 to 446,903. Since abundance in the reservoirs was the variable of interest in evaluating the life cycle of this species numbers refer to escapement rather than recruitment; values for recruitment to the Columbia River estuary ranged from 112,243 to 681,255 in the Fish Benefits memo (U.S. Bureau of Reclamation, HDR Engineering Inc., and Anchor QEA 2011; see above for discussion of escapement vs. recruitment).

Subsequent to that report, US BOR (J. D. Hubble 2012) published an Environmental Impact Statement containing a revised estimate of sockeye abundance forecasts resulting from the YBIP. This later revision reflected a more sophisticated ecological approach in that it included a discounting for relative quality of reservoir area in terms of water clarity and production capacity, as well as relating reservoir area to smolt production rather than adult spawner density. This later revision resulted in a significant reduction in the high production scenario forecast. The range of these revised forecasts for sockeye adult abundance in all reservoirs ranged from 112, 428 to 251,310.

Figure 23 shows how these forecasts for sockeye abundance compare with the recent history of abundance. Recent fish counts in the Yakima River system have ranged from 0 to 691 adults, but the forecasts range to the four hundred thousands. Thus, the plotted scale gives the incorrect impression that the current abundance is zero with little or no variance. While the plot does not easily convey the recent abundances of sockeye from monitoring data, it does convey the wide gap between the recent history of abundance and where the YBIP anticipates things to go within the planning horizon. It seems prudent to ask if there is information to allow an assessment of relative likelihood of any of the outcomes within this wide range.

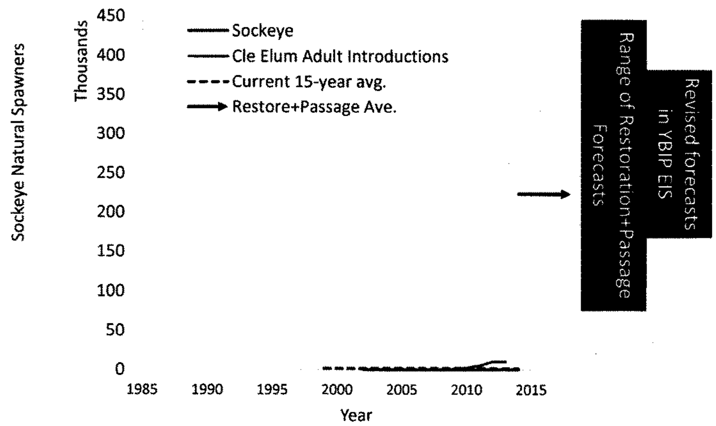

Figure 23: Time series plot of recent adult sockeye salmon abundance scaled to escapement forecasts in the Four Accounts analysis.

Some of this gap results from the modelled capacity of reservoir area to support spawners (30/hectare). The literature suggests that 30 may be at the high end of the range for this value in similar lakes, with other studies estimating the value between 0.1 and 50 sockeye spawners per hectare (Groot and Margolis 1991; Goodlad, Gjernes, and Brannon 1974). Studies have documented higher spawner densities, but the estimates were done in very different watersheds with the highest values in the Siberian far East, and with different anthropogenic impact, freshwater travel distance to the sea, and hatchery influence (Burgner 1991; Groot and Margolis 1991). Parsimony suggests that the reservoirs in the Yakima basin may be variable with spawner densities that will frequently be lower than the modelled estimates in the YBIP.

These forecasts may also be optimistic in light of comparisons to estimates of historical sockeye salmon population sizes in the Yakima. There have been multiple attempts to estimate the size of the populations of sockeye that were present in the system prior to when the dams were built in the early 20th century. Population size estimates have ranged from 100,000 (Davidson 1953) to approximately 200,000 (Gustafson et al. 1997; CBFWA 1990). These estimates are both on the lower end of the range of YBIP forecasts. Indeed, if the IP achieves sockeye population levels near those of the late 19th century (but less than half of the IP forecasts) regardless of management regime, it would be remarkable given the presence of so many other sources of mortality in play now such as mainstem dams and high seas fisheries. With this in mind, it would seem parsimonious to suggest that the forecasts of twice the largest estimate of historical population size (i.e. >400K) be viewed as a very low likelihood.

Importantly, sockeye population forecasts based on reservoir area may exceed historical levels given that the dams built in the early 20th century greatly increased the total lake area in the Yakima basin. On the one hand, the increased area may indeed support increased numbers of fish. On the other hand however, this new lake bottom area has never been shown to sustain sockeye, and it remains to be seen if the naïve lake bottom has suitable quality manifest in fish use. The combination of reintroducing fish to habitat that itself has also been "introduced" in this context makes the IP proposal a more complicated management experiment, and more difficult to predict quantitative responses of fish populations than if the fish were the only re-introduction, as was the case with coho salmon in the Yakima basin.

Independent of the capacity of the habitat to support a larger sockeye salmon population, one needs to ask where the additional fish would come from. Given the current monitoring data showing adult sockeye in the Yakima basin in the range of 40 to ca. 700 individuals over the last five years, it is important to ask what level of population growth would be required to generate a mean population of 100K to 400K fish on the current planning horizon. Based on estimates of current monitoring data of sockeye abundance in the Yakima basin the population growth rates (λ) would have to exceed any known biologically realistic value. Indeed, even extending the time horizon out to 30 years, to 2045, the necessary values of λ would have to exceed 10. A biologically relevant range for λ for a growing population would be between 1.0 and 1.3, with few Columbia River salmon populations exceeding 1.05 (McClure et al. 2003).

As previously mentioned, the Yakima/Klickitat Fisheries project of the Yakima Tribe and Washington Dept. of Fish and Wildlife has been introducing adult sockeye salmon into the Cle Elum reservoir starting in 2009 (Bureau of Reclamation and Washington State Department of Ecology 2012; U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012). The program started with 1000 fish in 2009 and has increased up to 2500 in 2010, 4800 in 2011 and 10,000 in each of the last two years, and are composed of Wenatchee and Lake Osoyoos stocks. There is some variability in the time spent holding in freshwater and in the number of years spent in the ocean, but on average sockeye produced in one brood year will return after four winters have passed (Groot and Margolis 1991). Thus, potential spawners from this program will only be returning in the last two years and may in fact be reflected in the increase in observed sockeye in the basin in 2013 and 2014.

If this program continues, and these introduced adults are incorporated into the breeding population of sockeye, we can re-evaluate the population growth rate necessary to reach the YBIP forecasts (Figure 24). If we include the introduced adult sockeye and estimate the 4-year geometric mean abundance as the standing stock, we then can estimate the abundance of fish at the end of the planning horizons for various population mean growth rates. We use the four-year, geometric mean to accommodate the multi-year population structure, resulting population cycles and high, year-to-year sampling variance as is customary (e.g. McClure et al. 2003). At a population growth rate of 1.05 the current stock would grow to over 12,000 fish in the 10 year planning horizon, and 17,000 fish after 30 years. If the long-term population growth rate is as high as 1.2, then abundances may exceed 16,000 after 10 years, and will enter the lowest YBIP forecasts after 30 years (Figure 24).

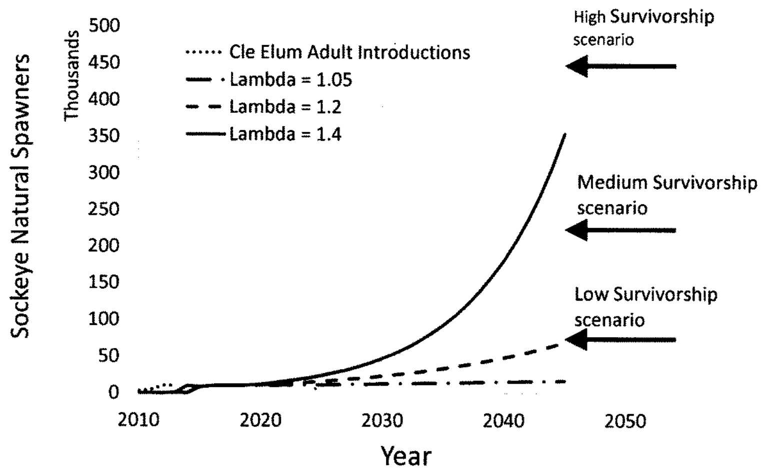

Figure 24: Projections of sockeye salmon abundance based on a range of population growth rates over the BIP planning horizon. These projections incorporate current reintroductions.

Abundances reach the higher end of YBIP forecasts only if the population growth rate is set to an extraordinary high values (e.g. 1.4) and the planning horizon is 30 years. In spite of the limitations this analysis suggests, this introduction program seems to be a requirement for any level of sockeye recovery in the Yakima basin. Given the profoundly low numbers of sockeye currently monitored in the basin, it seems unlikely that even if passage issues are resolved large numbers of adults will recolonize the reservoirs within the forecast time horizons without some intervention such as these introductions. Indeed, the ability of coho reintroductions to sustain in the absence of a parallel, hatchery-based supplementation has been viewed as unlikely (Bosch et al. 2007). Importantly, the costs of maintaining a re-introduction program are not included in the IP cost structure and would represent additional challenge to a favorable B/C ratio.

These estimates require a large set of assumptions for which there is little support from specific studies on these fish. In each case we have allowed what are aggressive assumptions about potential carrying capacity and population growth rates. And yet the results indicate that the higher value estimates in the YBIP are a relatively low likelihood. The lower value estimates for sockeye abundance attributed to the YBIP would on the one hand be a disappointing in terms of balancing the benefit-costs of the IP, but on the other hand would be a major conservation success in approximating historical abundances of an extirpated population. It is likely however, that sustaining this success would still require extended maintenance of the management plan out into the future given reasonable estimates of population growth rates.

The preceding analysis represents a coarse approach; there are undoubtedly more nuanced analyses that would need to be performed to resolve a more specific forecast for sockeye in the Yakima (e.g. explicitly age structured population models, discretized stage-specific survivorship, stochastic population growth, etc.). Embarking on those analyses at this point appears premature. Indeed, introducing hundreds of thousands of "non-native" salmonids into habitat occupied by listed steelhead and bull trout, with whom far more numerous sockeye smolts will surely compete for resources, will certainly require a consultation with the ESA regulatory authorities (NMFS and US FWS). Such consultations would trigger much more involved population status assessments and recovery planning, and make a more detailed analysis at this point moot.

This coarse approach does suggest that it is worth downscaling the anticipated benefits for sockeye that one can attribute to the IP. Given a revised estimate of ***mean*** population abundance, a priori reasons to change the ***relative*** contributions of each of the passage projects are not at hand. Thus, the relative benefits of each project can be estimated once a reasonably discounted estimate of population abundance is resolved. Unfortunately, while we have good support for asserting that the largest forecasts of the IP (681K fish recruiting to the Columbia River) are unlikely, the reasons reviewed above make it difficult to propose a single best alternative estimate.

As stated, asking what is a reasonable level of recovery given the historical capacity of the basin and the present-day sources of mortality is a challenge. There are no entirely comparable case studies of an endangered species that has been so completely extirpated from its range and subsequently reintroduced to sustainable levels. Of the 27 species that have been delisted in the United States several, including Gray whales, Bald Eagles and Brown Pelicans, have been driven to very low population status and have experienced large recoveries (Goble, Scott, and Davis 2005; National Research Council 1995), but these species were never so extensively extirpated from their ranges as have sockeye salmon in the Yakima basin. Example species that have been largely extirpated and reintroduced, such as Mexican Wolves (U.S. Fish and Wildlife Service 2013b), California Condors (U.S. Fish and Wildlife Service 2012) and Black Footed Ferrets (U.S. Fish and Wildlife Service 2013a) have not yet seen a similar, robust level of recovery. As such, the levels of recovery of Yakima sockeye forecast in the IP are unprecedented and thus difficult to which to attach likelihoods.

The closest parallel for sockeye is surely coho salmon in the Yakima. As mentioned above, wild coho were largely extirpated in the 1980's and ongoing hatchery fish releases were leveraged to reintroduce them to the Yakima basin (Dunnigan, Bosch, and Hubble 2002). As highlighted above however, reintroducing coho was not also accompanied by large increases in habitat capacity, and it is unclear if the reintroduction will achieve sustainability independent of supplementation (Bosch et al. 2007) Those limitations aside, estimates of historical coho abundance in the Yakima range from 44,000 to 100,000 (Kreeger and McNeil 1993; Bosch et al. 2007; Yakama Indian Nation, Washington Department of Fisheries, and Washington Department of Wildlife 1990). In the twenty years since the coho reintroduction program started, adult abundance has increased, with a mean of ca. 4,080 over the last 15 years (see below), or means more than an order of magnitude lower than historical abundance estimates. If a similar level of success is achieved with sockeye, one could see abundances of 6,000 to 20,000[57], which while lower than the high abundance forecasts, would still be a considerable achievement in terms of conservation. However, this abundance would only be achieved with significant expense attributed to the hatchery and reintroduction program, none of which are YBIP activities, are included in IP cost structures, nor considered here.

b. *Non-sockeye species: Empirical examination of forecast accuracy*

As mentioned, coho, chinook salmon and steelhead trout population responses to the YBIP were modelled with the EDT process coupled with the All-H simulator. The All-H simulator is an accessory to the population process model that allows the consideration of alternative management scenarios, but its outputs are dependent on the population estimates it receives from EDT. In principle, EDT works on the premise that each habitat unit has intrinsic qualities that affect the survivorship of the fish that encounter it. These qualities can vary across units, and their functional responses can vary across the life history stages and species of fish; a specific feature of a given pool might positively affect the parr of one species, but negatively affect smolts of a different species. If the unit-level estimates are accurate, one could sum them up over all units for all life stages of each species and forecast the abundance of fish and have quantitative associations between abundance and habitat quality – allowing the prioritization of specific habitat improvement actions. Conceptually, this is a rational approach.

In actuality, this approach has a number of limitations. Many of these limitations have been summarized elsewhere (Paine et al. 2000; McElhany et al. 2010) and so here will not be repeated in detail but only as a list of relevant highlights. From a statistical point of view, this approach is a multi-regression with many (many hundreds to thousands, McElhany et al. 2010) parameters used to estimate numbers of fish in the future. This is widely recognized as over-parameterization, and it results in the generation and propagation of errors and generating untestable predictions (Burnham and Anderson 2002; Freedman and Freedman 1983; Freedman, Navidi, and Peters 1988; Leinweber 2007). In addition, this approach makes demands on the habitat quality data far in excess of available monitoring data. For those many EDT parameters for which fish and habitat data are lacking, experts are polled for their opinions on what the actual values are likely to be. Thus, much of EDT products result from an "expert-panel" process rather than a data-based, scientific process. As such, many of the uncertainties that exist within the process that might otherwise influence our characterization of the uncertainty in the ultimate forecasts are subjective, based on opinion rather than data, and ultimately unknowable. Due to its high spatial resolution, EDT does provide very specific forecasts, although its uncertainties mean its accuracy cannot be evaluated. This is an important distinction, that EDT is an expert-panel process does not make its predictions wrong, but it does limit the ability for a scientific review to test its predictions. That said, the limited literature that attempts to characterize the reliability of EDT forecasts has indicated that it has relatively poor performance and is not useful for forecasting population sizes based on habitat assessment (McElhany et al. 2010).

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[57] The historical sockeye population size of 200,000 times the rate of current coho per historical coho (4,080/100,000) result in an equivalent success level of 8,160 sockeye as a benchmark.

With those cautions in hand, it should be acknowledged that there are few alternatives to EDT to deploy in this context. In order for an alternative modelling framework to perform better than EDT and also provide a basis for scientific testing of the habitat-basis for its fish population forecasts, such an alternative would require far more environmental and fish monitoring data than are currently available. In addition, a far more extensive information base on the functional relationships between each habitat character and specific life-stage survival of fish would be required than currently exists. Absent the necessary data and knowledge bases, the alternatives to EDT are only able to make very imprecise estimates, although their accuracies and uncertainties can be evaluated.

Absent independent measures of uncertainty from the expert panel process, it is difficult to attach likelihoods to the range of forecasts for fish benefits in the YBIP. One approach adopted here is to compare the range of forecasts in the YBIP with recent histories of fish abundances in the Yakima basin. We can evaluate this comparison through the habitat-capacity lens described above; we can create opportunities for fish to exploit new or improved habitat, but that is only an opportunity – we cannot create new fish.

If we plot the time series of estimates of spawners for the various species for the last 15-30 years for Fall and Summer chinook and coho salmon and steelhead trout, we can then compare these to the YBIP forecasts for these species (Figure 25). There are some common features across these comparisons. All of these fish were at very low abundance (<5000 per annum) in the period prior to 1998, and then experienced large increases (5000-10,000 per annum) in the period since, with in some cases large year-to-year variability. This is consistent with current population process models that attribute large, saltatory changes in survivorship to alternation of ocean conditions (Logerwell et al. 2003; Lawson et al. 2004; Mark D. Scheuerell and Williams 2005). This observation has the additional implication that caution is required in evaluating recent increases in abundance; recent step-change increases, in the presence of large inter-annual variation, could easily be mistaken for an increasing trend, but which could as easily be followed by a step decrease as ocean conditions revert to prior states.

Also evident in these figures, the potential forecast increase in fish numbers due to passage beyond that due to habitat improvement is quite small for these species (i.e. the difference between green and black vertical bars). This is consistent with our understanding of their ecology, and lack of exploitation of the reservoir habitats (for review see: Groot and Margolis 1991). This provides a foundation for attributing fish benefits to specific component actions in the YBIP; passage projects are anticipated to generate benefits for sockeye salmon, flow management and habitat restoration provide benefits for non-sockeye.

Another common feature of these forecasts is that the lower range of the forecasts for all scenarios are only marginally, although consistently, higher than the recent (15-year) average population size. While one could suggest that the lowest forecast expectations are optimistic given that they are somewhat larger than the recent past, this difference is modest. More importantly, that these lower bounds are similar to recent abundance estimates is consistent with our understanding of the recovery paradigm outlined above. Specifically, that forecasts need to include current values within the range for forecasts because our management can create opportunities for fish, but cannot force the numbers of fish to increase.

These comparisons do suggest a basis for evaluating the relative likelihoods for the range of forecasts provided by the EDT process. As pointed out above, we lack explicit estimates of the uncertainties in the EDT forecasts. However, when we compare them to the recent history of spawner estimates, we see that the lowest forecasts are similar to recent conditions that they go up from there. Given that there is a large amount of autocorrelation in the time series of spawner abundance (Fall chinook first order autocorrelation coefficient = 0.705, Spring chinook = 0.516, steelhead = 0.603, coho = not sig.), we can expect any given trajectory of future spawner

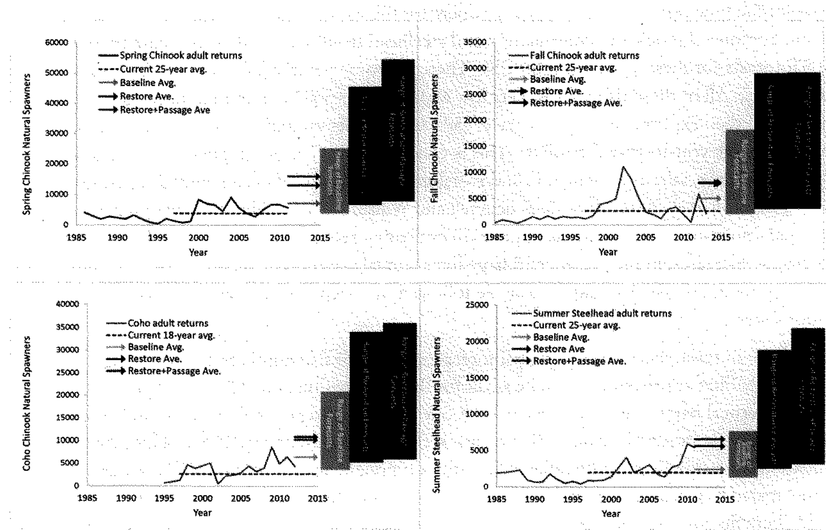

Figure 25 Time series of recent adult spawner estimates for A) spring chinook, B) fall chinook, C) coho and D) steelhead trout in the Yakima Basin. In each case the time series are compared with the estimates of escapement for each species from the Fish Benefits Memorandum for the Baseline, Restoration and Restoration plus Passage scenarios (U.S. Bureau of Reclamation, HDR Engineering Inc., and Anchor QEA 2011).

abundances to be more similar to, rather than more different from current conditions. While we cannot yet forecast how quickly the probability will decrease going from the low to high abundance forecasts, all things being equal we do expect the probability to decrease going from the low end to the high end of the forecasts range.[58] Importantly, this is a "weight of evidence" and parsimony approach, rather than a statistical test.

2. The role of habitat and flow in salmonid survival

As described above, the YBIP proposes a strategy for salmonid recovery and resulting economic benefits that is based on a set of tactics to change passage, in-stream flow and habitat quality. We have further dichotomized passage as a prerequisite for sockeye salmon recovery, but habitat restoration and flow as principally focused on the other anadromous species. These benefit estimates arise from the EDT process (described above), the predictions of which are based on expectations for changes in habitat unit-based survival impacts, rather than being based principally on historical relationships between survival and habitat variability. Data on in-stream flow in the basin, the history of habitat restoration in the Yakima basin and contemporary estimates of smolt production and adult spawner abundance do exist. Thus, we can evaluate the degree to which variability in potential predictor variables predict estimates of salmon survival in order to estimate the potential population effects of changes in flow or habitat restoration.

Using available time series data on adult and smolt abundance for each species, abundance of restoration actions, spill at McNary dam and flow residuals in the lower mainstem Yakima river (see Sections III.D and Appendix Section VII.E.a), we built statistical regression models where we predict the smolt to adult return (SAR) and smolt produced per adult spawner (SPA) for each species within the years we have data for with measures of restoration Projects, Flow and Spill. We use these models to test the hypothesis that there are measurable effects of Flow and Restoration with which we may evaluate the fish benefits in the YBIP that are attributable to specific management outcomes.

a. *Data and analysis details*

The data and methodological details of the above statistical analysis are presented below, along with full regression output.

(1) *Salmonid data*

(a) Steelhead

Data on the annual escapement for wild adult steelhead were obtained for the period of record (1980-2013) available from Washington Department of Fish and Wildlife (WDFW) (WDFW 2014). The same source provided annual escapement data at the resolution of major sub-basins in which steelhead are known to spawn, including the Upper Yakima River sub-basin (1992-2013), Satus Creek sub-basin (1988-2013), Toppenish Creek sub-basin (1989-2013), and the Naches River sub-basin (1994-2013). Annual escapement estimates for the entire Yakima River basin are based on

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[58] This is to say that the probability density function will tend to be higher on the left (low end of future abundance) and lower at the high end of abundance.

counts at Prosser Dam plus tribal harvest below Prosser and minus sport and tribal harvest above Prosser. Escapement estimates for the major geographic areas were calculated using a combination of fish counts at Prosser and Roza Dams, combined with estimates of mortality and movement (based on historical radio-tracking), using the expansion method developed by the ICTRT (2008). In addition to dam counts, redd counts are conducted over the course of the spawning season by foot and as weather allowed season in several tributaries in the Satus Creek and Toppenish Creek geographic areas, with that data also being incorporated into the expansion method (ICTRT 2008).

Data on juvenile steelhead was based on information provided by StreamNet (www.streamnet.org, 5 August, 2014), in which we obtained data for the Upper Yakima River (HUC 4 #17030001), Naches River (HUC 4 #17030002), and the Lower Yakima River sub-basin and tribs (HUC 4 #17030003). We used two types of data. First, we obtained estimates of steelhead smolt passage at Chandler Juvenile Monitoring Facility (CJMF), where daily counts are expanded by the canal entrainment, canal survival and sub-sampling rates to estimate daily passage at Prosser Dam and from smolt trapping efforts in Satus, Toppenish and Ahtanum Creeks (Neeley 2000). Second, we compiled estimates of steelhead smolt capacity for all sub-basins listed on StreamNet (www.streamnet.org, 5 August, 2014) and summed the estimates for each major geographic area to generate a total smolt capacity estimate. Methodology for model estimates is described in Fast et al. (1989).

(b) Chinook salmon

Data on the annual escapement for wild and hatchery chinook salmon were available at the scale of three major sub-basins were obtained for the period of record (1984-2013) available from WDFW (WDFW 2014). Data for the Upper Yakima River (1984-2013) were based on Roza Dam counts and a census of hatchery and wild fish from 1997 to present, while the escapement estimate for the Naches River sub-basin were based on counts at Prosser Dam minus harvest above Prosser and minus the Roza Dam count. Escapement estimates for the American River geographic area were based on Prosser Dam counts minus harvest below Prosser and minus Roza Dam, and that number is multiplied by the proportion of redds in the American River sub-basin (American/Naches+American). Data on Yakima River fall chinook salmon for the Lower Yakima sub-basin were based on fish counts at Prosser Dam from 1983-1999 and redd count surveys below Prosser Dam from 1999-2013, which were conducted by the Yakama Nation fisheries personnel in the main-stem Yakima River once per week for six weeks during the spawning season.

We relied on three types of data for juvenile chinook salmon. First, we used the number of hatchery chinook salmon smolts released at three acclimation ponds on the main-stem Yakima River from 2000-2011, including Clarks Flat, Easton, and Jack Creek (Sampson, Fast, and Bosch 2012). Second, we used estimates of wild and hatchery chinook salmon smolt production in the Yakima River basin for 2000-2010 from Sampson et al. (2012) and from StreamNet (www.streamnet.org, 6 July, 2014). Lastly, we compiled estimates of chinook salmon smolt capacity for all sub-basins listed on StreamNet (www.streamnet.org, 6 July, 2014) and summed the estimates for each major geographic area to generate a total smolt capacity estimate via Fast et al. (1989).

(c) Coho salmon

Data on the annual escapement for adult coho salmon, number of adults estimated to spawn in the Yakima River basin, were obtained for the period of record, 1995-2013 (Washington Department of Fish and Wildlife 2014). The period of record is shorter for coho salmon because they were extirpated and then reintroduced in the early 1990's (YRBS-FBATM 2011). Escapement estimates are based on fish counts at Prosser Dam, excluding jacks, although those estimates are likely high because several hundred fish a year may be removed for hatchery brood stock.

We accessed two types of data on juvenile coho salmon. First, we used the number of hatchery coho salmon smolts released from 2000-2011. We also used estimates of coho salmon smolt passage at CJMF for 2000-2005 at StreamNet (www.streamnet.org, 6 July, 2014), where daily counts are expanded via raw counts of smolts (Forrest 1998).

(d) Sockeye salmon

Data on the annual escapement for adult sockeye salmon, number of adults estimated to spawn in the Yakima River basin, were obtained for the period of record (2002-2013) available at Roza Dam (http://www.cbr.washington.edu/dart/query/adult_daily). Escapement estimates are unaltered counts from the dam, although in recent years (2009-current) a large number of adult sockeye salmon have been recaptured from other locations in the Columbia River and transported into the upper Yakima River to jumpstart recovery (http://yakamafish-nsn.gov/restore/projects/sockeye). Data on juvenile sockeye salmon was not available.

(2) *Habitat data*

(a) Habitat Restoration Actions

Measures of habitat restoration projects are total project number with a completion date in the year prior to the salmon outmigration year. Data were compiled from the Pacific Northwest Salmon Habitat Project Database (PNSHP, Katz et al. 2007b). Restoration project data are reported as total projects regardless of type as the metadata for extent and complexity of each project are not available.

(b) Time series of Spill and Flow

In June 2005, the U.S. district court (="the Redden Court") granted a preliminary injunction requiring NMFS, via the US ACE & Bonneville Power Administration, to increase flow and spill at certain FCRPS dams starting the summer of 2005 and continuing (U.S. Court of Appeals for the Ninth Circuit - 481 F.3d 1224). The premise was that increasing water flux through the mainstem hydro-system would improve survival of outmigrating fish. Under this injunction a set of operating rules were put in place where some dams (e.g. Bonneville) had fixed values of spill, but others (e.g. McNary) had spill that was a specified fraction of discharge and was therefore variable.

Data on daily discharge and spill from McNary Dam was downloaded from the Fish Passage Center at www.fpc.org/river/flowspill/flowspill_query.html . Daily data was summed to estimate average daily spill for each month from January, 1990 to August, 2014. A plot of the monthly spill values for these years is presented in Fig. 25.

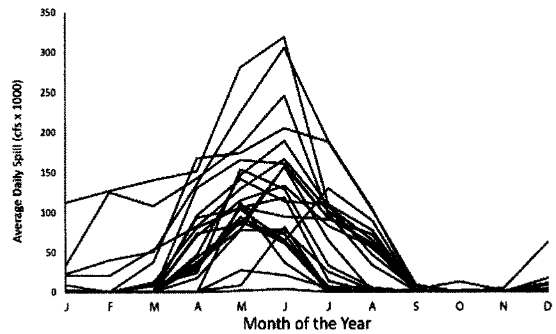

Figure 26. Daily average Spill at McNary dam for each month of the year from 1990 to 2014.

The seasonal pattern of spill is characterized by a highly variable spring and summer season, with a more regulated fall and winter. From a statistical point of view, the high variability seen in the summer months conveys the greatest signal of year to year difference. In addition, it is the time of year when much of the smolt outmigration reaches the mainstem river. For these reasons, the four months of May, June, July and August were averaged to produce an average value for each calendar year considered in the modelling that follows.

Measures of Flow represent flow within the Yakima basin, measured at the USGS stream gauge at Kiona, WA (USGA Stream Gauge 12510500; http://waterdata.usgs.gov/usa/nwis/uv?site_no=12510500). Average daily flow for each month of the year is plotted in Figure 27 for this period. Analysis of monthly average flow over the prior 25 years indicates that the greatest variance, and therefore statistical signal, of year-to-year variability occurs in the Spring months which also coincides with a large fraction of smolt outmigration (Groot and Margolis 1991). On that basis, flow for each year is reported as the average of April-May-June (AMJ). This index of flow and Spill share significant correlation (r = 0.9) and this lack of independence is a problem in linear model estimation. Therefore, this index of flow was regressed on Spill, and the residuals used in the linear models under the label Flow.

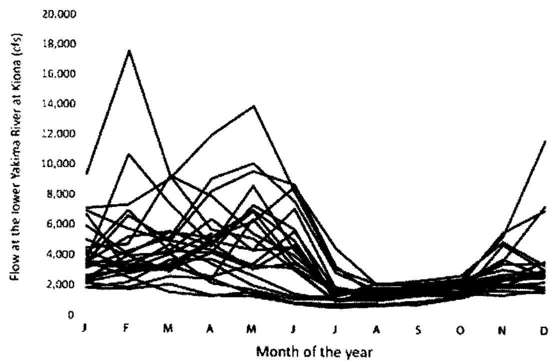

Figure 27: Daily average flow in the lower Yakima River measured at Kiona, WA, for each month of the year from 1990 to 2014

b. *Statistical modelling of fish survivorship and habitat management actions and flow*

Available data for fish spawner abundance and smolt production were combined to estimate the average number of adults returning to the basin per smolt outmigrant at an earlier time (SAR), and the number of smolt outmigrant fish per adult spawner abundance at an earlier time (SPA). SAR is a more common measure of salmonid survival, and in this case provides an index of fish survival for the part of the life history outside the Yakima basin. Relative survival over this period is anticipated to reflect in part fish condition developed in the prior portion of the life history, but is dominated by mortalities that accrue to the population from mainstem and ocean events (e.g. M.D. Scheuerell and Williams 2005).

Outmigrating smolts per adults in prior years is a less common metric of fish survival. This is because SAR's can be calculated from counts of individual fish passing mainstem dams, where the fish have a unique identifier from an acoustic or passive integrated transponder (PIT) tag. The rate of adult and smolt passage can be estimated without having detailed information about where the adults were going after leaving the mainstem Columbia. In this study, we have adults and smolts counts for fish originating and ending in the Yakima basin and so we can also estimate the freshwater portion of the life history with SPA.

Salmon within a single population do not either outmigrate nor return as adults at the same age (Groot and Margolis 1991), with spawners often ranging from 2 to 7 years of age with a broad distribution of spawner ages that varies with population within species. Exact estimation of both SAR and SPA require detailed knowledge of the age structure of the fish, which we lack in this study. Therefore, we adopted an average value for each life stage of each species and referenced time to the year of smolt outmigration. For steelhead trout the SAR's are estimated using the estimated number of adults returning two years after the smolts outmigrate, while the SPA is estimated as the number of smolts normalized by the estimate of adult abundance two years prior.

Both chinook salmon types have SAR's estimated using the estimated number of adults returning three years after the smolts outmigrate, but Spring chinook SPA's are estimated as the number of smolts normalized by the estimate of adult abundance two years prior, while Fall chinook SPA's are estimated using the estimated adult abundance one year prior to smolt outmigration. Coho salmon SAR's are estimated using estimated adult abundance three years after smolt outmigration, while the SPA is estimated with estimated adult abundance the year prior to smolt outmigration. While this approximation is not unusual, it is a simplification that introduces some error to the estimates of SAR and SPA. As long as the age structure of the returning adults does not vary profoundly, and as long as the year-to-year variation in age structure is stochastic rather than systematic, this simplification may lower precision of the estimates, but not the accuracy.

What follows are the detailed results from the statistical analysis of relationships between flow, spill and habitat restoration actions and our estimates of salmonid survival metrics (SAR & SPA). The data are presented for Steelhead trout, fall chinook, spring chinook and coho salmon in turn, in each case models are constructed to predict first SAR's and then SPA's. In each case, results are presented for the linear model estimates first, and the analysis of variance second. The estimates for the coefficients of the linear model are statistical estimates of the effect size, which in this case can be interpreted as expected change in the output variable (SAR or SPA) per unit change in the input variable (e.g. Flow). The analysis of variance on the other hand, expresses the degree to which the variance in the predictor set of variables predicts the variability in the output variables. It is possible, and observed below, for linear models to be able to predict the temporal pattern of variability in output variables well (= with high statistical significance) without any one predictor variable having a significant effect – i.e. no single predictor variable has an effect size that would allow one to say with confidence "we expect an XX% change in survivorship per unit change in flow."

Each model starts as a complete model with all possible main effects and interactions. Alternative models are selected using backward selection, where individual variables are removed and the fit of the model is evaluated with Akaike Information Criteria (AIC), which is a statistical method that takes the goodness of fit of the model and discounts it by the number of parameters used to estimate the model (Burnham and Anderson 2002). Up to a point, the more parameters that exist in a given model, the better that model will predict the data. Therefore, AIC "penalizes" more complex models to balance the goodness of fit with a reasonable complexity of statistical model (for detailed review, see: Burnham and Anderson 2002). The models reported below are those with the smallest AIC score, which along with the r^2 is reported in each case. All statistical models were performed in the R programming environment (R Core Team 2012).

c. *Modelling Results*

The results are mixed. In each case, different combinations of Flow, Spill and Projects and their statistical interactions produced the best fit of the statistical model to the observed time series of survival. The complete descriptions and tests for significance for the best models based on AIC are presented below in Tables 46-61. In two cases, SPA for coho and SAR for fall chinook, the time series was short and lack sufficient degrees of freedom to establish statistical significance. In the remainder, restoration Projects and some combination of Flow and/or Spill were common terms in the best fitting model of the survival data. Steelhead SAR's and spring chinook SPA's are examples of particularly good correspondence between the data and the models.

(1) *Steelhead*

Table 46: Steelhead SAR regression

Model: Projects + Spill + Flow + Projects:Flow (AIC=-52.093)				
Coefficients	Estimate	Std. Error	t value	p
Intercept	0.019970	0.025720	0.776	0.45
Projects	0.002147	0.000741	2.898	0.011
Spill	0.000441	0.000291	1.517	0.15
Flow.res	-0.000028	0.000018	-1.533	0.146
Projects:Flow.res	0.000001	0.000001	1.885	0.079

Table 47: Steelhead SAR ANOVA

ANOVA	Df	Sum Sq	Mean Sq	F-value	p-value
Projects	1	0.0298	0.0298	9.395	0.00786 **
Spill	1	0.00272	0.002717	0.858	0.36903
Flow.res	1	0.00002	0.000016	0.005	0.94425
Projects:Flow.res	1	0.01125	0.011254	3.553	0.07895
Residuals	15	0.04751	0.003167		

Table 48: Steelhead SPA regression

Model: Projects + Spill + Projects:Flow (AIC: 207.26)				
Coefficients:	Estimate	Std. Error	t value	p
(Intercept)	18.882	15.72144	1.201	0.2462
Projects	-0.0715	0.644335	-0.111	0.91294
Spill	0.622137	0.170745	3.644	0.00201 **
Projects: Spill	-0.01362	0.006015	-2.264	0.03694 *

Table 49: Steelhead SPA ANOVA

ANOVA	Df	Sum Sq	Mean Sq	F-value	p
Projects	1	9618	9618	11.074	0.00398 **
Spill	1	7291	7291	8.394	0.01002 *
Projects:Spill	1	4452	4452	5.126	0.03694 *
Residuals	17	14765	869		

(2) *Spring Chinook*

Table 50: Spring Chinook SAR regression

Model: Projects + Spill + Flow + Projects:Flow (AIC: -72.192)				
Coefficients:	Estimate	Std. Error	t value	p
(Intercept)	0.0129000	0.0155600	0.829	0.4201
Projects	-0.0001751	0.0004483	-0.391	0.7015
Spill	0.0002882	0.0001759	1.639	0.1221
Flow	0.0000257	0.0000110	2.334	0.0339 *
Projects:Flow	-0.0000006	0.0000004	-1.553	0.1413

Table 51: Spring Chinook SAR ANOVA

ANOVA	Df	Sum Sq	Mean Sq	F-value	p
Projects	1	0.000267	0.000267	0.23	0.6384
Spill	1	0.008287	0.008287	7.147	0.0174 *
Flow	1	0.004108	0.004108	3.543	0.0794
Projects:Flow	1	0.002796	0.002796	2.411	0.1413
Residuals	15	0.017392	0.001159		

Table 52: Spring Chinook SPA regression

Model: Projects + Spill + Flow + Projects:Spill + Projects:Flow (AIC: 226.14)				
Coefficients:	Estimate	Std. Error	t value	p
(Intercept)	31.44871	18.26929	1.721	0.104453
Projects	0.776971	0.82863	0.938	0.36236
Spill	0.931162	0.225234	4.134	0.000779 ***
Flow	-0.02232	0.011607	-1.923	0.07243
Projects:Spill	-0.02372	0.007854	-3.02	0.008134 **
Projects:Flow	0.000661	0.000342	1.932	0.071323

Table 53: Spring Chinook SPA ANOVA

ANOVA	Df	Sum Sq	Mean Sq	F value	p
Projects	1	9402	9402	7.58	0.0141 *
Spill	1	9384	9384	7.566	0.0142 *
Flow	1	106	106	0.086	0.7734
Projects:Spill	1	7418	7418	5.98	0.0264 *
Projects:Flow	1	4628	4628	3.731	0.0713
Residuals	16	19846	1240		

(3) *Fall Chinook*

Table 54: Fall Chinook SAR regression

Model: Projects (AIC: -19.704)				
Coefficients:	Estimate	Std. Error	t value	p
(Intercept)	0.100681	0.036759	2.739	0.0169 *
Projects	-0.00106	0.001651	-0.643	0.5314

Table 55: Fall Chinook SAR ANOVA

ANOVA	Df	Sum Sq	Mean Sq	F value	p
Projects	1	0.00503	0.005034	0.413	0.531
Residuals	13	0.15828	0.012175		

Table 56: Fall Chinook SPA regression

Model: Projects + Spill + Flow + Spill:Flow (AIC: 172.6)				
Coefficients:	Estimate	Std. Error	t value	p
(Intercept)	67.97457	30.60973	2.221	0.0506
Projects	-1.32845	1.045703	-1.27	0.2327
Spill	0.106127	0.355963	0.298	0.7717
Flow	-0.0556	0.027551	-2.018	0.0712
Spill:Flow	0.000621	0.000241	2.584	0.0272 *

Table 57: Fall Chinook SPA regression

ANOVA	Df	Sum Sq	Mean Sq	F value	p
Projects	1	12289	12289	3.134	0.1071
Spill	1	9628	9628	2.456	0.1482
Flow	1	1521	1521	0.388	0.5473
Spill:Flow	1	26177	26177	6.677	0.0272 *
Residuals	10	39207	3921		

(4) *Coho*

Table 58: Coho SAR regression

Model: Projects + Spill + Flow + Spill:Flow (AIC: -12.872)				
Coefficients:	Estimate	Std. Error	t value	p
(Intercept)	-0.079130	0.090090	-0.878	0.4135
Projects	0.005340	0.002306	2.315	0.0598
Spill	0.001896	0.001173	1.617	0.157
Flow	-0.000072	0.000090	-0.802	0.4533

Spill:Flow	0.000001	0.000001	1.422	0.2048

Table 59: Coho SAR ANOVA

ANOVA	Df	Sum Sq	Mean Sq	F value	p
Projects	1	0.08565	0.08565	7.655	0.0326 *
Spill	1	0.00228	0.00228	0.204	0.6676
Flow	1	0.04841	0.04841	4.327	0.0827
Spill:Flow	1	0.02263	0.02263	2.023	0.2048
Residuals	6	0.06714	0.01119		

Table 60: Coho SPA regression

Model: Spill:Projects (AIC: 76.392)				
Coefficients:	Estimate	Std. Error	t value	p
(Intercept)	10.69803	2.420208	4.42	0.00129 **
Spill: Projects	-0.00069	0.000583	-1.186	0.263

Table 61: Coho SPA

ANOVA	Df	Sum Sq	Mean Sq	F value	p
Spill: Projects	1	34.88	34.88	1.407	0.263
Residuals	10	247.9	24.79		

These results suggest that intensity of restoration, flow and spill variability play some role in determining the pattern of temporal variability in fish survivorship in the Yakima basin. However, the pattern of temporal variability in survivorship is different from a net change in survivorship or the amount of fish. To evaluate the effect of a unit change in Projects, Spill or Flow on changes in survivorship we look to the estimates of the coefficients in the fitted models. These coefficients are presented in Table 62 below, normalized by the estimate of the mean survivorship (= the "intercept" in the models), and reported as a percentage. Some of them are statistically significant, some are not, but our ability to estimate the values to a statistical significance does not provide a measure of their relative impact on survivorship metrics, which are also intrinsically highly variable. Therefore, also listed in Table 62 are measures of coefficient of variation (CV's) of the survivorship metrics, which is a measure of variability in the signal and estimated as the mean value normalized by its standard error and expressed as percent.

Table 62: Fish survival regression results.

Species Survival metric	CV (%)	Ratio of effect size for *Projects* and *Flow* to estimate of intercept (=mean) in best linear model	
Steelhead			
SAR	79.847	10.751%	*Projects*
		-0.140%	*Flow*
SPA	112.94	-0.379%	*Projects*
		r.f.m.[1]	*Flow*
Spring Chinook			
SAR	132.03	1.357%	*Projects*
		0.199%	*Flow*
SPA	123.48	2.471%	*Projects*
		0.071%	*Flow*
Fall Chinook			
SAR	111.91	1.055%	*Project*
		r.f.m.	*Flow*
SPA	74.570	1.954%	*Projects*
		0.082%	*Flow*
Coho			
SAR	74.926	6.748%	*Projects*
		0.091%	*Flow*
SPA	60.442	r.f.m.	*Projects*
		r.f.m.	*Flow*

(r.f.m. = removed from model due to lack of predictive power)

The important result of this analysis is the small effect size for Project and Spill. Looking at SPA's, which are the survivorship metric affected principally by YBIP implementation, Flow and Project have normalized effect sizes that range from 0.33% to 2.6% of the intrinsic variability in the survivorship metric. In addition, these effects are not consistently in the same direction; sometimes the effect is positive (Projects on Steelhead SAR's), and sometimes the effect is negative (Projects on fall chinook SAR's). This small relative magnitude and inconsistency in the direction of the impact, in the face of a highly variable signal does not support a credible forecast of numbers of adult fish in the basin that can be attributed to individual components of the YBIP plan.

This is an important distinction; the predictor variables do contain information that allows us to use them to predict the variability in fish survivorship, or indeed to detect a prior expression of restoration or flow effectiveness, but they contain poorer information with which to estimate absolute values of survivorship into the future. The absolute values of survivorship are determined more so by other drivers, some of which like ocean conditions and harvest rates, we are aware of, some of which we may not yet know. In either event, they are predictors we don't have access to in our modelling framework and do not appear to be under the control of the YBIP management program. In addition, resolving the limitations on the predictive power of restoration Projects and

Flow on fish survival also illuminates the reasons we are not able to make credible forecasts for fish abundance changes based on individual components of the IP; the effect sizes are too small to support individual forecasts with any certainty.

F. Fish valuation

This appendix supplements the discussion in the main text on valuing fish improvements. This appendix begins with a discussion of methods and the broader economic valuation literature that provide general support for the Four Accounts methods and results. We next provide more detail on the criticisms of the LBP valuation study and its application to the IP. The section concludes with a focus on two criticisms that are amenable to sensitivity testing: the time needed to achieve fish population increases and the "baseline" population of fish in 2012. We provide more detail on how we adapt the LBP valuation function for these calculations, and report results.

1. The LBP study and similar valuation studies

The LBP study is just one of many fish valuation research efforts that has been conducted since the 1980's. Many use the same valuation methodology (contingent valuation, CVM), estimating the value of various salmon species in Washington, Oregon, California, Rhode Island, Maine (Atlantic salmon) and Canada. Other studies do not collect their own primary data, but use existing studies to "transfer" the benefit estimate or function to their specific study site and species improvement. Because the IP's fish improvement and management plan do not match exactly those given respondents in the LBP study, the Four Accounts study is also a benefit transfer approach. A third type of study (meta-analyses) statistically compare willingness to pay for different threatened and endangered species across different sites.

We extensively assessed existing studies and conducted a sensitivity analysis on the effect of using other valuation studies or methods to calculate the benefits of the "low-end" fish estimates in the Four Accounts. Table 63 lists the other studies we found valuing salmon in the United States since the 1990's. We exclude studies before 1990 because a) household preferences are likely to have changed significantly over such a long time period and b) older studies are more likely to have used methods that are now considered less reliable. Table 64 compares estimates from the LBP (applied to the IP's low-end fish estimates) with those that might result from use of other valuation studies. As the table demonstrates, using a functional form from existing meta-analyses of willingness to pay for threatened or endangered species would lead to even higher estimates. The table also shows how sensitive the benefit estimates are to a) discount rates, b) standing (Washington residents only), c) changes in real income and differences in assumed income elasticity (the percentage increase in WTP with a 1% increase in income.

Table 63. Comparison of Willingness-to-Pay Estimates for Anadromous Salmon in the United States, Post- 1990

Year	Type*	Authors	Study location	Sample size	Pmt Per.	Pmt Freq	Baseline (1000s fish)	Change (1000s fish)	WTP	Pmt mech
1990	CVM - DC	Hanemann, Loomis, Kanninen	CA, OR, WA	1003	NS	Ann.	0.1	15	$324	taxes
1991	CVM - OE	Olson, Richards, Scott	WA, OR, ID, MT	1400	one-time	Mo.	2500	2500	$49 - $137	electric bill
1991	CVM - DC	Stevens et al	MA	1000	5 yr	Ann.	NA	complete loss	$13 (Atlantic salmon only)	trust fund
1992	CVM - OE	Duffield and Patterson	MT	796	one-time	lump sum	NS Status Quo	NS	$31	trust fund
1996	MA	Loomis & White	NA	NA	NA	NA	NA	NA	$100	NA
1996	CVM - DC	Loomis	WA & USA	1174	10 yr	Ann.	50	350	$91 - $113	taxes
2001	CVM – R	Layton, Brown, Plummer	WA & OR	1611	20 yr	Mo.	2000	3000	$167	utility bill
2003	CVM - DC	Bell, Huppert, Johnson	WA & OR	2209	5 yr	Ann.	64 - 69	64 - 146	$101 - $162 (WA)	taxes
2006	WTP - MC	Montgomery and Helvoigt	OR	5300	NS	Mo.	SQ	NS	$15 - $46 (mode)	utility bill
2007	BT (LBP 1999)	Goodstein and Matson	OR & WA	NA	NA	NA	NA	33 - 66% decrease	$33-$144	NA
2008	MA	Martin-Lopez et al	NA	NA	NA	NA	NA	NA	$76 - $149	NA
2009	MA	Richardson, L. and Loomis, J.	NA	NA	NA	NA	NA	NA	$92	NA
2009	BT (Loomis 1999)	Helvoigt and Charlton	OR	NA	NA	NA	NA	NA	$33	NA
2009	CVM - CE	Rudd, M.	Canada	2761	20 yr	Ann.	SQ	50 - 200% increase	$86	taxes
2012	CVM - CE	Johnston et al	RI	522	NS	Ann.	SQ	NS	NA	taxes
2012	CVM - CE	Wallmo, K. and Lew, D. K.	US	8476	10 yr	Ann.	SQ	De-list as threatened	$40	taxes
2012	CVM - CE	Mansfield et al	OR & CA	3,372	20 yr	Ann.	SQ	30 – 150% increase	$121 - $213	Taxes

Notes: *Primary valuation approaches include the contingent valuation method (CVM), benefit transfer (BT), and meta analysis (MA). CVM studies can be further classified by the survey response format: dichotomous choice (DC), open-ended (OE), choice experiment (CE), or censored ranking (R). Some survey characteristics are not applicable to individual studies (NA) or are not specified in individual studies (NS). Full references for the studies are available from the authors on request.

Table 64. Sensitivity of YBIP Low – End Fish Benefits* to Alternative Modelling Assumptions.

Scenario and Description	Fish Pop Increases (%)		Average Annual Household WTP ($)		Total Bens($B NPV)
[P1 & P2 represent period 1 & period 2]→	P1	P2	P1	P2	P1 + P2
1. FAA Low Base: 9.1% 2012 – 2051 fish population increases with linear growth through 2042 and stable thereafter, stable baseline fish populations without the IP, same WTP function for P1 and P2 as described in Figure on p.7; WA and OR residents have standing; 0.38 income elasticity of WTP for fish increases but zero change in real income since 1998; 4% discount rate	5.8	3.3	73	19	5.0
2. Loomis and White functional form (1996 meta-analysis of WTP for threatened and endangered species)	5.8	3.3	133	71	10.3
3. Richardson and Loomis functional form (2009 meta-analysis of WTP for threatened and endangered species)	5.8	3.3	126	77	10.1
4. FAA Low Base with 6% discount rate	5.8	3.3	73	19	4.1
5. FAA Low Base with 2% discount rate	5.8	3.3	73	19	6.3
6. FAA Low Base with standing for WA residents only	5.8	3.3	73	19	3.1
7. FAA Low Base with real annual income changes of -5% in WA since 1998 and -15% in OR relative to Washington in 1998 when LBP was conducted (refer to FAA, p.25). Income elasticity of WTP=0.38 from Jacobsen and Hanley (2009). Zero real income changes after 2012	5.8	3.3	WA–71 OR-67	WA-19 OR-17	4.8
8. Same as **7** with + 1 s.d. change in income elasticity of WTP (=0.62)	5.8	3.3	WA–70 OR-63	WA-18 OR-16	4.6
9. Same as **7** with -1 s.d. change in income elasticity of WTP (=0.14)	5.8	3.3	WA–72 OR-71	WA-19 OR-18	4.9

Notes: **The FAA estimate for low end estimate from the FAA assumes IP-related population increases 181,650 fish. CBD = cannot be determined from LBP (1999)

2. *Critiques of the LBP study and its application to the IP*

Below we describe several concerns about the LBP study and the way if was applied to the IP. We are able to address only a couple of these in any quantitative way for this study, but all have implications for fish benefit estimation.

a. *The uncertainty in IP fish outcomes is large*

The LBP survey does not directly confront respondents with the uncertainty inherent in predicting the impact of the IP's components on fish populations. They follow what is standard practice in stated preference surveys, in part because of respondents' difficulty in understanding probabilities and uncertainty, although a number of early stated preference studies engaged uncertainty by estimating option values (Desvousges, Smith, and Fisher 1987; Shogren and Crocker 1990).

LBP follows the accepted professional norms by including statements such as "issues dealing with fisheries are very complex and have been generalized for the purpose of this survey", and "scientists cannot say with certainty how the population of each and every species will change over the next 20 years". Their best estimates of the past and future population trends under the current set of fishery programs are shown below..." It is argued that the scientific uncertainty in forecasts can be dealt with separately from valuation of the endpoints by assuming that respondents are risk-neutral (or that the government as a public risk-aggregator should act as a risk-neutral agent) and one can simply examine expected values (probability of outcome x value of outcome). One could also incorporate an aversion to risky outcomes using relatively standard measures of risk aversion observed from experiments and behavior. The degree of uncertainty inherent in modeling survival of anadromous fish is, however, quite large relevant to many other types of stated preference topics. In essence, the survey is asking respondents to commit money to a risky investment where there is little professional consensus on how effective the program will be, as described elsewhere in this report. As Bell et al (2003, 28) note, "public confidence in the salmon enhancement program is inextricably linked to the willingness-to-pay for such a program." Many members of the public may misunderstand the degree of uncertainty inherent in fish recovery, and it is possible that a stated preference scenario that explicitly provided the risk of the program failing, or provided a wide range of outcomes, might deliver lower valuation estimates than those implied by simply weighting outcomes by scientists' best estimate of the probability of success. Some recent studies have experimented with providing respondents uncertain outcomes (Roberts, Boyer, and Lusk 2008; Rolfe and Windle 2014); Mansfield et al. (2012) elicit willingness-to-pay to reduce the numerical probability of two species in the Klamath River Basin from going extinct by 2060 as well as to increase their abundance.

b. *Hatchery vs. wild fish*

There is no distinction made in LBP or the IP between improvements in hatchery fish versus wild fish. Like most of the existing surveys eliciting values for recovering salmon runs, the LBP survey does not mention hatchery fish. It is possible, however, that respondents value improvements to wild fish populations differently than more-genetically-homogenous hatchery fish (which comprise the vast majority of returning adult fish in the Yakima, and will continue to under the IP improvements). On the other hand, members of the general public who are not active in the fishing community may have little knowledge or understanding of the difference between the two, as found in focus groups for a planned stated preference study of fish improvements in the Willamette River Basin in Oregon (Weber, Matthew and Papenfus, Michael 2014). On the other hand, the LBP study did not identify any fish populations as "endangered" or "threatened" under the Endangered Species Act. Since the Yakima Basin does contain endangered populations, willingness-to-pay would likely have been higher had this information been presented to respondents.

c. *Some households might object to the IP management plan*

Because the description in LBP of how fish improvements would be achieved is deliberately vague, it does not correspond directly to the proposals that comprise the IP. This gap in descriptions may impact valuation estimates. In particular, it is likely that a sizeable fraction of surveyed Washington households might object to the construction of a new storage project (Wymer) and resulting loss of shrub-steppe habitat, or the expansion of Bumping Reservoir and the loss of approximately 980 acres of old-growth forest that the expansion would entail (Johnston et al. 2012).

It is accepted practice in stated preference studies to have respondents focus on ecological endpoints (i.e. increases in returning adult fish) rather than the intermediate ecological conditions (i.e. increased stream flow, restored habitat) because of the potential for double-counting and because respondents may be confused by ecological terminology (Johnston et al. 2012). The focus is then typically on developing a management plan that can deliver the endpoints of interest in a way that is credible to respondents. However, details about the specific approaches to satisfy hypothetical fish abundance improvements can affect WTP. Dams have historically been controversial, in no small part due to their impacts on fish. Because the IP as proposed includes several water storage projects such as Wymer and the Bumping Lake expansion, achieving the hypothetical fish population increases via the proposed IP package might elicit substantially different WTP estimates, which we hypothesize might be lower because of the inclusion of dams and storage expansion.

d. *Standing: The use of Oregon households*

The question of standing and the distribution of benefits across states is likely relevant to investments by the State of Washington. The Four Accounts analysis was premised on both federal, state and local cost-sharing. From the perspective of the federal government, all U.S. citizens have "standing" in the project and any benefits or costs that accrue to them "count" in the benefit-cost analysis. In this sense, the benefits in the Four Accounts analysis (restricted to Washington and Oregon residents only) are conservative since it assumes no citizens in any of the other 48 states value salmon recovery in the Yakima Basin, or come to the Basin to fish recreationally. From the perspective of the Legislature, however, benefits that accrue to residents of Oregon or any other state may not have standing. The Four Accounts reports fish-related benefits to Washington residents only of $3.1 billion to $4.6 billion (pg. 32), instead of $5.0–$7.4 billion for fish-related benefits to households in both Washington and Oregon. In addition, these estimates obscure uncertainty in the underlying preferences of respondents, such that the actual benefits might be lower or higher (D. Layton, Brown, and Mark Plummer 1999, 20).

e. *The LBP payment period is long*

The length of the hypothetical payment period (20 years) assumed in the LBP study is relatively long. Although the LBP survey highlighted for respondents that the additional payments on their monthly water bill would be for the next twenty years, and did an exemplary job asking respondents to think about how these increased bills would displace other consumption, the period still may not have been particularly salient to respondents. This timeframe is fairly long by the standards of most stated preference studies, and is even long among those valuing salmon restoration, an activity with a naturally-long time frame (Table 65 summarizes relevant studies). Most respondents would have little experience with committing to monthly expenditures to a public good on such a long time scale.

The typical assumption is that respondents are forecasting into the future the impact of the increased taxes on their household budget, and discount those values into present-day terms. Using the 4% real discount rate used throughout the Four Accounts analysis, this assumes that a respondent would vote the same way when a scenario is presented with a payment of $25 per month for 20 years or a one-time payment of $4,377. Many, though not all, studies that have done split-sample tests vary annual vs. monthly payment or vary the length of time periods. A common finding from these studies is that respondents do distinguish between lump-sum and periodic payments, but that responses imply discount rates far higher than 4% (see Table 65). This in turn would imply that the present value of benefits to households is much less than $4,377.

Table 65. Summary of studies examining payment periods in contingent valuation studies

Author	Topic	Split Sample Pmt Sched	Payment Period	Sample size (RR)*	Implied discount rate**	Summary of Findings
Andersson et al (2013)	Car safety risk reduction (Losing $)	Annual vs. monthly	Not specified	N = 920 (49%)	NR	No significant difference in WTP at the lowest levels of risk reduction; for intermediate and high levels, annual payments are more than 2x as large as monthly payments per unit risk reduction
Beattie et al (1998)	Car safety risk reduction (Losing $)	Lump sum	1 year vs. 5 year	N = 52 (NA)	NR	5 year annual equivalent mean (median) WTP is 1.7 (2.6) times greater than the WTP for the 1 year program for low levels of risk reduction; and 2.0 (3.0) times greater for high levels of risk reduction.
Hammitt & Haninger (2007)	Reduced risk of foodborne illness (Losing $)	Per meal vs per month	Perpetuity	N = 3500 (NA)	NR	No significant difference in WTP
Bond et al (2009)	Protection of critical habitat (Losing $)	Annual	1, 5 and 15 years	N =3,000 (42 – 45%)	23% - 243%	Joint estimation of WTP and discount rate ("r"). If r is fixed across 1,5,10 year periods, it varies from 23% - 80%. If r is fixed across periods but varies by education and gender, it ranges from 64% - 243%. With covariates at mean values, r is 35% - 73%.

Warner and Pleeter (2001)	Armed services payments (Receiving $)	Lump sum vs. annual	Perpetuity, nominal $	N = 65,000 (NA)	0% - 30%	Military veterans demonstrate a strong preference for lump sum over annuity benefit payments. Allowing veterans to select their preferred method of payment saved the U.S. government $2.5 B compared with a scenario in which only annuity payments were available.
Harrison et al (2002)	Receive generic cash payout (Receiving $)	Lump sum	0.5, 1, 2, and 3 years	N = 268 (NR)	20% - 36%	There is no significant differences in discount rates between the 1 year and 3 year treatment horizons. Discount rates vary systematically by household characteristics, namely according to education and wealth
Kahneman & Knetsch (1992)	Toxic waste treatment (Losing $)	Lump sum vs Annual	5 years	N = 206 (NR)	NR	No significant difference between lump sum and 5 annual year payment periods for median WTP. Mean WTP is distorted by small sample effects and outliers.
Rowe et al (1992)	Oil spill prevention program (Losing $)	Lump sum vs Annual	5 years	NR (70 %)	20%	Mean lump sum WTP is 2.8 times mean annual WTP
Stevens et al (1997)	Movie pass (a) and salmon restoration (b) (Losing $)	Movie pass: lump sum vs weekly Salmon: lump sum vs. annual	Movie pass: 8 weeks; salmon: 5 years	N = 88 (NR)	50 – 270% salmon; >1000% movie passes	Students prefer to pay lump sum amounts rather than annual amounts for both scenarios (a) and (b). Median WTP was 1.3 – 2.9 times greater with lump sum than for annual payments for different levels of restoration.
Stumborg et al(2001)	Water pollution reduction (Losing $)	Annual	3 and 10 year	N = 500 (44%)	40%	With a 4% discount rate and covariates at mean values, NPV of average WTP with a 10 year schedule is $89 more than with a 3 year schedule
Kovacs and Larson (2008)	Open space (Losing $)	Monthly	1,4,7 and 10 years	N = 420 (37%)	Approximately 30%	The magnitude and range of the implicit discount rate increases as the payment schedule decreases. Implicit discount rates range from -5% to +71% for different functional forms and between different periods.
Curtis (2002)	Fishing profits (Losing $)	Annual. foregone profits in years 1 – 2 for increased profits in years 2 - 8	8 years	N = 40 (NR)	30 -40%	Individual discount rates range from 1 – 345% with most individuals reporting implied discount rates between 30 and 40%
Kim and Haab (2009)	Oyster reef restoration (Losing $)	Annual vs. lump sum	5 and 10 year and perpetual payments	NR (NR)	22% - 129%	WTP for the 5 year project is greater than for the 10 year project. There is support for hyperbolic discounting. There is no significant differences in WTP due to payment schedule when the project length is fixed. WTP otherwise varies widely across payment schemes and project lengths.

*Survey response rate (RR).
** Some study characteristics were not applicable to individual studies (NA) or not reported by study authors (NR)

f. *The baseline fish population and the impact of non-IP programs*

The Four Accounts analysis assumes that the total number of returning migratory fish in the Columbia is the same number of 2 million returning fish used in the LBP study in 1998 as the baseline fish population. Figure 28 show returning fish counts at Bonneville Dam and Willamette Falls for both salmonids (on the left) and all migratory/anadromous fish (including lamprey) on the right. There are several features of this graph relevant to the application of the LBP study to the IP.

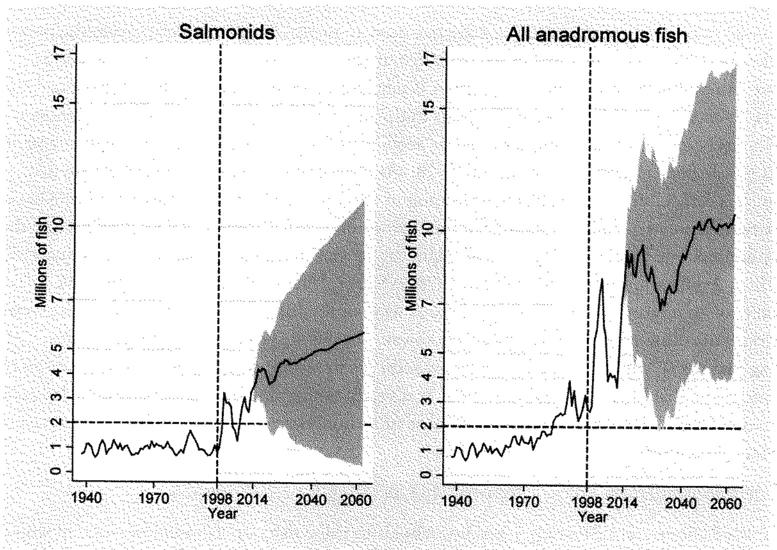

Figure 28. Fish counts at Bonneville Dam and Willamette falls. Total Salmonids (left) and all anadromous fish (right). Forecasts and 95% confidence intervals (grey area) beyond 2014 generated using an AutoRegressive Integrated Moving Average (ARIMA) model of order (1,1,1), with a 3-year seasonal lag.

First, the LBP survey does not specify whether migratory species should include non-salmon or steelhead species, merely defining migratory fish "such as salmon or steelhead." One could argue that the trend in populations of all migratory fish (including lamprey) has trended up since 1998, although a change in data collection methods in 2000 confounds the time trend. A second point is that although populations of salmon and steelhead are probably now varying around a mean of 2 million, in 1998 an assumption of 1 million or less might have been more appropriate. We suspect most respondents were not aware that lamprey are migratory fish and were not including them in their valuations. LBP also told respondents that populations of Eastern Washington/Columbia River migratory species "twenty years ago" was 8 million fish, which seems unsupported by the data in the Figure. This would have the effect of dramatically overstating the 20-year decline (1978-1998) and possibly upward-biasing willingness-to-pay under the declining baseline treatment. It may also have led to an overstatement of valuations in the constant baseline case if respondents believed that the fall in population had occurred in the recent, post-dam past, rather than in the pre-dam era of the late-19th and early-20 century (which is what we believe this number was meant to represent), and thus could be reversed with the type of programs described in LBP rather than large-scale dam decommissioning.

The second important point is whether there has been an increase in fish populations in the period since the late 1990's. As described in the main text, if any other non-IP programs designed to improve fish populations anywhere in "eastern Washington and the Columbia River" have had any impacts, or *could be expected* to have any impacts in the same timeframe as the IP, the willingness-to-pay of households for those changes should be accounted for in evaluating the IP. Year-to-year fish returns clearly fluctuate dramatically in Figure 28. As discussed in the preceding section on fish biology, it is difficult to attribute changes in smolt to adult returns to an inventory of existing habitat programs or changes in spill resulting from the Redden decision. We cannot definitively refute the assumption that the baseline population of migratory species in the Columbia Basin has remained constant at 2 million in the period between 1998 and 2012. The figure certainly suggests the possibility of an upward trend in fish populations without the Integrated Plan because of the many other local, tribal, state and federal actions underway. In the next section we present results showing that the IP's fishery benefits are highly sensitive to assumptions about the effectiveness of other programs that have preceded it in time. It is worth noting that this result is entirely dependent on the use of the LBP valuation function because of its nonlinear nature (which implies diminishing marginal value of fish as fish numbers increase).

g. *The timing of IP-related fish increases and adapting the LBP function*

As discussed above, the LBP study asked households to value fish population increases that would occur over the 20 years following the survey (i.e. 1998 – 2018). In contrast, the increases attributable to the IP are expected to take longer to reach their full effect. According to the Four Accounts analysis, some fish increases will occur in the first 20 years (i.e. 2012-2032), but the full effects will not be reached until 2042. This discrepancy in time periods between LBP and the application of LBP's valuation function to the IP is important given the predominance of non-use benefits in justifying the IP. Furthermore, as discussed above, we feel that 1) these fish population growth rates are optimistic and 2) fish populations are likely to have increased between 1998 and 2012, lowering the marginal value to households of further increases in fish populations. In this section we explain how the Four Accounts manages the discrepancy between time periods. We then model the benefits of slower-growing populations, and calculate IP-related benefits to households if fish populations have actually increased between 1998 and 2012, prior to the IP.

To reconcile the 20-year timeline of the LBP study with the expected time needed for the IP to reach its full effect (30 years), an analyst has two options. The first is to simply assume that household's annual willingness-to-pay (WTP) would extend to 30 years; implicitly assuming that households are patient and willing to pay an additional ten years of higher utility bills to see fish populations increases. This would be similar to assuming that WTP is – roughly speaking – 33% higher, and is very likely to lead to an overestimate of WTP. A second option, and the one followed by the Four Accounts, is to break the IP period into 20-year blocks. For the first 20 years (2012-2032), the LBP valuation function is used to calculate annual economic benefits for the percentage increase that accrues ***in that time period only.*** Annual household WTP for that period is multiplied by the number of households in Washington and Oregon in 2012, and the total annual WTP in future years (2013-2032) is discounted in the normal fashion. One then imagines that a new survey is administered in 2032, and the results of this survey produce the exact same relationship between percentage increases in fish populations and household's willingness to pay, i.e the same valuation function. Annual household WTP is then calculated based on the percentage increase in fish that occurs *only in the second period* (2032-2052), multiplied by the number of households in WA and OR projected in 2032, and discounted to current dollars.[59]

For example, the Four Accounts analysis' "high-end" fish population increase is 472,450, or a 23.6% increase over an assumed base of 2 million fish in 2012. This increase would occur over 30 years, with fish populations stabilizing after 2042. They assume populations increase linearly over those 30 years such that roughly two-thirds of the 23.6% increase, or 15%, happens in the first 20 year period, and the remainder (8.66%) occurs in the second 20-year period. To value the benefits to households in 2012, one can use the LBP valuation function for a 15% increase. The LBP function for monthly WTP for an *x* percent increase in eastern Columbia migratory fish populations is a piece-wise function that is linear for the first 5% increase and logarithmic for larger increases. The logarithmic portion is:

$$Monthly\ WTP = \frac{\beta_{columb.migr}(0-\ln(x))}{\beta_{cost}}\ for\ x > 5\%$$

The zero in the numerator of the equation above derives from the fact that LBP normalize results to a baseline change of zero. Substituting the coefficients from LBP's Table 3C[60]:

$$Monthly\ WTP = \frac{0.0673(0-\ln(x))}{-0.0266} = -2.53(0-\ln(x)))\ for\ x > 5\%$$

For changes less than 5%, one simply linearly interpolates between 0 and the WTP for a 5% improvement. Monthly WTP in 1999 dollars for a 5% improvement is equal to -2.53(-ln(5)) = \$4.0719, so a linear interpolation implies that monthly WTP = 0.8144*x for x<=5%[61].

To convert to 2012 dollars, the Four Accounts uses a standard inflation index implying one 1999 dollar is equal in purchasing power to 1.377 dollars in 2012. Monthly payments are multiplied by 12 to get annual payments, ignoring any discounting within the year. The equations linking percentage improvements to economic benefits become:

$$Annual\ WTP(2012\$) = \begin{cases} 12 * 1.377 * 2.53 * \ln(x) = 41.81 * \ln(x)\ for\ x > 5\% \\ 12 * 1.377 * 0.813 * x = 13.457x\ for\ x \le 5\% \end{cases}$$

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[59] Because both theory and empirical evidence suggests that willingness-to-pay for environmental goods increases with income, any changes in real, inflation-adjusted income between 2012 and 2032 are relevant. To deal with this, the Four Accounts analysis assumes no change in real incomes over these twenty years. Given the difficulty in predicting economic growth for the median household, we think this assumption is reasonable and also rely on it for our calculations.

[60] These coefficients correspond to the "stable" baseline case in LBP.

[61] The Four Accounts (pg. 12) uses a linear interpolation factor of 1.06 rather than 0.8144. We believe this was an erroneous calculation, though it had no impact on the results because the IP improvements are modeled as larger than 5% and the linear portion of the valuation function was never actually used.

Returning to the 15% "high-end" improvement in the first period (2012-2032), the annual household WTP is 41.81 * ln(15) = $113. The total "high-end" improvement is 23.6%, however, with 8.6% occurring in the period 2032-2052.

The question now becomes how to value this 8.6% increase for households surveyed in 2032. One option is to simply assume the same valuation function as above for households in 2032, or 41.81*ln(8.6%) = $90 per household per year. Under the IP, however, a household surveyed in 2032 would have experienced a historical *increase* of 15% in the previous 20 years, a baseline not modeled in LBP. Given that WTP was lower in the constant baseline treatment of LBP than the declining treatment, it is reasonable to assume that WTP would be lower still for an "increasing baseline" treatment. We have no basis, however, for estimating how much lower.

A second option is to continue to use the 2012 fish population as the "baseline" for the 2032 hypothetical survey. This is the approach used in the Four Accounts and the one we use below. The first step is to calculate WTP for the total IP-related fish improvements: i.e. 41.81*ln(23.6%) = $132. The WTP associated with the first period is then subtracted from this total; i.e. $132 - $113 = $19, which is credited to the second period. This approach is consistent with the LBP approach of calculating WTP for state 2 and subtracting WTP for state 1. The time period, however, is not the 20 years used in LBP but much longer, which is again questionable. Nevertheless, we follow this approach to investigate the effect of increases in fish populations from 1998 – 2012.

Consider now an example. The average salmonid population between 1998 and 2012 (inclusive) is 2.21 million (2 million + 207,000, s.d.=0.77 million).[62] Assuming that the population of eastern Columbia migratory fish was 2 million in 1998, and if the population increased from 1998 to 2012 by 207,000, the baseline fish population in 2012 would be 2.207 million. This represents a 10.35% increase from the 1998 baseline of 2 million, and annual household WTP in 2012$ for this state of the world would be 41.81*ln(10.35) = $97.71. Suppose again the IP increases fish populations by 472,450 over 30 years. The total fish increase by 2042, adding the non-IP and the IP fish increases, is 679,450, or a 33.97% increase over the 1998 baseline of 2 million. The total WTP for this increase (in 2012$) would be 41.81*ln(33.97) = $147.40. The fish population at the end of the first period (2031) would be 2 million + 207,000 (non-IP) + 299,218 (IP-related increases in period 1) = 2,506,218 or a 25.31% increase from a base of 2 million. WTP for this state of the world is 41.81*ln(25.31) = $135.09. Following the same logic as above, annual WTP in the second period beginning in 2032 is $147.40 - $135.09 = $12.31. Annual WTP attributable to the IP in the first period is $135.09 - $97.71 (non-IP-related increases) = $37.38.

Table 66 summarizes this information for this sample calculation. This exercise of adding 207,000 additional fish before the IP is implemented has a dramatic impact on IP-related benefits: ***total net present value of benefits to households in Washington and Oregon falls from $7.4 billion to $2.6 billion, or 36% of***

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[62] 1998 was the lowest value in this range at 845,939, and the 2013 value of 3,291,654 is omitted from this range, which would be the highest value. If 1998 were omitted and 2013 were included, the average for the period would be 2,369,867 (2 million plus almost 370,000 above baseline. Thus using the 1998-2012 range is conservative in this regard.

the larger estimate. This is because of the form of the LBP valuation function which places a much higher marginal value on the earliest fish improvements, which in this case are non-IP increases.

Table 66. Example calculation for non-IP increase between 1998 and 2012 of 207,000 fish and the high-end IP increase of 472,450 fish by 2042

Year	Fish population	Percentage increase from 2m	Annual household WTP for this state	Annual WTP attributable to the IP
1998	2 m	--	--	---
2012	2.207m	10.35% (non-IP)	$ 97.71	$135.09 - $97.71 = **$37.38**
2032	2.506m	25.31%	$135.09	$147.39 - $135.09=**$12.30**
2042	2.679m	33.97%	$147.39	

To investigate the timing of fish increases, we use the same assumption that fish populations increase linearly. For example, a high-end increase of 472,450 over 30 years implies an increase of 472,450/30 = 15,748 fish per year. Assuming the IP takes 50 years to take full effect implies 9,449 fish per year. Rather than two periods (2012 and 2032), we assume growth could be slow enough to require a third, fourth, and fifth period of benefits equivalent to new surveys in 2052, 2072, and 2092. Again, though, because of discounting, benefits accrued after 2052 or so are heavily discounted, so the main effect of slower fish population growth is drawing fish improvements away from the first period. We make the same assumption as the Four Accounts about the number of households in Washington and Oregon in 2032. We assume the increase in the number of households in each future period is the same as between 2012-2032.

Figure 29 shows the impact of any non-IP related fish improvements that have occurred between

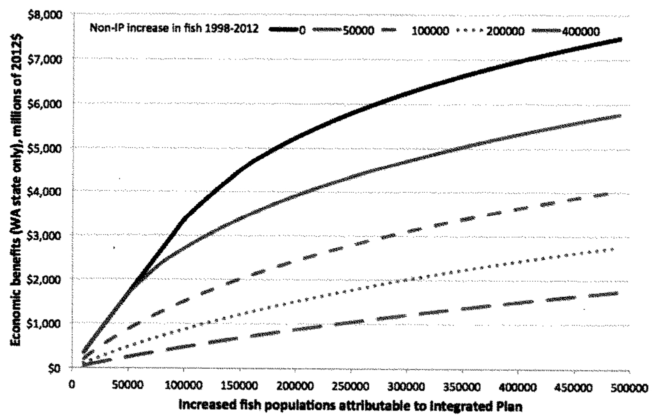


Figure 29. Benefits to Washington and Oregon households of IP fish improvements if the 2012 baseline population is higher than 1998.

1998 and 2012, but assuming that all IP-related fish improvements occur in 30 years. The black line represents the Four Accounts assumption that the 2012 population was the same as in 1998, or 2 million. For an increase of 472,450 fish (the high-end estimate), the total economic benefits to households in Washington and Oregon would be $7,387 million, replicating the result in the Four Accounts. If, however, there has been an increase in fish populations of 50,000 in the period 1998 to 2012 (solid gray line), and the new 2012 fish population is 2,050,000, the total fish-related economic benefits of the IP drop to $5,690 million. If the baseline fish population in 2012 is 2.4 million, the total benefits are $1,073 million.

Figure 30 shows the effects of increasing the time needed for the IP to affect fish populations. The black line shows the economic benefits of the IP when fish populations stabilize in 30 years, again replicating the Four Accounts results for the low- and high-end fish population estimates. The gray solid line calculates benefits when the IP takes 40 years to take effect, with populations stabilizing in 2052. If populations do not stabilize until 2072, total economic benefits for a high-end increase fall from the Four Accounts $7,477 million to $6,432 million.

3. Reassessment of fish benefits based on baseline and population growth

We have argued above that there is evidence to suggest that the baseline fish abundance appears higher than was assumed in the Four Accounts analysis, and that there is also evidence to suggest that the fish population growth rates implicit in the Four Accounts analysis are unreasonably high, especially for the high-end estimates. Section IV.E provides a description of our selection of baselines and their implications.

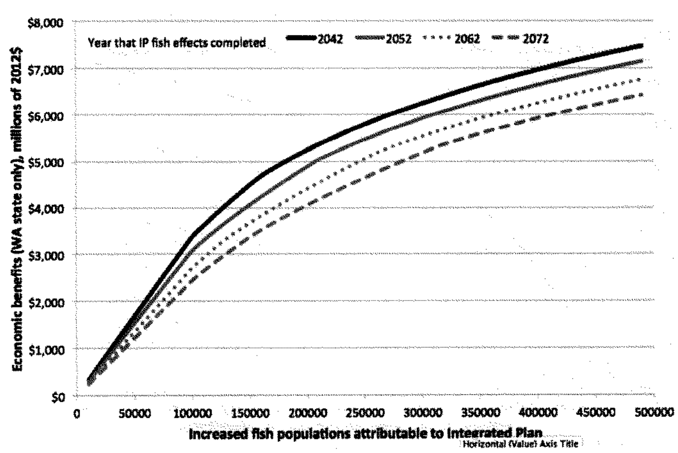


Figure 30. Benefits to Washington and Oregon households of IP fish improvements if the IP-related increase in population takes longer than 30 years.

G. Power Subordination

A portion of the Yakima Basin Integrated Water Resource Management Plan instream flow benefits would be produced by subordinating hydropower production at the Roza and Chandler power plants. The water currently used to produce electricity, but that would be relegated to instream flow under the IP, represents a cost from foregone electricity sales. At Roza, 14,000 fewer MWh would be produced over the months of April and May. At Chandler, 11,000 fewer MWh would be produced over the months of April, May and June(U.S. Bureau of Reclamation 2011d). To estimate the cost of foregone electricity production, we multiply monthly electricity prices by the amount of reduced power production in each month. Because it is not possible to predict the exact timing of electricity sales in a given year, we assume electricity sales would be spread equally across the subordination months (14,000 MWh/ 2 months = 7,000 MWh per month from Roza; 11,000 MWh/ 3 months= 3,667 MWh per month from Chandler), so that a total of 10,667 MWh less electricity would be sold in the months of April and May and 3,667 MWh less electricity would be sold in June.

Table 67 shows electricity rates reported by BPA as well as the average rates calculated to estimate the costs of subordinated power production. We report 2009 prices in to be consistent with the Power Subordination Technical Memorandum (U.S. Bureau of Reclamation 2011d, 2), but we then inflate the aggregate numbers to represent 2012 prices to be consistent with the Four Accounts analysis around which we most prices.

Table 67: Power rates by month (2009 prices)

Month	HLH Rate Amt* (mills/kWh)	LLH Rate Amt* (mills/kWh)	Average Load Rate ($/MWh)
January	30.42	22.00	26.21
February	31.07	22.22	26.65
March	28.82	21.12	24.97
April	27.04	19.44	23.24
May	22.59	15.61	19.10
June	20.45	10.86	15.66
July	25.18	18.44	21.81
August	29.49	21.88	25.69
September	30.45	24.43	27.44
October	32.19	23.58	27.89
November	34.33	25.04	29.69
December	35.83	26.29	31.06

* $1/MWh = 1 mill/kWh = $0.1¢/kWh

Monthly amounts of foregone electricity production are multiplied by average load rates, by month. Average load rates are calculated from the high load rates (HLH) and low load rates (LLH) reported by Bonneville Power Authority (Bonneville Power Administration 2010, 7).

Table 68 The total cost of foregone electricity production in a given year is estimated as $509,048. According to the Bureau of Labor Statistics (http://www.bls.gov/cpi/#tables, derived from table 25), 2012 energy prices were about 5% higher than 2009, so this value inflated to 2012 prices is $534,500.

Table 68: Estimated annual value of foregone electricity production.

	Combined Power Subordination at Roza and Chandler (MWh)	Average Electricity Rate ($/MWh)	Cost ($)
April	10,667	23.24	247,901
May	10,667	19.10	203,740
June	3,667	15.66	57,407
Annual Total	25,001	NA	509,048

To estimate the total value of foregone power production over the 100-year life of the Integrated Plan, we discount the annual cost of fewer electricity sales and sum over 100 years:

Total Present Value Cost = $PVC_1 + PVC_2 + \ldots + PVC_{100} = \frac{\$509{,}048}{1.04^1} + \frac{\$509{,}048}{1.04^2} + \cdots + \frac{\$509{,}048}{1.04^{100}} =$ $12.47 M

Using the same discount rate of 4 percent from the Four Accounts Analysis(ECONorthwest, Natural Resources Economics, and ESA Adolfson 2012), the present value of foregone power production is estimated to be $13.1 million.

Key Points

An Economic Review of the Yakima Basin Integrated Plan (YBIP)

"How errors, inaccurate assumptions and false constraints drive the YBIP forward"

The current YBIP (formally called the Yakima River Basin Integrated Water Resource Management Plan and also called the "IP") is a water management plan for Yakima River Basin of South-central Washington State that has arisen out of the broader Yakima River Basin Water Enhancement Project (YRBWEP). It has taken years to develop, cost millions of dollars and resulted in a substantial amount of published documentation.

The YBIP released its federally mandated Benefit-Cost analysis in the October 2012 Four Accounts Analysis (4AA) which concludes the net benefits of the IP as a whole range from $6.2 billion to $8.6 billion and associated costs ranging from $2.7 billion to $4.4 billion. However, this analysis contains significant mathematical errors and the data used in the analysis is now outdated and no longer valid. Specifically, the Washington State Water Research Center's (WRC) 2014 study of the YBIP economics revealed significantly lower total benefits in the $1.1 – 2.2B range. At the same time, currently projected costs of $3.8B have increasing significantly. Just two of the early projects (KDRPP & KKC) have had recent cost increases of nearly $600M (300% as disclosed in the USBR feasibility study). Total YBIP costs of the IP are now at least $4.4B and still growing.

Specific shortcomings of the current IP are as follows:

- ***The 4AA B-C analysis is filled with outright errors and flawed assumptions.*** Correcting for these reduces the benefits approximately $6B to just over $1B while simultaneously the costs are at $3.8B and climbing ($4.4B with the recent cost updates). Only Fish Passage comes even close to passing B-C minimums. Given the magnitude of errors, flawed assumptions and cost increases, the B-C analysis according to the 4AA and cited in the proposals is inaccurate by orders of magnitude and therefore an updated B-C analysis must be mandated.
- ***Net...Net, the YBIP spends $2,794 per sockeye and $127,725 per non-sockeye fish.*** The IP benefits are fundamentally based on sockeye salmon (94% of fish benefits, 76% of total IP benefits), which primarily depend on Fish Passage for effective reintroduction. Non-sockeye require expensive habitat restoration and in-stream flow changes and represent only 6% of fish benefits. Clearly the place to start is with sockeye restoration, which can be accomplished without the inefficient non-sockeye restoration as proposed.
- ***Alternatives to draining lakes and building dams exist and should be objectively evaluated (not by USBR or the irrigators) before funding any projects.*** Hay and wheat use 41% of the water in the Yakima Basin. Combined, hay and wheat use nearly 3,500 gallons of water per $1 of net revenue, over 4x more than the average of 846 gallons for other Yakima Basin crops. These non-strategic, high water using, low economic value crops provide only 14% of Yakima Basin net revenue (most of it is exported as well) and are readily sourced from other regions in Washington. Exploring drought year deficit watering strategies provides 600 KAF of water use savings and reduces the economic impact of droughts by over 50% ($71M vs $150M). The 4AA study and the USBR continue to ignore this option.
- ***The USBR must provide accurate long-term analysis of water levels for Lake Kachess.*** The USBR has not responded to requests for the 100 year analysis based on their drought assumptions. Models developed based on the YBIP assumptions suggest catastrophic impacts on Lake Kachess water levels with below current minimum pool levels occurring 50% of the time.
- ***Determine reimbursement responsibility and amounts before any funding is released or construction starts.*** The federal government mandates significant non-federal funding while WA State mandates significant non-state funding. The resulting confusion is unacceptable. Specific, detailed, significant and achievable irrigator financial responsibility should be clearly defined before any funding is released. Current cost projections indicate irrigators could not support profit or repayment.

June 29, 2015

Summary of revised YBIP B-C Analysis:

Overview: Present Value Preliminary Cost Allocation – 2012: With Adjustments

	Total ($M)
4AA Benefits	**7,395**
Adjustments to 4AA Benefits	**(6,255)**
Correct Calculation Errors	**(3,255)**
Adjust for 200k higher initial fish populations and their corresponding lower incremental WTP values	(2,700)
Adjust for present value impact of not including fish benefits until fish projects are actually completed	(200)
Correct lease vs purchase price and calculation errors for Municipal Water Use	(355)
Adjust for Flawed Assumptions	**(3,000)**
Remove potential for Fish Populations to increase above 181k fish	(1,200)
Adjust PV due to 30 additional years to achieve 181k fish population totals	(1,200)
Correct for future climate scenario, reduce from 8x worse than historical to 4x worse (50% reduction)	(400)
Correct for overly constrained water trade assumption of 10%; Allow for 50% inter-district trade reducing FAA Benefits by 50%	(200)
Revised Total Benefits	**1,140**
4AA Total Cost Allocation	**3,520**
Revised Total Cost Allocation: Add $600M for KDRPP/KKC	**4,120**

Revised Total Benefit-Cost	**(2,980)**
Revised Total Benefit-Cost Ratio	**0.28**

4AA Projected Total Benefit-Cost	**3,875**
4AA Projected Total Benefit-Cost Ratio	**2.10**

June 29, 2015

Executive Summary

An Economic Review of the Yakima Basin Integrated Plan (YBIP)

"How errors, inaccurate assumptions and false constraints drive the YBIP forward"

INTRODUCTION:

The current YBIP (formally called the Yakima River Basin Integrated Water Resource Management Plan and also called the "IP") is a water management plan for Yakima River Basin of South-central Washington State that has arisen out of the Yakima River Basin Water Enhancement Project (YRBWEP). It has taken years to develop, spent millions of dollars and published a substantial level of documentation. The overall Plan incorporates over 30 distinct projects focused primarily on fish passage, additional water supply & storage, habitat restoration and conservation efforts that aim to provide improved fish population results and water availability during droughts for agriculture.

The YBIP released its federally mandated Benefit-Cost analysis in the October 2012 Four Accounts Analysis (4AA) which suggests the net benefits of the IP as a whole range from $6.2 billion to $8.6 billion with costs ranging from $2.7 billion to $4.4 billion. The 4AA B-C results were provided for the full proposed implementation of the IP and did not provide estimates of the net benefits of the individual components of the IP. To address this lack of individual project B-C analysis, the Washington State Legislature commissioned the Washington State Water Research Council (WRC) to evaluate the YBIP economics and provide both an overall B-C analysis as well as a project level assessment. Unlike the 4AA report, the WRC study found total benefits in $1.1 – 2.2B range, well below the currently projected costs of $3.8B (with recent cost increases at two early projects (KERPP & KKC) of nearly $600M, the total now is at least $4.4B). Of the individual projects considered, only the fish passage projects passed B-C analysis (benefits which at least equal the costs i.e. B-C of 1.0) with all other YBIP projects significantly failing B-C analysis.

Given the prevalence of the Lake Kachess and Lake Keechelus projects in the overall YBIP and within the current Phase I planning and funding effort, a group of Lake Kachess area homeowners have come together to address the many YBIP shortcomings and concerns. The group includes the Kachess Ridge Maintenance Association, Kachess Community Association, East Kachess Homeowner's Association and the Hyak Property Owners Association (representing over 700 directly affected homeowners) as well as Kittitas County Fire District #8 and Snoqualmie Pass Fire and Rescue. Sadly, the USBR and WA Department of Ecology did not engage with any these groups in the build-up and planning process for the YBIP. In fact, many homeowners were first informed of the YBIP when they received the Lake Kachess (KDRPP) and Lake Keechelus (KKC) project DEIS documents in January 2015. As the group worked over the last 6 months to respond to the YBIP process, a team was tasked to evaluate the economic analysis of the YBIB. The following is an Executive Summary of this analysis and represents a brief review of the analysis and conclusions of a longer and deeper analysis.

BACKGROUND:

There are over 100 documents listed or attached to the YBIP's website. The various reports collectively create a mind-numbing level of complexity that comes across as deeply analytical but in reality is nothing more than a carefully managed and curated set of assumptions gathered to support a foregone conclusion. By weaving together the specific self-interests of disparate groups into an "integrated" approach, the YBIP hopes to pursue individual projects that are economically unsupportable but somehow become acceptable when they are all done together. As the following analysis demonstrates, by simply pulling on a few individual strands (including some very basic flawed assumptions), the seemingly ornate and sophisticated economic bow of the IP readily falls apart. In the end, true economic benefits, when calculated using accurate math, come in at $1.1B (vs. the projected Four Accounts Analysis report Benefits of $6.2-7.5B) against costs of $3.8B and growing (costs for KDRPP and KKC have increased from $276M in 4AA to now over $850M in just 18 months). Of the entire "integrated plan", only Fish Passage projects clear B-C hurdles as they represent 74% of total revised IP Benefits and only 13% of total revised IP costs. All other elements significantly fail B-C mandates (See Section 8 below).

FLAWED ANALYSIS:

Specifically, the Four Accounts Analysis (4AA) economic analysis has had to rely on a small number of key assumptions and constraints to generate its overall integrated B-C results. However, by simply ...

1. Correcting parameters on future fish populations and starting points for rehabilitation results
2. Correcting outright accounting & calculation errors and updating for significant cost increases
3. Correcting for the 4AA built-in climate change calculation that mathematically models the most severe climate-related economic outcomes and instead using the higher probability "most likely case" climate change scenario
4. Correcting for overly restrictive water trade assumptions that equally prioritize water supply to high water use, low economic value crops like hay and wheat (vs more water efficient and higher economic value crops like fruit, hops, wine/grapes and vegetables)

... the economics of the IP and the corresponding B-C results change dramatically.

Based on a detailed analysis of the 4AA B-C analysis (and using the 2014 Water Research Center (WRC)[1] study commissioned by the WA State Legislature), the overall YBIP economic projections change as follows:

[1] The State of Washington Water Research Center (WRC) was established 51 years ago as a member of the National Institutes for Water Resources (NIWR) under the Water Resources Act (WRRA) of 1964 with the charge of (1) arranging for competent research that addresses water problems or expands understanding of water and water-related phenomena, (2) aiding the entry of new research scientists into the water resources fields, (3) helping to train future water scientists and engineers, and (4) disseminating sponsored research results to water managers and the public.

1) **Use realistic fish population growth rates & timing**: The current 4AA fish population projections use growth rates of over 10% to achieve the higher ends of the fish population projections. As economic benefits are directly related to fish populations, larger projected fish populations translate directly to higher projected economic benefits. Unfortunately, the high 10%+ growth rates are without any meaningful long-term scientific support. The highest rate used in current fish modeling analysis is 5%. At 5%, the YBIP fish population projections should be limited to the low end of the 4AA targets with a total increase of 181.65k fish. It will also take an additional 30 years to achieve these more accurate target populations. ***Impact on 4AA Benefits: fish benefits are reduced by $2.4B*** *(see the WRC report for detailed calculations).*

2) **Correct the calculation errors in the fish benefit assumptions**: the current 4AA analysis fails to incorporate higher existing fish populations (there are 200k more fish currently in the relevant habitats than used in the analysis). Furthermore, the 4AA analysis erroneously assumes the calculation of fish benefits accrue prior to the completion (or even the initiation) of the necessary fish passage, habitat and in-stream flow projects required to create the fish population benefits. These errors substantially overstate the "Willingness to Pay" (WTP) calculations that include a diminishing marginal value of fish based on both starting populations and delayed population growth timing. ***Impact on 4AA Benefits: fish benefits are reduced by $2.9B*** (see the WRC report for detailed calculations)

3) **Correct the Municipal water Benefit calculation errors:** The municipal water supply benefits in 4AA have an outright error in the formulas which overstates the benefits by 90%. 4AA alternatively uses annual lease purchases and prices in perpetuity (vs purchasing a permanent water right at 10% of the cost) and uses a 1 time permanent water purchase price as an ongoing annual lease calculation (the permanent right only needs to be purchased 1 time, not every year) which also reduces the 4AA calculated benefits. ***Impact on 4AA Benefits: municipal benefits are reduced by $0.36B*** *(see the WRC report for detailed calculations) thus reducing the current $0.4B projected benefit by 90% to $0.04B.*

4) **Fix the agricultural cost allocation errors:** Based on the October 2012 Preliminary Cost Allocation Technical Memorandum, the 4AA cost allocation calculations include material errors that significantly understate the costs allocated to Agriculture by $679.3M. In the present value analysis presented on page 17, the adjustment on Row 4 for Agriculture Justifiable Expenditure is incorrectly reduced from the Single Purpose Alternative Costs of $1,222M to the assumed Agricultural Benefits of $800M. This adjustment does not follow standard cost accounting protocols for determining an appropriate cost allocation and is an error. Further, the 4AA cost allocation model also allocates 0% of Wymer Dam costs and only 38% of Bumping Lake costs to agricultural use, despite numerous statements in the YBIP documentation around their intended benefits to irrigators and agricultural use. The analysis further (and incorrectly) uses reduced project costs for the allocation process (again for Wymer Dam and Bumping Lake) but then uses full project costs for the final B-C calculations, again an error relative to cost accounting standards.

Correcting the allocations to include full costs and allocating 50% of the Wymer Dam and Bumping Lake costs to agricultural use corrects the above errors and allows for a more accurate B-C analysis of YBIP agricultural programs. ***Impact on 4AA Benefit-Cost calculations: agricultural costs are increased by $0.679B and ecological restoration costs are reduced by $0.477B and municipal costs are reduced by $0.203B***

5) <u>**Use more accurate & current cost projections:**</u> IP cost estimates are incomplete and changing (increasing) rapidly and the 4AA analysis fails to capture this. The USBR has readily acknowledged in its recent public meetings (May 4, 2015 in Ellensburg, WA and May 5, 2015 in Cle Elum, WA) that costs relative to a number of issues are not yet reflected in the IP calculations. Costs for domestic well mitigation, potential SEPA/NEPA issues with associated mitigations, home value decrease mitigations, etc. are yet to be incorporated into the 4AA analysis (for example, no costs associated with private property mitigations are considered in the analysis). Further, estimated costs are increasing rapidly. For example, the combined KDRPP/KKC projects have gone from $276M in the 4AA analysis, to $645M in the DEIS to now $850M in the most recently published Feasibility Design Analysis (published after the DEIS). Given that YBIP hard construction costs are over 75% of total costs, it would seem a 3x increase in costs for the most visible near term projects would warrant revisiting the 4AA B-C analysis that is clearly now outdated, incorrect and overstated. It also suggests total YBIP costs will easily exceed $6-7B if other construction projects experience the same cost escalations as the KDRPP/KKC projects. The WRC study explicitly calls for continued monitoring and incorporation of cost increases especially as it relates to construction cost changes and more accurately including mitigation costs. ***Impact on 4AA Benefit-Cost calculations: conduct necessary analysis to determine erroneously overlooked costs which will result in an logically reduce B-C results of the 4AA analysis by an as yet determined amount.***

6) <u>**Correct the overly aggressive climate change calculations**</u>: The weather scenario used for the baseline 4AA agricultural analysis and benefit calculations is 8x more severe than historical data with no supporting data to justify the extreme deviation from the known data. Since, here again, the YBIP benefits increase with the severity of future climate change scenarios, it is important to use a more realistic and moderate set of assumptions. However, just as using the most severe climate regime is likely not appropriate, nor is ignoring the potential for climate change warranted. Accordingly, simply selecting a "middle of the road," or most likely case scenario of climate assumption, seems most appropriate. Therefore, a 4x climate change assumption (roughly 50% of the current benefit calculation) is a more prudent and justifiable approach. ***Impact on 4AA Benefits: agricultural benefits are reduced by $0.4B*** *(see the WRC report for detailed calculations) thus reducing the current $0.8B projected benefit by 50% to $0.4B.*

7) <u>**Allow for appropriate inter-district water trading:**</u> The assumed constraint of no more than 10% inter-district water leasing completely compromises the 4AA analysis and more than doubles the benefits. Since the real issue is using valuable water for high water using - low economic value crops like hay and wheat, especially in in KRD and WIP, vs high economic value crops in Roza

(fruits, wine and hops), the impact of a 10% inter-district trade constraint is to mandate water (nearly 600 KAF in total) goes to low economic value-high water using crops in KRD and WIP (as well as other water districts). Specifically, it takes water that at a minimum will cost over $170 per AF to supply and uses it on crops with an average net revenue of under $100 per AF and no more than $128 per AF of water (Alfalfa hay). Surprisingly, the 4AA analysis is willing to project radically different climate scenarios but is unwilling to even moderately conceptualize how the water districts might behave differently. Given the impact of this one assumption, it seems 4AA should have at least conducted sensitivity analysis around the 10% trade limit and tested the impact of options up to 50-60% trade limit. For example, using a 50% inter-district trade constraint (rather than 10%) allows for over 400 KAF of inter-district trading and reduces the agricultural present value economic impact of future draughts by 50%. ***Impact on 4AA Benefits: agricultural benefits are reduced by an additional 50% or $0.2B.***

8) Summary of revised YBIP B-C Analysis with the above adjustments included:

(See next page)

Present Value Preliminary Cost Allocation – 2012: With Adjustments

	Project Purposes			
	Ecological Restoration	Agriculture	Municipal & Domestic	Total ($M)
4AA Benefits	**6,200**	**800**	**395**	**7,395**
Adjustments to 4AA Benefits	**(5,300)**	**(600)**	**(355)**	**(6,255)**
Remove potential for Fish Populations to increase above 181k fish	(1,200)			
Adjust PV due to 30 additional years to achieve 181k fish population totals	(1,200)			
Adjust for 200k higher initial fish populations and their corresponding lower incremental WTP values	(2,700)			
Adjust for present value impact of not including fish benefits until fish projects are actually completed	(200)			
Correct for future climate scenario, reduce from 8x worse than historical to 4x worse (50% reduction)		(400)		
Correct for overly constrained water trade assumption of 10%; Allow for 50% inter-district trade reducing FAA Benefits by 50%		(200)		
Correct lease vs purchase price and calculation errors for Municipal Water Use			(355)	
Revised Total Benefits	**900**	**200**	**40**	**1,140**
4AA Total Cost Allocation	**2,440**	**729**	**351**	**3,520**
Adjustments/Reallocations to 4AA Costs	**(477)**	**679**	**(203)**	**0**
Correct Footnote 3 error: limiting SPA costs to the maximum of total benefits is an incorrect cost accounting step	(209.7)	247.9	(38.2)	0
Correct SPA allocations for Wymer and Bumping Lake to include 50% allocation for Agricultural Use; Also use full cost of projects	(267.0)	431.3	(164.3)	0
Cost Increases: KDRPP/KKC has increased over 300% from $276M to $850M+	?	?	?	?
Revised Total Cost Allocation	**1,963**	**1,408**	**148**	**3,520**

Revised Total Benefit-Cost	**(1,063)**	**(1,208)**	**(108)**	**(2,380)**
Revised Total Benefit-Cost Ratio	**0.46**	**0.14**	**0.27**	**0.32**

4AA Projected Total Benefit-Cost	**3,760**	**71**	**44**	**3,875**
4AA Projected Total Benefit-Cost Ratio	**2.54**	**1.10**	**1.13**	**2.10**

9) **Recognize the substantial difference in B-C outcomes for sockeye vs non-sockeye fish:** As detailed on page 10 of the 4AA report, sockeye salmon represent 170k of the total 181.65k salmon/steelhead population increases associated with the IP (at the low end of the fish population projections). Accordingly, 93.6% of Fish Benefits should be assigned to sockeye and 6.4% to non-sockeye species. Similarly, all sockeye will benefit from fish passage as will roughly

25% of non-sockeye fish (see page 93 of the WRC report). Given the total of 11.65k non-sockeye in the above total fish population as reported in the 4AA, an additional ~3k fish need to be added to the above sockeye count for a total of 173k benefiting from fish passage, of which 98% of the Fish Passage costs should be allocated to sockeye and 2% to non-sockeye. Further, as sockeye only marginally benefit from certain in-stream flow enhancements in the IP and do not benefit from the habitat restoration/conservation elements of the IP, 100% of these costs should be allocated to non-sockeye species. Accordingly, separating the sockeye from non-sockeye for B-C calculations clearly points out the positive outcomes for sockeye (i.e. Fish Passage projects) and the extremely negative B-C outcomes for non-sockeye (i.e. Habitat Restoration/Conservation & In-Stream Flows). ***Impact on 4AA Benefit-Cost calculations: Sockeye Benefits of $842M vs Costs of $475M for a Total B-C of +$367M. A cost of per sockeye fish of $2,794. Non-Sockeye Benefits of $58M vs Costs of $1,488M for a Total B-C of -$1,430M. A cost of per fish of $127,725.***

Ecological/Fish Benefits - Present Value Preliminary Cost Allocation – 2012: With Adjustments

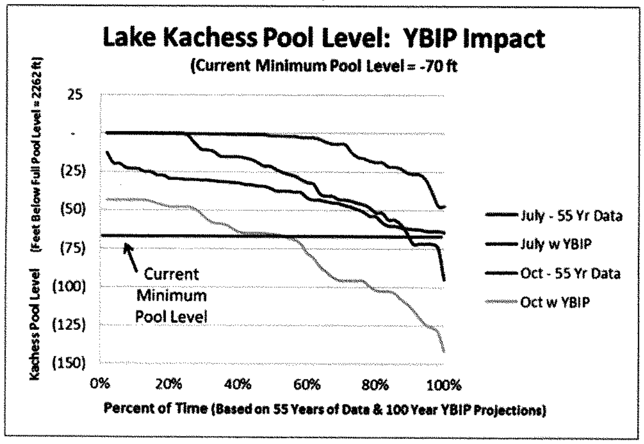
	Project Purposes: Ecological Restoration		
	Total	Sockeye	Non-Sockeye
Revised Ecological Total Benefits: Allocated to Sockeye & Non-Sockeye	**900**	**842**	**58**
Allocation of Ecological Benefits			
Allocate based on Fish Population Totals: Sockeye are 93.6% of Total Fish Population; Non-Sockeye are 6.4% at projected 181k Total Fish Population		842	58
Revised Total Ecological Cost Allocation: Allocated to Sockeye & Non-Sockeye	**1,963**	**475**	**1,488**
Allocation of Ecological Benefits			
Fish Passage: $351M in Specific Costs plus 12.8% of the Remaining Joint Costs for a Total Fish Passage of $485M. Allocate based Fish Passage Use (100% of Sockeye and 25% of Non-Sockeye Populations) = 98% Sockeye allocation and 2% non-Sockeye.	485	475	10
Habitat restoration/conservation and in-streamflows: $568M in Specific Costs plus 87.2% of the Remaining Joint Costs for a total of $1,478M. Allocated 100% to non-Sockeye.	1,478	-	1,478
Revised Ecological Restoration Total Benefit-Cost: Allocated to Sockeye & Non-Sockeye	**(1,063)**	**367**	**(1,430)**
Revised Ecological Restoration Total Benefit-Cost Ratio: Allocated to Sockeye & Non-Sockeye	**0.46**	**1.77**	**0.04**

Washington Only at 63% of Benefits & 100% of Costs

Revised Ecological Restoration Total Benefit-Cost: Allocated to Sockeye & Non-Sockeye	**(1,396)**	**55**	**(1,451)**
Revised Ecological Restoration Total Benefit-Cost Ratio: Allocated to Sockeye & Non-Sockeye	**0.29**	**1.12**	**0.02**

10) **<u>Provide a more accurate long-term analysis of water levels for Lake Kachess:</u>** The water supply analysis in the IP contains errors and needs much greater transparency. The RiverWare software is very sophisticated and can model many different scenarios. Accordingly, the existing analysis needs to clarify and correct for the stated 80 KAF minimum pool for Lake Keechelus. The 4AA

analysis either removes 60 KAF from the water supply or significantly compromises fish restoration at Lake Keechelus or further drains Lake Kachess. The USBR has not been able to clarify which of these is true. Therefore, the 4AA needs to provide much greater clarity to the assumption to the 100 year impact on water levels at Lake Kachess from the YBIP. The models and analysis are obviously available to provide this analysis, What is disturbing is the lack of transparency to make the results available to the public. In the absence of any details from USBR, a simple 100 year model of Lake Kachess water levels shows the devastating results of the YBIP on Lake Kachess (see below). Over 50% of the time Lake Kachess will be below the current minimum pool level (~ -70 Ft) by October. Focusing on July water levels (when recreational use is high), historically the lake is at or above -25 feet nearly 95% of the time. With the YBIP, this will drop to ~50% of the time with historical October low water levels now present nearly 35% of the time in July. Clearly USBR has to be more forthcoming with a similar analysis.



11) **<u>Clarify repayment responsibility & mechanisms before any construction starts:</u>** Repayment needs to be firmly addressed and finalized prior to any IP implementation. Under the current federal guidelines, *construction costs allocated to agricultural irrigation are generally reimbursable without interest, while those allocated to municipal and domestic supply are reimbursable with interest.* If this statement is meant to apply only to directly allocated "Specific Costs", the current 4AA cost evaluation would only charge $179M to irrigators and $0 to Municipal Use, as these are the only "specific costs" allocated to these uses. It follows then that with over 40% of the costs associated with the YBIP allocated to agriculture, irrigators should be responsible for 40% of the reimbursement costs and not the mere 5% of the costs for reimbursement as allocated in the 4AA. ***Impact on the 4AA calculations: correctly allocate 40% of the costs (an additional $1.253b) of reimburseable costs to the irrigators and identify if it is feasible for the irrigators to repay those costs.***

12) **Evaluate meaningful alternatives to draining lakes and more dams:** 41% of the water in the Yakima Basin goes to hay and wheat which generate only 14% of the Net Revenue. Combined, hay and wheat use nearly 3,500 gallons of water per $1 of net revenue, over 4x more than the average of 846 gallons for other Yakima Basin crops. Each AF of water yields net revenue of less than $100 per AF. It is therefore unsustainable for hay and wheat crops to pay $170 per AF cost of additional water as outlined in the YBIP. Given these hard economic realities, creating additional supply for crops that can't afford to pay for the cost of the water makes little long-term economic sense. Accordingly, the only viable long-term solution is to focus on deficit watering strategies and ensuring valuable water supplies are delivered to the highest value crops, while financially reimbursing those impacted by water curtailment. To this end, the 20/50 Drought Deficit Watering Strategy has been developed. It is driven by the logic that droughts in the Yakima Basin create a loss of ~600 KAF of water, so a drought relief strategy needs to reduce use or increase supply by this amount. Accordingly, in any year where a drought is declared, the following could occur:

a) **All hay and wheat crops would immediately be prorated 50%.** This would still allow a "first cutting" for hay, so the economic impact is significantly lessened to a 40% economic loss. Wheat farmers would simply need to plant half as much wheat. Farmers with senior water rights would be payed the full value of their economic loss. Junior water rights may be compensated depending on the funding mechanisms (see below). This creates a savings of 385 KAF of water.
b) **All other crops would be immediately prorated 20%.** This would still allow meaningful crop production with perhaps a 10% economic loss. It preserves water for our most valuable crops. Farmers with senior water rights would be payed the full value of their economic loss. Junior water rights may be compensated depending on the funding mechanisms (see c) below). This creates a savings of 221 KAF of water.
c) **Introduce a Yakima Basin water usage tax to fund drought reimbursements:** A simple $10 per AF tax would provide a significant base to provide reimbursement to farmers impacted by drought year curtailments. Given the approximate use of 1,800 KAF per year, this would generate ~$18M per year of tax revenue to be held in reserve for drought years. The cost of 100% net revenue reimbursement in a) and b) above is ~ $71M, so the $10 AF tax should cover the droughts that occur on a 4-5 year interval.
d) **Implement the proration at the water district level (and they can manage the Senior Water rights holders as well):** Since inter-district trading seems to be so challenging, this approach would provide a calculation up front for how much water each district will receive based on its recorded crop mix. The districts would also receive a lump payment based on the reimbursement strategy in c) above to reimburse farmers within each district appropriately. The districts would then coordinate and manage the process within their respective water districts. If the districts want to add additional intra-district trading, that would be their option.
e) **In-Stream fish water use can also be accommodated:** Since the above is based on a most severe drought status, in many years there would be additional water supply available for in-stream fish population management. Given the relatively modest needs for in-stream flows (~70 KAF), it should be possible for the USBR to determine the best balance between in-stream and out-of-stream water uses in any given drought year.
f) **Fund Fish Passage as an Initial Step:** While not directly related to the above, Fish Passage projects should be funded as an initial step in salmon reintroduction. Once Fish Passage has

proven its ability to benefit salmon recovery, additional habitat restoration projects should be considered.

Based on the above proposal, there are two important economic foundations for the 20/50 Drought Deficit Watering Strategy. The first is based on broader groupings of crop types and shows the impact by crop. As the 4AA analysis shows an economic cost of ~$150M in a drought year, the 20/50 Drought Deficit Watering Strategy reduces this amount by over 50% to $71M, clearly presenting a compelling need for further analysis and review beyond that currently provided in the YBIP.

Alternative Approach for the YBIP: 20/50 Drought Deficit Watering Strategy

Crop Type	Net Revenue/ Acre	Net Rev/AF	Acres	A/F	Percent of AF	AF per Acre	Total Net Revenue	Gallons of Water per $ of Net Revenue	Percent of Total Net Revenue	Drought Deficit Watering Reduction	Water Savings with 20/50 Deficit Watering Strategy	Assumed Reduction on Total Net Revenue from Drought Deficit Watering Reduction	Reduction on Total Net Reveneu from Drought Deficit Watering Reduction
Fruit	$ 1,832.37	$ 339.02	83,504	451,332	24%	5.40	$ 153,009,872	961	31%	20%	90,266	10%	$ 15,300,987
Hops	$ 3,481.00	$ 876.16	29,845	118,575	6%	3.97	$ 103,890,445	372	21%	20%	23,715	10%	$ 10,389,045
Wine/Grapes	$ 1,813.18	$ 496.10	51,672	188,854	10%	3.65	$ 93,690,589	657	19%	20%	37,771	10%	$ 9,369,059
Hay/Wheat	$ 459.97	$ 93.80	157,409	771,897	41%	4.90	$ 72,402,773	3,474	15%	50%	385,948	40%	$ 28,961,109
Misc	$ 785.00	$ 175.30	49,211	220,374	12%	4.48	$ 38,630,635	1,859	8%	20%	44,075	10%	$ 3,863,064
Veg	$ 1,405.02	$ 289.38	25,621	124,397	7%	4.86	$ 35,997,962	1,126	7%	20%	24,879	10%	$ 3,599,796
Grand Total	$ 1,252.63	$ 265.34	397,262	1,875,429	100%	4.72	$ 497,622,276	1,228	100%	32%	606,655	14%	$ 71,483,060

The second analysis is of the impact by water district. Given the significant hay farming in Kittitas County, the primary economic issue for the YBIP is how to deal with hay farming in Kittitas County in particular and hay and wheat farming more generally within the Yakima Basin. Better water use strategies that limit hay and wheat water consumption are quite literally the crux of the issue.

Impact of 20/50 Drought Deficit Watering Strategy

Water District	Total AF of Water	Hay/Wheat AF of Water	Percent Hay/Wheat of Total AF	Water Savings with 20/50 Deficit Watering Strategy	20/50 Drought Deficit Total Water Reduction	Total Net Revenue	Reduction on Total Net Revenue from Drought Deficit Watering Reduction	Percent Reduction in Total Net Revenue from Drought Deficit Watering Reduction	Projected Annual Water Use Tax at $10.00 per AF	Percent of Annual Total Net Revenue
KRD	287,369	277,664	97%	140,773	49%	$ 31,782,923	$ 12,033,126	38%	$ 2,873,686	9.0%
KSR (Kittitas Senior)	190,429	188,624	99%	94,673	50%	$ 20,011,692	$ 7,808,648	39%	$ 1,904,290	9.5%
Roza	322,496	27,840	9%	72,851	23%	$ 130,284,737	$ 13,672,199	10%	$ 3,224,958	2.5%
SVID	430,411	101,110	23%	116,415	27%	$ 129,077,002	$ 15,862,400	12%	$ 4,304,110	3.3%
WIP	565,949	172,845	31%	165,043	29%	$ 144,712,511	$ 17,829,929	12%	$ 5,659,488	3.9%
YTID	78,776	3,814	5%	16,899	21%	$ 41,753,411	$ 4,276,758	10%	$ 787,756	1.9%
Total	1,875,429	771,897	41%	606,655	32%	$ 497,622,276	$ 71,483,060	14%	$ 18,754,288	3.77%

Impact on the 4AA calculations: 50% savings in economic costs of droughts over IP proposal.

SUMMARY:

The IP process and Work Group have worked very hard over an extended period of time to develop the current approach. They are to be commended for exerting an extreme level of effort and bringing together organizations that typically are on opposite sides. Unfortunately, there is a deep and obvious truth that needs transparency and much stronger review. All of the special interests involved in the IP get something for their efforts. The irrigators get more water, the Yakama Nation gets fish passage and meaningfully revitalized sockeye population, land environmentalist get the Teanaway forest and other land conservation purchases, the river interests get substantial river fish habitat restoration and in-stream flow benefits and municipalities get a marginal benefit for long term water needs and security.

The key ingredient for all of this to work is that none of them really have to pay for it. In all instances, the IP magic works to keep all of these groups together as long as US and WA taxpayers are willing to pay for all the costs. Knowing this, the Work Group has thus far been able to keep the "integrated only" view of the plan together, negating the insights and diligence required to truly evaluate the plan. Accordingly, the economic analysis must rely on a small number of key assumptions and constraints to generate its overall integrated B-C results. However, by simply correcting a few parameters on future fish populations and starting points, correcting outright accounting & calculation errors, allowing for most likely future climate change (rather than defaulting to the most severe climate/economic outcomes) and eliminating overly restrictive water trade assumptions, the economics of the 4AA and the corresponding B-C results change dramatically. Specifically, this report identifies the following critical deficiencies:

- ***The 4AA B-C analysis is filled with outright errors and flawed assumptions.*** Correcting for these reduces the benefits approximately $6B to just over $1B while simultaneously the costs are at $3.8B and climbing ($4.4B with the recent cost updates). Only Fish Passage comes even close to passing B-C minimums. Given the magnitude of errors, flawed assumptions and cost increases, the B-C analysis according to the 4AA and cited in the proposals is inaccurate by orders of magnitude and therefore an updated B-C analysis must be mandated.

- ***Net...Net, the YBIP spends $2,794 per sockeye and $127,725 per non-sockeye fish.*** The IP benefits are fundamentally based on sockeye salmon (94% of fish benefits, 76% of total IP benefits), which primarily depend on Fish Passage for effective reintroduction. Non-sockeye require expensive habitat restoration and in-stream flow changes and represent only 6% of fish benefits. Clearly the place to start is with sockeye restoration, which can be accomplished without the inefficient non-sockeye restoration as proposed.

- ***Alternatives to draining lakes and building dams exist and should be objectively evaluated (not by USBR or the irrigators) before funding any projects.*** Hay and wheat use 41% of the water in the Yakima Basin. Combined, hay and wheat use nearly 3,500 gallons of water per $1 of net revenue, over 4x more than the average of 846 gallons for other Yakima Basin crops. These non-strategic, high water using, low economic value crops provide only 14% of Yakima Basin net revenue (most of it is exported as well) and are readily sourced from other regions in Washington. Exploring drought year deficit watering strategies provides 600 KAF of water use savings and reduces the economic impact of droughts by over 50% ($71M vs $150M). The 4AA study and the USBR continue to ignore this option.

- ***The USBR must provide accurate long-term analysis of water levels for Lake Kachess.*** The USBR has not responded to requests for the 100 year analysis based on their drought assumptions. Models developed based on the YBIP assumptions suggest catastrophic impacts on Lake Kachess water levels with below current minimum pool levels occurring 50% of the time.

- ***Determine reimbursement responsibility and amounts before any funding is released or construction starts.*** The federal government mandates significant non-federal funding while WA State mandates significant non-state funding. The resulting confusion is unacceptable. Specific, detailed, significant and achievable irrigator financial responsibility should be clearly defined before any funding is released. Current cost projections indicate irrigators could not support profit or repayment.

CONCLUSION:

In conclusion, the current YBIP approach and 4AA analysis do not provide the appropriate transparency and rigorous (and honest) analysis that the public deserves and it is the responsibility of taxpayer elected officials to ensure this occurs. Please correct this as the YBIP comes forward for additional funding, legislative and programmatic approvals.

Submitted on behalf of the Kachess Ridge Maintenance Association, Kachess Community Association, East Kachess Homeowner's Association and the Hyak Property Owners Association (representing over 700 directly affected homeowners), Kittitas County Fire District #8, Snoqualmie Pass Fire and Rescue and other interested parties in the Lake Kachess area. This economic analysis was prepared by James Schwartz with significant use of the WRC study. Mr. Schwartz earned a BBA in Finance from the University of Notre Dame and an MBA from The Stanford Graduate School of Business. He has over 15 years of strategy consulting and business analysis experience with Bain & Company, McKinsey & Company and Lake Partners. He resides in Seattle and owns property and a home near Lake Kachess as well.

An Economic Review of the Yakima Basin Integrated Plan

"How errors, inaccurate assumptions and false constraints drive the Integrated Plan forward"

INTRODUCTION:

The current Yakima Basin Integrated Plan (formally called the Yakima River Basin Integrated Water Resource Management Plan and also called the "IP") is a water management plan for Yakima River Basin of South-central Washington State that has arisen out of the Yakima River Basin Water Enhancement Project (YRBWEP). It has taken years to develop, cost millions of dollars and resulted in a substantial amount of published documentation. The overall Plan incorporates over 30 distinct projects focused primarily on fish passage, additional water supply & storage, habitat restoration and conservation efforts that aim to provide improved fish populations and water availability during droughts for irrigation and agriculture.

The IP released its federally mandated Benefit-Cost (B-C) analysis in the October 2012 Four Accounts Analysis (4AA). The 4AA report concludes the net benefits of the IP as a whole range from $6.2 billion to $8.6 billion with costs ranging from $2.7 billion to $4.4 billion. The 4AA B-C results were provided for the full proposed implementation of the IP and did not provide estimates of the net benefits of the individual components of the IP. To address this lack of individual project B-C analysis, the Washington State Legislature commissioned the Washington State Water Research Center (WRC)[1] to evaluate the IP economics and provide both an overall B-C analysis as well as a project level assessment. Unlike the 4AA report, the WRC study found total benefits in $1.1 – 2.2B range, well below the currently projected costs of $3.8B. Of the individual projects considered, only the fish passage projects passed B-C analysis (benefits which at least equal the costs i.e. B-C of 1.0) with all other IP projects significantly failing B-C analysis.

Given the prevalence of the Lake Kachess and Lake Keechelus projects in the overall IP and within the current Phase I planning and funding effort, a group of Lake Kachess area homeowners have come together to address the many IP shortcomings and concerns. The group includes the Kachess Ridge Maintenance Association, Kachess Community Association, East Kachess Homeowner's Association and the Hyak Property Owners Association (representing over 700 directly affected homeowners) as well as Kittitas County Fire District #8 and Snoqualmie Pass Fire and Rescue. Sadly, the USBR and WA Department of Ecology did not engage with any these groups in the build-up and planning process for the IP. In fact, many homeowners were first informed of the IP when they received the Lake Kachess (KDRPP) and Lake Keechelus (KKC) project DEIS documents in January 2015. As the group worked over the last 6 months to respond to the IP process, a team was tasked to evaluate the economic analysis of the YBIB.

The following analysis includes an Executive Summary (pages 2-9) as well as details of the full analysis (pages 10-34).

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[1] The State of Washington Water Research Center (WRC) was established 51 years ago as a member of the National Institutes for Water Resources (NIWR) under the Water Resources Act (WRRA) of 1964 with the charge of (1) arranging for competent research that addresses water problems or expands understanding of water and water-related phenomena, (2) aiding the entry of new research scientists into the water resources fields, (3) helping to train future water scientists and engineers, and (4) disseminating sponsored research results to water managers and the public. (https://swwrc.wsu.edu/)

OVERVIEW:

There are over 100 documents listed or attached to the IP's website. The various reports collectively create a mind-numbing level of complexity that comes across as deeply analytical but in reality is nothing more than a carefully managed and curated set of assumptions gathered to support a foregone conclusion. By weaving together the specific self-interests of disparate groups into an "integrated" approach, the IP hopes to pursue individual projects that are economically unsupportable but somehow become acceptable when they are all done together. As the following analysis demonstrates, by simply pulling on a few individual strands (including some very basic flawed assumptions), the seemingly ornate and sophisticated economic bow of the IP readily falls apart. In the end, true economic benefits, when calculated using accurate math and accounting, come in at $1.1B (vs. the projected Four Accounts Analysis report Benefits of $6.2-7.5B) against costs of $3.8B and growing (costs for KDRPP and KKC have increased from $276M in 4AA to now over $850M in just 15 months). Of the entire "integrated plan", only Fish Passage projects clear B-C hurdles as they represent 74% of total revised IP Benefits and only 13% of total revised IP costs. All other elements significantly fail B-C mandates.

EXECUTIVE SUMMARY:

Specifically, the Four Accounts Analysis (4AA) economic analysis has had to rely on a small number of key assumptions and constraints to generate its overall integrated B-C results. However, by simply ...

1. Correcting parameters on future fish populations and starting points for rehabilitation results
2. Correcting outright accounting & calculation errors and updating for significant cost increases
3. Correcting for the 4AA built-in climate change calculation that mathematically models the most severe climate-related economic outcomes and instead using the higher probability "most likely case" climate change scenario
4. Correcting for overly restrictive water trade assumptions that equally prioritize water supply to high water use, low economic value crops like hay and wheat (vs more water efficient and higher economic value crops like fruit, hops, wine/grapes and vegetables)

... the economics of the IP and the corresponding B-C results change dramatically as follows:

1) **Use realistic fish population growth rates & timing**: The current 4AA fish population projections use growth rates of over 10% to achieve the higher ends of the fish population projections. As economic benefits are directly related to fish populations, larger projected fish populations translate directly to higher projected economic benefits. Unfortunately, the high 10%+ growth rates are without any meaningful long-term scientific support. The highest rate used in current fish modeling analysis is 5%. At 5%, the YBIP fish population projections should be limited to the low end of the 4AA targets with a total increase of 181.65k fish. It will also take an additional 30 years

to achieve these more accurate target populations. ***Impact on 4AA Benefits: fish benefits are reduced by $2.4B*** *(see the WRC report for detailed calculations).*

2) **<u>Correct the calculation errors in the fish benefit assumptions</u>**: the current 4AA analysis fails to incorporate higher existing fish populations (there are 200k more fish currently in the relevant habitats than used in the analysis). Furthermore, the 4AA analysis erroneously assumes the calculation of fish benefits accrue prior to the completion (or even the initiation) of the necessary fish passage, habitat and in-stream flow projects required to create the fish population benefits. These errors substantially overstate the "Willingness to Pay" (WTP) calculations that include a diminishing marginal value of fish based on both starting populations and delayed population growth timing. ***Impact on 4AA Benefits: fish benefits are reduced by $2.9B*** (see the WRC report for detailed calculations)

3) **<u>Correct the Municipal water Benefit calculation errors:</u>** The municipal water supply benefits in 4AA have an outright error in the formulas which overstates the benefits by 90%. 4AA alternatively uses annual lease purchases and prices in perpetuity (vs purchasing a permanent water right at 10% of the cost) and uses a 1 time permanent water purchase price as an ongoing annual lease calculation (the permanent right only needs to be purchased 1 time, not every year) which also reduces the 4AA calculated benefits. ***Impact on 4AA Benefits: municipal benefits are reduced by $0.36B*** *(see the WRC report for detailed calculations) thus reducing the current $0.4B projected benefit by 90% to $0.04B.*

4) **<u>Fix the agricultural cost allocation errors:</u>** Based on the October 2012 Preliminary Cost Allocation Technical Memorandum, the 4AA cost allocation calculations include material errors that significantly understate the costs allocated to Agriculture by $679.3M. In the present value analysis presented on page 17, the adjustment on Row 4 for Agriculture Justifiable Expenditure is incorrectly reduced from the Single Purpose Alternative Costs of $1,222M to the assumed Agricultural Benefits of $800M. This adjustment does not follow standard cost accounting protocols for determining an appropriate cost allocation and is an error. Further, the 4AA cost allocation model also allocates 0% of Wymer Dam costs and only 38% of Bumping Lake costs to agricultural use, despite numerous statements in the YBIP documentation around their intended benefits to irrigators and agricultural use. The analysis further (and incorrectly) uses reduced project costs for the allocation process (again for Wymer Dam and Bumping Lake) but then uses full project costs for the final B-C calculations, again an error relative to cost accounting standards. Correcting the allocations to include full costs and allocating 50% of the Wymer Dam and Bumping Lake costs to agricultural use corrects the above errors and allows for a more accurate B-C analysis of YBIP agricultural programs. ***Impact on 4AA Benefit-Cost calculations: agricultural costs are increased by $0.679B and ecological restoration costs are reduced by $0.477B and municipal costs are reduced by $0.203B***

5) **Use more accurate & current cost projections:** IP cost estimates are incomplete and changing (increasing) rapidly and the 4AA analysis fails to capture this. The USBR has readily acknowledged in its recent public meetings (May 4, 2015 in Ellensburg, WA and May 5, 2015 in Cle Elum, WA) that costs relative to a number of issues are not yet reflected in the IP calculations. Costs for domestic well mitigation, potential SEPA/NEPA issues with associated mitigations, home value decrease mitigations, etc. are yet to be incorporated into the 4AA analysis (for example, no costs associated with private property mitigations are considered in the analysis). Further, estimated costs are increasing rapidly. For example, the combined KDRPP/KKC projects have gone from $276M in the 4AA analysis, to $645M in the DEIS to now $850M in the most recently published Feasibility Design Analysis (published after the DEIS). Given that YBIP hard construction costs are over 75% of total costs, it would seem a 3x increase in costs for the most visible near term projects would warrant revisiting the 4AA B-C analysis that is clearly now outdated, incorrect and overstated. It also suggests total YBIP costs will easily exceed $6-7B if other construction projects experience the same cost escalations as the KDRPP/KKC projects. The WRC study explicitly calls for continued monitoring and incorporation of cost increases especially as it relates to construction cost changes and more accurately including mitigation costs. ***Impact on 4AA Benefit-Cost calculations: conduct necessary analysis to determine erroneously overlooked costs which will result in an logically reduce B-C results of the 4AA analysis by an as yet determined amount.***

6) **Correct the overly aggressive climate change calculations**: The weather scenario used for the baseline 4AA agricultural analysis and benefit calculations is 8x more severe than historical data with no supporting data to justify the extreme deviation from the known data. Since, here again, the YBIP benefits increase with the severity of future climate change scenarios, it is important to use a more realistic and moderate set of assumptions. However, just as using the most severe climate regime is likely not appropriate, nor is ignoring the potential for climate change warranted. Accordingly, simply selecting a "middle of the road," or most likely case scenario of climate assumption, seems most appropriate. Therefore, a 4x climate change assumption (roughly 50% of the current benefit calculation) is a more prudent and justifiable approach. ***Impact on 4AA Benefits: agricultural benefits are reduced by $0.4B*** *(see the WRC report for detailed calculations) thus reducing the current $0.8B projected benefit by 50% to $0.4B.*

7) **Allow for appropriate inter-district water trading:** The assumed constraint of no more than 10% inter-district water leasing completely compromises the 4AA analysis and more than doubles the benefits. Since the real issue is using valuable water for high water using - low economic value crops like hay and wheat, especially in in KRD and WIP, vs high economic value crops in Roza (fruits, wine and hops), the impact of a 10% inter-district trade constraint is to mandate water (nearly 600 KAF in total) goes to low economic value-high water using crops in KRD and WIP (as well as other water districts). Specifically, it takes water that at a minimum will cost over $170 per AF to supply and uses it on crops with an average net revenue of under $100 per AF and no more than $128 per AF of water (Alfalfa hay). Surprisingly, the 4AA analysis is willing to project radically different climate scenarios but is unwilling to even moderately conceptualize how the water districts might behave differently. Given the impact of this one assumption, it seems 4AA should have at least conducted sensitivity analysis around the 10% trade limit and tested the impact of options up to 50-60% trade limit. For example, using a 50% inter-district trade constraint (rather than 10%) allows for over 400 KAF of inter-district trading and reduces the agricultural present value economic impact of future draughts by 50%. ***Impact on 4AA Benefits: agricultural benefits are reduced by an additional 50% or $0.2B.***

8) **Recognize the substantial difference in B-C outcomes for sockeye vs non-sockeye fish:** As detailed on page 10 of the 4AA report, sockeye salmon represent 170k of the total 181.65k salmon/steelhead population increases associated with the IP (at the low end of the fish population projections). Accordingly, 93.6% of Fish Benefits should be assigned to sockeye and 6.4% to non-sockeye species. Similarly, all sockeye will benefit from fish passage as will roughly 25% of non-sockeye fish (see page 93 of the WRC report). Given the total of 11.65k non-sockeye in the above total fish population as reported in the 4AA, an additional ~3k fish need to be added to the above sockeye count for a total of 173k benefiting from fish passage, of which 98% of the Fish Passage costs should be allocated to sockeye and 2% to non-sockeye. Further, as sockeye only marginally benefit from certain in-stream flow enhancements in the IP and do not benefit from the habitat restoration/conservation elements of the IP, 100% of these costs should be allocated to non-sockeye species. Accordingly, separating the sockeye from non-sockeye for B-C calculations clearly points out the positive outcomes for sockeye (i.e. Fish Passage projects) and the extremely negative B-C outcomes for non-sockeye (i.e. Habitat Restoration/Conservation & In-Stream Flows). ***Impact on 4AA Benefit-Cost calculations: Sockeye Benefits of $842M vs Costs of $475M for a Total B-C of +$367M. A cost of per sockeye fish of $2,794. Non-Sockeye Benefits of $58M vs Costs of $1,488M for a Total B-C of -$1,430M. A cost of per fish of $127,725.***

9) **Provide a more accurate long-term analysis of water levels for Lake Kachess:** The water supply analysis in the IP contains errors and needs much greater transparency. The RiverWare software is very sophisticated and can model many different scenarios. Accordingly, the existing analysis needs to clarify and correct for the stated 80 KAF minimum pool for Lake Keechelus. The 4AA analysis either removes 60 KAF from the water supply or significantly compromises fish restoration at Lake Keechelus or further drains Lake Kachess. The USBR has not been able to clarify which of these is true. Therefore, the 4AA needs to provide much greater clarity to the assumption to the 100 year impact on water levels at Lake Kachess from the YBIP. The models and analysis are obviously available to provide this analysis. What is disturbing is the lack of transparency to make the results available to the public. In the absence of any details from USBR, a simple 100 year model of Lake Kachess water levels was developed to show the devastating results of the YBIP on Lake Kachess. Over 50% of the time Lake Kachess will be below the current minimum pool level (~ -70 Ft) by October. Focusing on July water levels (when recreational use is high), historically the lake is at or above -25 feet nearly 95% of the time. With the YBIP, this will drop to ~50% of the time with historical October low water levels now present nearly 35% of the time in July. Clearly USBR has to be more forthcoming with a similar analysis.

10) **Clarify repayment responsibility & mechanisms before any construction starts:** Repayment needs to be firmly addressed and finalized prior to any IP implementation. Under the current federal guidelines, *construction costs allocated to agricultural irrigation are generally reimbursable without interest, while those allocated to municipal and domestic supply are reimbursable with interest.* If this statement is meant to apply only to directly allocated "Specific Costs", the current 4AA cost evaluation would only charge $179M to irrigators and $0 to Municipal Use, as these are the only "specific costs" allocated to these uses. It follows then that with over 40% of the costs associated with the YBIP allocated to agriculture, irrigators should be responsible for 40% of the reimbursement costs and not the mere 5% of the costs for reimbursement as allocated in the 4AA. ***Impact on the 4AA calculations: correctly allocate 40% of the costs (an additional $1.253b) of reimbursable costs to the irrigators and identify if it is feasible for the irrigators to repay those costs.***

11) **Evaluate meaningful alternatives to draining lakes and more dams:** 41% of the water in the Yakima Basin goes to hay and wheat which generate only 14% of the Net Revenue. Combined, hay and wheat use nearly 3,500 gallons of water per $1 of net revenue, over 4x more than the average of 846 gallons for other Yakima Basin crops. Each AF of water yields net revenue of less than $100 per AF. It is therefore unsustainable for hay and wheat crops to pay $170 per AF cost of additional water as outlined in the YBIP. Given these hard economic realities, creating additional supply for crops that can't afford to pay for the cost of the water makes little long-term economic sense. Accordingly, the only viable long-term solution is to focus on deficit watering strategies and ensuring valuable water supplies are delivered to the highest value crops, while financially reimbursing those impacted by water curtailment. To this end, the 20/50 Drought Deficit Watering Strategy has been developed. It is driven by the logic that droughts in the Yakima Basin create a loss of ~600 KAF of water, so a drought relief strategy needs to reduce use or increase supply by this amount. Based on the above proposal, there are two important economic foundations for the 20/50 Drought Deficit Watering Strategy. The first is to focus water use and limited curtailment (i.e. target 20% curtailment) on water-efficient high economic value crops (fruit, hops, wine grapes, vegetables, etc.) and target water inefficient crops (hay and wheat) for broader curtailment (i.e. 50% reduction). Accordingly, the 20/50 Drought Deficit Watering Strategy reduces the economic impact of a drought by over 50% to $71M as compared to the 4AA analysis which shows an economic cost of ~$150M in a drought year. This presents a clear and compelling need for further analysis of deficit watering strategies and significantly more review beyond that currently provided in the YBIP. The second foundation issue is of the impact by water district. Given the significant hay farming in Kittitas County (95+% hay), the primary economic issue for the YBIP is how to deal with hay farming in Kittitas County in particular and hay and wheat farming more generally within the Yakima Basin. Better water use strategies that limit hay and wheat water consumption are quite literally the crux of the issue. ***Impact on the 4AA calculations: 50% savings in economic costs of droughts over IP proposal***

Specifically, based on a detailed analysis of the 4AA B-C analysis and the 2014 WRC study commissioned by the WA State Legislature, the overall IP economic projections change as follows when the errors in the 4AA analysis are corrected:

(See following page)

Overview: Present Value Preliminary Cost Allocation – 2012: With Adjustments

	Total ($M)
4AA Benefits	7,395
Adjustments to 4AA Benefits	(6,255)
Correct Calculation Errors	(3,255)
Adjust for 200k higher initial fish populations and their corresponding lower incremental WTP values	(2,700)
Adjust for present value impact of not including fish benefits until fish projects are actually completed	(200)
Correct lease vs purchase price and calculation errors for Municipal Water Use	(355)
Adjust for Flawed Assumptions	(3,000)
Remove potential for Fish Populations to increase above 181k fish	(1,200)
Adjust PV due to 30 additional years to achieve 181k fish population totals	(1,200)
Correct for future climate scenario, reduce from 8x worse than historical to 4x worse (50% reduction)	(400)
Correct for overly constrained water trade assumption of 10%; Allow for 50% inter-district trade reducing FAA Benefits by 50%	(200)
Revised Total Benefits	1,140
4AA Total Cost Allocation	3,520
Revised Total Cost Allocation: Add $600M for KDRPP/KKC	4,120

Revised Total Benefit-Cost	(2,980)
Revised Total Benefit-Cost Ratio	0.28

4AA Projected Total Benefit-Cost	3,875
4AA Projected Total Benefit-Cost Ratio	2.10

These conclusions in the above summary are explained in detail in this report. The following analysis will first identify and evaluate the impact of Benefit Calculation Errors and Cost Calculation Errors. This will be followed by revised B-C analysis correcting for the identified errors. Additional assessment of Water Supply Calculation Errors and concerns around Repayment will also be presented. Finally, an alternative approach to the IP will also be presented as a way to stir more honest debate of different solutions to the Yakima Basin water problems.

It is important to recognize that the material accounting, mathematical and assumption errors are readily available from existing data. The fact that I was able, as an individual taxpayer, to find some of these material errors, untested assumptions and missing data, is disturbing at best. Obviously, the Washington Legislature desired to have an independent and more detailed B-C analysis than the 4AA and most of these errors were identified in the WRC report. However, taxpayers have paid millions of dollars for the development of the IP proposals and yet substantial holes and errors are readily found. Taxpayers and their elected representatives deserve accountability from project proponents to ensure accurate, unbiased and appropriately audited economic analysis. This has not happened with the 4AA analysis. Furthermore, the proponents of the IP dismiss the independent and authoritative WRC study despite its commendable and accurate treatment of many of these issues.

The scope, cost and impact of the IP are significant to taxpayers and the environment. Prior to any decision regarding the IP, the proponents must be required to provide accurate analysis. Specifically, no material funding (Authorizations or Appropriations) or capital budgets should be undertaken for the IP until these issues are accurately addressed.

<u>FLAWED ANALYSIS</u>

The following sections provide in-depth details and analysis regarding the above Executive Summary points.

<u>Benefit Calculation Errors</u>

1) Benefits of the IP are calculated incorrectly. Based on the 4AA document, the following errors and assumptions cause the 4AA to materially, and incorrectly, overstate IP benefits. (Note: much of this analysis and the ensuing calculations are based on the work contained in the WRC's report on the IP).

   a) Fish Benefits of $5-7B are based on erroneous assumptions and are significantly overstated; accurate calculations of actual fish benefits are less than $1B.

      The following corrections to the current analysis lead to this conclusion:

      i) There is no data to support the 4AA projected fish population growth rates. In order for the 4AA to achieve the higher end fish population projections, the model uses 10% population growth rate, which is double the *highest* growth rate used in current fish modeling analysis of

5%. Yet the 4AA analysis this aggressive high end growth rate and does so without any scientific data to support this extreme deviation from standard growth rate assumptions. At 5% high end growth rates, fish population projections would be limited to the low end of the plan with a target total increase of 181.65k fish. It would also take an additional 30 years to achieve these more accurate target populations. Further, the original pre-extirpation sockeye salmon populations in the Basin are estimated to be 100-200k. Sockeye represent over 85% of the total fish benefits in IP. Yet the IP forecasts potential Sockeye increases of over 2x the historical pre-extirpation size. Given the many additional fish migration, habitat and survival challenges present now that were not there 100+ years ago (pre-extirpation), it seems unlikely that pre-extirpation populations can be achieved and there is no data cited to support this projection.

Perhaps a baseball analogy will help put the various fish population growth rates into perspective:

A 5% average growth rate for salmon populations is like a .300 batting average in baseball. Over the years, 1000's of MLB players have averaged .300 for a season or two. Yet only 139 players have reached that batting average for their entire career. Accordingly, modeling a 5% fish population growth rate is an achievable rate of growth, but it is on the far end of the realistic range over a 100 year period. Given this achievable, yet very high rate of growth of 5%, it will take an extra 30 years for fish populations to reach the low fish population totals (i.e. 181k fish) called for in the 4AA B-C calculations.

Alternatively, consider the baseball batting average analogy based upon the 4AA growth rate of 10%. Assuming a fish population growth rate of 10%+ is comparable to a .400 batting average. In MLB history, only 24 players have achieved it for a single season, so it's technically possible, just like the 4AA high-end fish population growth rates might be technically possible for a year or two. That said, no player has ever achieved a .400 batting average over the course of their career (even short careers). The closest was Ty Cobb, who had achieved a career .376 batting average when he retired in 1928. In perhaps an interesting corollary with fish populations, the last time a player batted .400 even for a season was Bill Tyler in 1930. Much has changed in baseball since then just has much has changed in the ability for fish to reach historical population levels in the Yakima Basin. Accordingly, a 100-year fish benefit calculation that depends on any rate of growth above 5% is a substantially speculative projection without any long-term scientific data to support the deviation from historical data.

ii) Accordingly, the potential for future fish populations above the low of 181.65k fish should be abandoned as the probability is too low to warrant any expected value. The impact of these lower and delayed benefits on the Benefits Analysis is twofold. First, the total fish benefit of \$6.2B is reduced by \$1.2B due to the maximum total fish benefits of no more than 181k fish. Second, this lower present value total of \$5.0B needs to be reduced by an additional ~\$1.2B to reflect the additional 30 years it will take to achieve the total maximum population of 181k fish.

iii) WTP fish benefits need to be adjusted to account for increases in fish populations not associated with the IP. As the 2011 Fish Benefits analysis discusses, on-going efforts not associated with the IP will yield an 18% increase in fish populations. The WTP data comes from a 1998 household study which assumed a baseline Columbia Basin fish population of ~2M and included decreasing marginal WTP values as fish populations increased. Therefore, the starting point for the IP fish benefit should be adjusted by the 18% increase (~200k fish) and fish values decreased based on the now lower marginal WTP values. As outlined in the WRC analysis, this change reduces total benefits (on the low fish population levels assumed in (1) above by a further $2.7B. The 4AA analysis effectively takes credit for this 18% increase in fish populations that are unrelated to the IP and applies the benefits to the B-C analysis. Furthermore, it fails to adjust the marginally decreased WTP values due to the higher populations. Therefore, the analysis is making the basic accounting mistakes of taking credit for prior inventory and valuing the inventory at a value higher that the price the inventory can be sold for. These are basic accounting errors that cannot produce erroneous and unreliable results.

iv) Fish Benefits should not start accruing until the projects that will benefit fish are actually completed. Fish Passage and habitat reclamation projects take time and will require several decades to fully complete. The fish cannot enjoy the benefits of the projects until they are designed, funded, constructed and completed. Yet the current 4AA Benefit calculations assume fish benefits start at the beginning of the projects, which is simply not possible. The benefits start at the completion of the projects (as there can be no fish passage unless the actual fish passage infrastructure is built and functioning). Given the impact of timing on present value calculations, this error material increases fish benefits simply from a timing perspective. While project by project completion dates should be used, a simple 4 year delay provides a solid baseline assumption for this delay and decreases fish benefits a further 20% in the above present value calculations and equals a further $0.2B reduction from (1) and (2) above. This is also a basic accounting error. It is tantamount to General Motors projecting sales revenues for a new line of autos to start before the factories have even been constructed to build the cars. The benefits simply cannot accrue until years later. Therefore the quantity of cars that can be sold and the value of the revenues GM would receive from those sales (which must be discounted using present value analysis), is dramatically reduced based upon accurate accounting.

v) In summary, these accounting corrections reduce the 4AA projected benefits of $6.2B associated with fish to just $0.9B. Further, this benefit amount is based on 4AA calculations that include both Washington and Oregon households. As Oregon is not currently planning to financially support the IP, total fish benefits drop $333M to $0.567B when only Washington households are considered. This is also an important adjustment for Washington legislators to consider when reviewing the IP and its funding proposals.

b) Agricultural and Municipal water supply benefits of $1.4B are based on erroneous assumptions and include outright errors; True Agricultural & Municipal benefits are $0.24B or less. Thus the asserted 4AA $1.4B benefit is overstated by more than 5x the actual benefit.

The following corrections to the current analysis lead to this conclusion:

(1) The weather scenario used for the baseline 4AA Agricultural analysis is 8x more severe than historical data. Based on the WRC analysis (pp 67-68), 4AA implicitly assumes a severe drought (70% curtailment) 21.76% of the time for the next 100 years without the IP. Given the assumed 70% curtailment for all droughts in 4AA, this translates into an average annual curtailment of 15.232% for the 100 year period. For perspective, the actual average annual curtailment for the 1925-2009 period was 11.09%. Therefore, the implied impact of climate change in the *baseline* 4AA analysis is a 37% increase (over historical data) in average annual curtailment without the IP.

Additionally, according to the WRC report, 4AA also calculates the estimated impact on average annual curtailment if the Full IP had been implemented from 1925-2009. The historical estimate is 10.0% average curtailment with the IP. So the IP would have improved average annual historical curtailment by 109 absolute basis points and 9.8%. Given the 4AA assumed 30% curtailment in all drought years with the IP, the average annual curtailment with the IP drops to 6.528%, an improvement of 807 basis points and 57% improvement on the 4AA baseline of 15.232%.

Since the benefits analysis calculates the value of the difference between the "no IP baseline" and the "with the IP" scenarios, it is calculating the benefit of moving from average annual curtailment of 15.232% to 6.528%. Thus the value of the average curtailment is improved by 807 basis points, which is ~8x greater than the calculated historical improvement of 109 basis points with the IP, yet there is data to support this 8x deviation. Of note, the average improvement of the IP under the most severe climate projection (HADGEM) shows an improvement of 757 basis points for the IP over no IP baseline. Therefore, the "net, net" 4AA climate change impact on projected benefits aligns with the most severe climate change regime in terms of absolute $ benefits. Just as using the most severe climate regime is likely not appropriate, nor is ignoring the potential for climate change warranted. Accordingly, simply selecting a "middle of the road" (or statistically most likely) climate assumption is the only justifiable approach unless reliable data is shown which supports a more aggressive calculation (this would require data to support both the basis for the high deviation from historical data and the probability associated with the outcome). Therefore, a 4x climate change assumption (roughly 50% of the current benefit calculation) is far more justifiable. This reduces the 4AA projected benefit of $.8B by 50% to $0.4B.

(2) The 4AA assumes a constraint of no more than 10% inter-district water leasing completely compromises the analysis and more than doubles the benefits. (see http://www.roza.org/images/2015%20Water%20supply%20management.pdf which demonstrates that even in the current drought season, inter-district water leasing is available at rates that are still profitable to producers and water is available to lease in sufficient quantities to meet demand). The 4AA analysis projects extreme climate change scenarios (which inflate benefits) but is does not meaningfully contemplate the possibility of alternative water use strategies including inter-district leasing.

There are substantially different net revenue values of agricultural activities in the various water districts. This is especially true of the high water using, low economic value crops of hay and wheat produced within the Kittitas Reclamation (irrigation) District (KRD) and Kittitas County (which is primarily hay) and to a lesser degree in the Wapato Irrigation Project and the Sunnyside Valley Irrigation District (which produce alfalfa hay and wheat) . The current 4AA analysis assumptions limiting inter-district trading effectively directs nearly 600 KAF of water to these low value crops and leaves significantly higher value crops to be prorated. Further, the 4AA assume water that will cost over $170 per AF to supply will be used on crops with an average net revenue of under $100 (and a maximum $128) per AF of water. It makes no economic sense and is unsustainable to supply water at a rate of over $170 per AF only to lose an average of $70 for each AF of water supplied.

Given the impact of this one assumption, the 4AA should have at least conducted sensitivity analysis around this arbitrarily imposed 10% trade limit and tested the impact of options up to 50-60% trade limit. The WRC report details a "Full Trade" option which allows 100% trading. The Full Trade option demonstrates (using the same data and methodology as the 4AA analysis) that the value of Agricultural benefits drops from $0.8B to $0.154B, an 81% decrease, if water is allowed to be used where it creates the greatest value. While the "Full Trade" assumption may be overly aggressive, certainly more than 10% is achievable (as demonstrated in 2015) and a higher level of level, based upon data and associated probabilities should have been considered and used. So while the exact number may need further analysis, assuming a 50% inter-district trade constraint will allow 50% of the value to be captured. Accordingly, the current 4AA report overstates the Agricultural value of the IP by 2x (see the WRC analysis) and therefore, the benefits cited by the 4AA should be reduced by 50%. Based on (1) above in this section, this represents a reduction of $0.2B of the remaining $0.4B in Agricultural benefits for a total Agricultural benefit of just $0.2B.

(3) The 4AA and WRC reports both fail to evaluate the option of deficit watering, which significantly impacts the benefits analysis. In both reports, the option to use deficit irrigation is not explored. Both assume the opposite extremes of fully harvested fields or fallowed fields in terms of the economic impact. Interestingly, in the current 2015 drought, there is much publicity around creative deficit irrigation and the offsetting impact this can have in the face of a drought. An example will help illustrate this point. The 4AA assumes a severe drought removes ~600K AF of Agricultural water supply. Based on the same assumptions and analysis used in 4AA and WRC, this ~600K AF reduction in supply can be managed simply by 1) reducing all hay (alfalfa, pasture, Timothy, and other hay) and wheat water appropriations (Senior & Junior) by 50%. This allows for at least a first cut for hay and a minimum of 50% production for wheat. and 2) reducing (i.e. deficit irrigation) all other crops in the Basin by 20% (Senior and Junior). This requires no additional storage. Furthermore, it allows those impacted to be compensated at a $ level 20% greater than their crops would generate, yet the economic impact of the drought would be less than half of the current 4AA drought impact projection of $150M per drought under the IP.

(4) The municipal water supply benefits in 4AA have an outright mathematical error in the formulas which overstates the benefits by 90%. 4AA alternatively uses annual lease purchases and prices in perpetuity (vs purchasing a permanent water right at 10% of the cost) and models a 1 time permanent water purchase expense as an ongoing annual expense (the permanent right only needs to be purchased 1 time, not every year). This math error also reduces the 4AA calculated benefit by 90%. As detailed in the WRC report (pp 156-159), adjusting for these two errors reduces the present value of municipal water benefits from $0.4B to under $0.04B, a 90% reduction.

(5) In summary, these changes reduce the projected $1.2B benefits associated with Agriculture and Municipal water to $0.24B.

c) In total, IP benefits drop from ~$7.4B to $1.14B, an 84% reduction. Without question, the above analysis reflects the significant impact a small number of incorrect assumptions and constraints has on the overall benefit calculations of the IP. By simply limiting the fish benefits to a historically relevant range (vs 2-3x historical norms), reflecting current reality in calculating fish benefits in terms of starting populations and aligning timing of benefits with the completion of projects that produce them, providing more realistic water trading constraints (50% rather than 10%) that better reflect economics and proven realities (and not holding our current water district structure as fixed in perpetuity), allowing for deficit irrigation to play its natural (and long established in fact) role in the process, and correcting a few unintended math errors, the entire group of IP benefits drops from $6.2B to $1.14B, an 82% reduction. Perhaps even more concerning is the cascade of failures that has allowed this process to become so far removed from accurate reporting. The IP has already cost taxpayers hundreds of millions of public funds. The IP has been years in planning and been reviewed by government agencies, legislative bodies, work groups and consultants. Yet all that time, expense and review can be undermined so completely by challenging and unraveled by a handful of faulty assumptions and constraints and non-rigorous accounting reviews. One must conclude the "group think" affect has been the dominant theme, with no one willing to look objectively at the assumptions and the math.

Cost Calculation Errors

2) Costs of the IP are materially understated and allocated incorrectly, dramatically favoring Agricultural interests: based on the 4AA and various Technical Memorandum documents, the following errors and assumptions cause the 4AA to materially and incorrectly understate and misallocate IP Agriculture costs.

   a) IP cost estimates are incomplete, have already changed dramatically and the 4AA analysis fails to capture these costs in the analysis resulting in flawed analysis and conclusions. The USBR has readily acknowledged in its recent public meetings (May 4, 2015 in Ellensburg, WA and May 5, 2015 in Cle Elum, WA) that costs relative to a number of issues are not yet reflected in the IP calculations. Costs for domestic well mitigation, potential SEPA/NEPA issues with associated mitigations, home value decrease mitigations, etc. are yet to be incorporated into the 4AA analysis (for example, no costs associated with private property mitigations are considered in the analysis). Further, estimated costs are increasing rapidly. For example, the combined KDRPP/KKC projects have gone from $276M in the 4AA analysis, to $645M in the DEIS to now $850M in the most recently published Feasibility Design Analysis (published after the DEIS). Given that IP hard construction costs are over 75% of total costs, it would seem a 3x increase in costs for the most visible near term projects would warrant revisiting the 4AA B-C analysis that is clearly now outdated, incorrect and overstated in favor of project B-C. It also suggests total IP costs will easily exceed $6-7B if other projects experience similar cost escalations as the KDRPP/KKC projects. The WRC study explicitly calls for continued monitoring and incorporation of cost increases especially as it relates to construction cost changes and more accurately including mitigation costs. This is the only logical approach to projects of this scope, magnitude and cost. Continued reliance on cost estimates known to be false, flies in the face of all basic principles of economics and accounting.

   b) The 4AA cost allocation model includes material errors that significantly understate costs allocated to Agriculture by $679.3M:

      i) In the October 2012 Preliminary Cost Allocation Technical Memorandum, the present value analysis presented on page 17 shows an adjustment on Row 4 for Agriculture Justifiable Expenditure. Footnote 3 states the adjustment is for the "Lesser of values from Row 2 (Benefits at $800M) and Row 3 (Single Purpose Alternative Costs of $1,222M). [Note: "Single Purpose Alternative" (SPA) – costs that benefit more than one Project Purpose (e.g. Agriculture) and are thus allocated across Project Purposes]." This is a misapplied and incorrect accounting adjustment. While it is true that the total costs allocated should not exceed total costs, this specific calculation is used to create the appropriate weighting of costs for the actual allocation step. By incorrectly reducing the amount in Row 4 by $422M, the cost allocation process reduces allocated costs to Agriculture by $247.9M. Therefore, this results in an over-allocation of the same amount of costs to Ecological Restoration $209.7M and Municipal Use by $38.2M. Thus, the weighting of costs which should then be applied to the total costs has instead been misrepresented to the benefit of Agriculture. The relevance of Footnote 3 is the real issue here and any basic cost accounting allocation review of this adjustment would clearly demonstrate the error in applying it to this situation/calculation.

ii) Further in the October 2012 Preliminary Cost Allocation Technical Memorandum and in the July 2012 Reduced-Size Projects for Single Purpose Alternative (SPA) Preliminary Cost Allocation memo, there are a number of project scoping changes that are used to adjust the total cost allocation approach. Smaller costs are inserted into the analysis for potential reduced in scope projects at Wymer and Bumping Lake. Of note is the following statement on page 1 of the July 2012 document: *"The reduced-size projects are intended solely to carry out the federal cost-allocation protocol, <u>and do not reflect any change in the planned capacity or projects described in the Integrated Plan</u>."* In other words, the allocation approach will use reduced costs for two projects that have a significant Agriculture benefit (thus understating the allocation to Agriculture) yet there is no plan to actually change those projects total costs or scope. This is simply flawed and incorrect accounting. As a result of the above, the allocation costs for Wymer projects are reduced by $377M or 34%.

Additionally, 100% of these costs are allocated to Ecological Use notwithstanding the numerous statements that Wymer benefits are 50% ecological and 50% agricultural (See 2012 Final Fish and Wildlife Coordination Report p 37). For Bumping Lake, costs for Ecological Use and Municipal Use are reduced by 15-20% and only 38% of the Bumping Lake allocation costs are assigned to Agriculture. It follows that if the project cost allocation approach has significantly changed that the overall discussion in the IP and the IP B-C analysis should be significantly restated as well.

For the moment, let's assume the above statement that these adjustments are *"intended solely to carry out the federal cost-allocation protocol"* is irrelevant and no change is needed in IP projects scope and benefits. Accordingly, we simply have an accounting allocation error since the allocation approach should in fact mirror the benefits intended given the SPA approach. Correcting for this error, assuming 50% of the allocation costs for Wymer and Bumping Lake should be allocated to Agriculture increases the Remaining Joint Costs charged to Agriculture by an additional $431.3M and reduces Ecological Use by an additional $267.0M and Municipal Use by an additional $164.3M.

iii) The above accounting errors do not change the total Remaining Joint Costs (RJCs) of $2,387M. However, i) and ii) above do reallocate the costs allocated to Agriculture from the current $532M (22.3% of RJCs) to $1,211M (50.7% of RJCs) to better align with proper cost allocation accounting methodologies. The above results in actual allocation calculations that more accurately reflect the stated project benefit categories. This increase of $679.3M in costs for Agriculture further stresses the negative Agriculture B-C IP results with total Agriculture related costs now at $1.4B compared to Agriculture Benefits of $0.2B for an Agricultural B-C of .14 (see section 1) b) above).

B-C Calculation Errors

3) B-C Calculation Errors: Given the above, the overall 4AA B-C calculations need to be revised as follows (Note: much of this analysis and the ensuing calculations are based on the work contained in the WRC's report on the IP with the exception of erroneous cost allocations):

   a) Summary of adjusted 4AA B-C analysis:

(See next page)

Present Value Preliminary Cost Allocation – 2012: With Adjustments

	Project Purposes			
	Ecological Restoration	Agriculture	Municipal & Domestic	Total ($M)
4AA Benefits	**6,200**	**800**	**395**	**7,395**
Adjustments to 4AA Benefits	**(5,300)**	**(600)**	**(355)**	**(6,255)**
Remove potential for Fish Populations to increase above 181k fish	(1,200)			
Adjust PV due to 30 additional years to achieve 181k fish population totals	(1,200)			
Adjust for 200k higher initial fish populations and their corresponding lower incremental WTP values	(2,700)			
Adjust for present value impact of not including fish benefits until fish projects are actually completed	(200)			
Correct for future climate scenario, reduce from 8x worse than historical to 4x worse (50% reduction)		(400)		
Correct for overly constrained water trade assumption of 10%; Allow for 50% inter-district trade reducing FAA Benefits by 50%		(200)		
Correct lease vs purchase price and calculation errors for Municipal Water Use			(355)	
Revised Total Benefits	**900**	**200**	**40**	**1,140**
4AA Total Cost Allocation	**2,440**	**729**	**351**	**3,520**
Adjustments/Reallocations to 4AA Costs	**(477)**	**679**	**(203)**	**0**
Correct Footnote 3 error: limiting SPA costs to the maximum of total benefits is an incorrect cost accounting step	(209.7)	247.9	(38.2)	0
Correct SPA allocations for Wymer and Bumping Lake to include 50% allocation for Agricultural Use; Also use full cost of projects	(267.0)	431.3	(164.3)	0
Cost Increases: KDRPP/KKC has increased over 300% from $276M to $850M+	?	?	?	?
Revised Total Cost Allocation	**1,963**	**1,408**	**148**	**3,520**

Revised Total Benefit-Cost	**(1,063)**	**(1,208)**	**(108)**	**(2,380)**
Revised Total Benefit-Cost Ratio	**0.46**	**0.14**	**0.27**	**0.32**

4AA Projected Total Benefit-Cost	**3,760**	**71**	**44**	**3,875**
4AA Projected Total Benefit-Cost Ratio	**2.54**	**1.10**	**1.13**	**2.10**

b) The 4AA Benefit calculation relies upon sockeye salmon recovery. Sockeye recovery relies predominantly on fish passage (there is a small element of improved in-stream flows that can also benefit sockeye salmon). It is relatively simple to separate sockeye fish passage benefits from habitat restoration and in-stream flow benefits. Therefore, the more appropriate B-C and cost allocation approach would be to separate fish passage and sockeye benefits/costs from those habitat restoration/conservation and in-stream flow project benefits/costs intended for non-sockeye fish species. In so doing, it is obvious the extent to which the fish passage and sockeye salmon related activities generate a significant proportion of the IP Fish benefits at a fraction of the total IP Fish costs. Specifically, sockeye related benefits total $842M vs Costs of $475M for a Total B-C of +$367M. Non-Sockeye benefits total $58M vs $1,488M in costs for a Total B-C of ($1,430M). The following analysis details these facts:

i) Overall Benefit Allocation for sockeye vs non-sockeye: As detailed above and on page 10 of the 4AA report, sockeye salmon represent 170k of the total 181.65k salmon/steelhead population increases associated with the IP (any higher increase in fish populations is simply not supported by science ... see WRC report pp 48-65). Accordingly, 93.6% of Fish Benefits should be assigned to sockeye and 6.4% to non-sockeye species.

ii) Fish Passage B-C assessment for sockeye vs non-sockeye: All sockeye will benefit from fish passage. In addition, as noted on page 93 of the WRC report, roughly 25% of the non-sockeye fish species will also benefit from fish passage. Given the total of 11.65k non-sockeye in the above total fish benefit, an additional ~3k fish needed to be added to the above sockeye count for a total of 173k benefiting from fish passage, of which 98% of the Fish Passage costs should be allocated to sockeye and 2% to non-sockeye.

iii) Habitat restoration/conservation and in-stream flow B-C assessment for sockeye vs non-sockeye: As sockeye only marginally benefit from certain in-stream flow enhancements in the IP and do not benefit from the habitat restoration/conservation elements of the IP, 100% of these costs should be allocated to non-sockeye species.

iv) Based on the "Specific Cost" (Costs directly attributable to only one Project Purpose (e.g. Ecological Use)) and "Single Purpose Alternative" (SPA – costs that benefit more than one Project Purpose and are thus allocated across Project Purposes) cost allocation methods applied in the October 2012 Preliminary Cost Allocation Technical Memorandum and now isolating Specific Costs and SPA allocated costs for Fish Passage and Habitat restoration/conservation and in-stream flows uniquely, the following results occur:

   (1) Of costs noted in the SPA category, 12.8% are for fish passage projects and 87.2% are for Habitat restoration/conservation and in-stream flows. These will be used to allocate Remaining Joint Costs below.

   (2) Fish Passage: $351M in Specific Costs plus 12.8% of the Remaining Joint Costs for Ecological Use of $1.043B for a total Fish Passage cost of $485M.

   (3) Habitat restoration/conservation and in-stream flows: $568M in Specific Costs plus 87.2% of the Remaining Joint Costs for Ecological Use of $1.043B for a total Habitat restoration/conservation and in-stream flows cost of $1,478M.

v) Applying the above $ amounts to the sockeye vs non-sockeye fish species based on (1), (2) and (3) above yields the following:

(1) Sockeye: Benefits = $842M (93.6% of $0.9B) vs Costs of $475M (98% of $485M); Total B-C of +$367M. A cost of per fish of $2,794.

(2) Non-Sockeye: Benefits = $58M (6.4% of $0.9B) vs $1,488M (100% of $1,478M + 2% of $485M); Total B-C of -$1,430M. A cost of per fish of $127,725.

vi) The specific calculations are as follows:

Ecological/Fish Benefits - Present Value Preliminary Cost Allocation – 2012: With Adjustments

	Project Purposes: Ecological Restoration		
	Total	Sockeye	Non-Sockeye
Revised Ecological Total Benefits: Allocated to Sockeye & Non-Sockeye	**900**	**842**	**58**
Allocation of Ecological Benefits			
Allocate based on Fish Population Totals: Sockeye are 93.6% of Total Fish Population; Non-Sockeye are 6.4% at projected 181k Total Fish Population		842	58
Revised Total Ecological Cost Allocation: Allocated to Sockeye & Non-Sockeye	**1,963**	**475**	**1,488**
Allocation of Ecological Benefits			
Fish Passage: $351M in Specific Costs plus 12.8% of the Remaining Joint Costs for a Total Fish Passage of $485M. Allocate based Fish Passage Use (100% of Sockeye and 25% of Non-Sockeye Populations) = 98% Sockeye allocation and 2% non-Sockeye.	485	475	10
Habitat restoration/conservation and in-stream flows: $568M in Specific Costs plus 87.2% of the Remaining Joint Costs for a total of $1,478M. Allocated 100% to non-Sockeye.	1,478	-	1,478
Revised Ecological Restoration Total Benefit-Cost: Allocated to Sockeye & Non-Sockeye	**(1,063)**	**367**	**(1,430)**
Revised Ecological Restoration Total Benefit-Cost Ratio: Allocated to Sockeye & Non-Sockeye	**0.46**	**1.77**	**0.04**

Washington Only at 63% of Benefits & 100% of Costs

Revised Ecological Restoration Total Benefit-Cost: Allocated to Sockeye & Non-Sockeye	**(1,396)**	**55**	**(1,451)**
Revised Ecological Restoration Total Benefit-Cost Ratio: Allocated to Sockeye & Non-Sockeye	**0.29**	**1.12**	**0.02**

c) Clearly the fish passage projects related primarily to sockeye salmon and secondarily to non-sockeye species are well warranted. Equally clear is the complete failure of habitat restoration/conservation and in-stream flow projects to pass any B-C assessment.

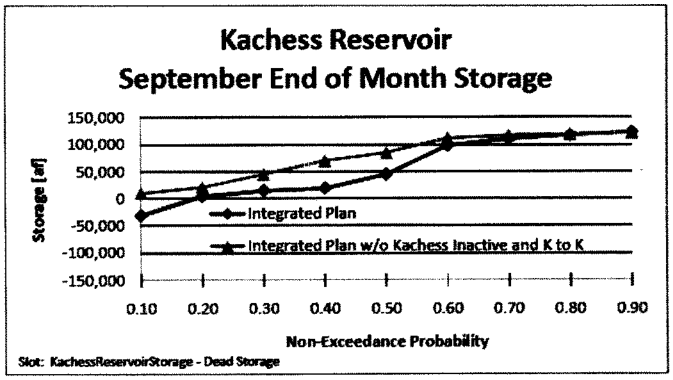
Water Supply Calculation Errors

4) The estimated impact to Lake Kachess is significantly understated, not fully communicated to stakeholders and includes a significant accounting/math error.

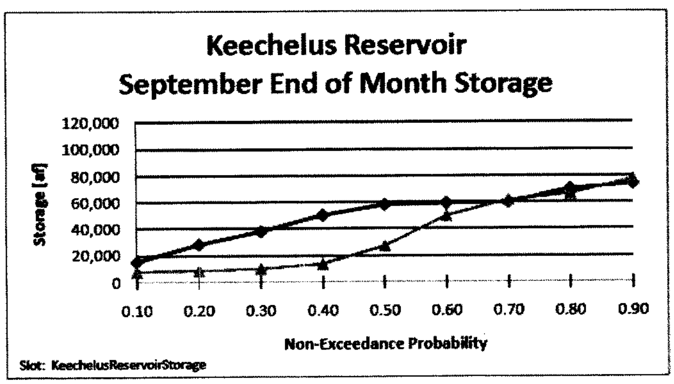
   a) There is already significant public feedback provided regarding the need for KDRPP and KKC DEIS to better address water levels and water supply issues. Items of significance include failure to address domestic water issues, NEPA/SEPA issues, and the impact on recreational benefits and home values. These issues have not been researched, mitigation strategies have not been provided nor have cost associated with mitigations been estimated. However, those issues will not be further repeated here.

   b) Interestingly, despite the existence of very sophisticated models, USBR has failed to provide any estimate directly to the public (including home owners) on the projected impact KDRPP and KKC projects would have on actual lake water levels. Given the substantial commentary in the various documents on RiverWare tools, this type of projection is reasonable and appropriate since it is readily available from the existing models and has been explicitly requested by stakeholders.

      USBR has provided views of the how the IP would have impacted water levels at Lake Kachess (had it been previously in place) over the last 25 years or so. That said, this time period has been relatively benign with significant wet years often following drought conditions. These views do not represent the projected 30%+ drought incidence implicit in the IP benefit-cost analysis. While not presented in any of the recent stakeholder meetings, there was an analysis done on water levels in June 2011 as part of the Modeling of Reliability and Flows Technical Memorandum. In this document (p 138) they provide a probability estimate of the End of September Lake levels with and without the IP (see below). From this analysis, one can conclude that the IP increases the odds of the Lake being below 50K AF nearly 70% from roughly 30% of the time without the IP to roughly 53% of the time with the IP. Sadly, USBR officials have never shared this analysis but rather state "low water levels are not likely to happen" when directly questioned on the topic. Clearly providing important and accurate facts to stakeholders has been missed in this instance.



c) Unfortunately, the analysis in b) above also contains a material error. Given the existence of the KKC pipeline, the above chart/analysis assumes surplus water from Lake Keechelus will be available to help refill Lake Kachess. A similar chart of Lake Keechelus on the same page of the report shows the extent of the typical Keechelus draw down to pool minimums roughly 40% of the time and at or below 60K AF roughly 70% of the time. If there were no operational changes to Lake Keechelus, the above chart for Lake Kachess would be correct. Unfortunately, this is not the case as will be shown in d) below.



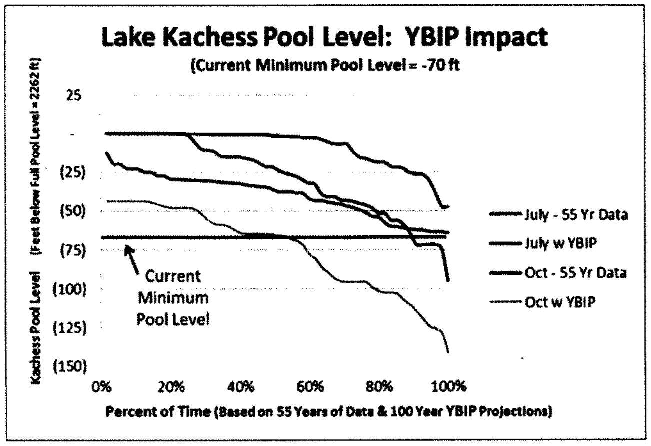
d) In the recently published March 2015 Feasibility Design Report – Draft Keechelus-to-Kachess Conveyance, section 10.2 on page 23 states:

> *"the Keechelus target storage above which water is transferred into Kachess is critically important to maximizing the benefit to Keechelus Reach in terms of reducing summer high flows, while avoiding drawing Keechelus Reservoir down so low that adverse up-migration impacts occur to bull trout in the reservoir. ... the target would affect the amount of water that is transferred through the KKC tunnel ... [and the] Keechelus Reservoir target storage [is] set at 80,000 acre-feet"* minimum pool.

In other words, transfer of water in the KKC to Lake Kachess is dependent on Keechelus water supplies being above 80K AF. Returning to the above chart for Lake Keechelus pool levels and now drawing a minimum pool level of 80K AF demonstrates a 90%+ likelihood of Keechelus being below this level and no transfers taking place during the summer to Kachess. Effectively, unless the difference of roughly 60K AF can be made up from another water source, this operating rule removes 60K AF from the summer water supply. Alternatively, if Keechelus does not maintain this minimum pool, there will be no migratory fish benefits based on access to Gold Creek and Cold Creek so the non-sockeye fish benefits of the KKC project would need to be radically reduced accordingly.

e) Given this net reduction of 60K AF from the Keechelus water supply, the obvious option is to try to take this water from Lake Kachess (or recognize and model the fact that the Lake Keechelus project of the IP will remove 60K AF from the current water supply and reduce the associated fish benefits in the B-C analysis consistent with this reduction in supply). Accordingly, the above Lake Kachess chart would need to be adjusted uniformly down by 60K AF. This means over 50% of the time the lake will be below current minimum pool levels and will be below 50K AF roughly 80% of the time, over a 250% increase from current average lake levels at the end of September. Clearly a significant impact and one that will drastically reduce recreational value and home values in the Lake Kachess area, let alone the potential impact on domestic wells.

f) Despite repeated requests for further clarification on this issue and release of 100 year water level projections for Lake Kachess, USBR has failed to clarify or provide the requested analysis. In the absence of any details from USBR, a simple 100 year model of projected Lake Kachess water levels was developed and demonstrates the devastating results of the YBIP on Lake Kachess (see below). Over 50% of the time Lake Kachess will be below the current minimum pool level (~ -70 Ft) by October. Focusing on July water levels (when recreational use is high), historically the lake is at or above -25 feet nearly 95% of the time. With the YBIP, this will drop to ~50% of the time with historical October low water levels now present nearly 35% of the time in July. Clearly USBR has to be more forthcoming with a similar analysis.



g) Note: The reduction in either total water supply, Lake Keechelus minimum pool or Lake Kachess minimum pool frequencies all have impacts on SEPA/NEPA compliance, ESA compliance as well as the fish passage, in stream flow and habitat restoration benefits cited in the 4AA. These will all be negatively impacted by the correction of this error, but this analysis does not seek to quantify those impacts as they will likely require biological research. The DEIS for the KDRPP/KKC projects should be redrafted based upon this corrected supply analysis with appropriate supporting biological data.

Irrigator Repayment Issues

5) Other than taxpayers (Washington and the Federal Government), there is no specific accountability or stated methodology for direct beneficiaries (irrigators) to help repay the appropriate costs of the IP, nor is there any analysis to demonstrate the ability and probability of repayment by the irrigators.

   a) At a Federal level, the 4AA report provides the framework to support US Government funding for projects based on the impact across four areas (accounts) of National Economic, Regional Economic, Environmental Quality, and Other Social Effects. What it does not do is lay out any specific plan for how the primary economic beneficiaries of the plan, agricultural water users, will help fund the costs of the IP. This question has come up repeatedly in community meetings with the response from Work Group members and USBR staff suggesting irrigators will pay for the water they use, but no specifics are given. It seems logical that taxpayers and their representatives should expect this critical component to be well established within the IP and supported by legally binding agreements prior to being asked to support such a large outlay of public funds.

b) Within the Federal USBR documentation, Section 7.0 Repayment in the October 2012 Preliminary Cost Allocation Technical Memorandum (p 19) outlines a high level concept for repayment:

> *Reimbursable project functions included in the Integrated Plan are agricultural irrigation and municipal and domestic water supply. Construction costs allocated to agricultural irrigation are generally reimbursable without interest, while those allocated to municipal and domestic supply are reimbursable with interest. For the Integrated Plan, cost-share partners such as the State of Washington, local governments or other parties, may participate in reimbursement.*

While this statement may sound good, it leaves much to interpretation. Taken literally, one would need to review costs directly allocated (i.e. "Specific Costs") to either Agricultural Use or Municipal/Domestic Use (project costs allocated under the SPA Costs would not be reimbursed) as these would be the only costs that qualify for reimbursement. Accordingly, Appendix B-1 of the above report identifies $179M of Specific Construction Costs assigned to Agricultural Irrigation and $0M of Specific Costs assigned to Municipal/Domestic Use. In other words, of total projected IP costs of over $3.5B, only 5.1% of the total costs would be subject to reimbursement. Further clouding the issue is the lack of clarity on who might qualify as the reimbursement partner. The above statement would allow WA State (and not irrigators) to qualify as the reimbursement partner.

c) Of particular interest is the additional clarification in the above document as follows: *Ecological restoration is generally a non-reimbursable function that is typically expected to be borne by the U.S. Treasury in combination with the state and other cost-share partners.* In other words, the more the IP can identify costs as Ecological Use, the more the U.S Treasury will fund. Perhaps this explains the preponderance of costs allocated for Ecological Use in the October 2012 Preliminary Cost Allocation Technical Memorandum, despite significant documentation of the water supply projects' Agricultural Irrigation use and benefits.

What is important to note here is the need for specific definitions that clearly outline costs where reimbursement is required. Additionally, the cost allocation methodologies must be thoroughly reviewed to ensure the financial details align with the broader intent. Specifically, since 40% of the total costs of the project can be assigned to Agricultural Irrigation use, then irrigators should pay 40% of the costs, not 5%. Otherwise, the IP is nothing more than a grand farm subsidy program that specifically benefits less than 5,000 farmers, many of whom grow low value crops like hay and wheat. Accordingly, more specificity, more transparency and greater binding reimbursement structures are needed.

It is also important to analyze the ability of the irrigators to reimburse the costs. As noted in the WRC report, many agricultural reimbursements are based upon the "ability to pay" as calculated on an annual basis after construction. Thus many projects which require reimbursement, are not in fact reimbursed due to poor cost estimates or poor analysis of the irrigator's ability to repay. An accurate analysis of the costs, cost allocations and irrigator responsibilities and abilities to repay are essential to prevent the taxpayers from being unwittingly saddled with inappropriate and unanticipated costs.

d) While Municipal/Domestic Use is also identified as a reimbursable element, the total water dedicated to these uses is minimal compared to agricultural uses. Additionally, municipal water districts and domestic well owners tend to purchase senior water rights to ensure adequate supply. Accordingly, the need for a reimbursement scenario for these uses is far less compelling.

e) Extending the same concern to the state level, WA State has already enacted stricter reimbursement guidelines than the Federal process. Via RCW RCW 90.38.120, the WA Legislature has required the following: *It is the intent of the legislature for the state to pay its fair share of the cost to implement the integrated plan. At least one-half of the total costs to finance the implementation of the integrated plan must be funded through federal, private, and other nonstate sources, including a significant contribution of funding from local project beneficiaries.* The statute also requires the State Treasurer's office to conduct an annual audit of the funding plan mandated by the law. What is still undefined, though, is the final and specific definition of the required "significant contribution" from "local project beneficiaries."

f) Funding Flip-Flop Issues: The above discussion highlights the concern associated with a funding "flip-flop" whereby the federal government allows Washington State to be the required reimbursement partner and Washington State relies primarily on the federal funding for its mandated 50% cost share with others. This lack of up-front specificity allows the IP to gain more momentum without addressing a fundamental and required issue surrounding irrigator repayment for agriculture benefits of the IP. Further, the history of similar USBR agriculture water supply projects is considered very questionable when it comes to mandated repayments actually taking place. Unless and until this issue is clearly defined and legally affirmed, the IP will continue to be viewed as a "farm subsidy" program poorly disguised as something else.

Evaluate meaningful alternatives to draining lakes and building more dams/storage

6) 41% of the water in the Yakima Basin goes to hay and wheat which generate only 14% of the Net Revenue. Combined, hay and wheat use nearly 3,500 gallons of water per $1 of net revenue, over 4x more than the average of 846 gallons for other Yakima Basin crops. Each AF of water yields net revenue of less than $100 per AF. It is therefore unsustainable for, hay and wheat crops to pay $170

per AF cost of additional water as outlined in the IP. Given these hard economic realities, creating additional supply for crops that can't afford to pay for the water it takes to grow them makes little long-term economic sense. Accordingly, the only viable long-term solution is to focus on deficit watering strategies and ensuring valuable water supplies are delivered to the highest value crops, while financially reimbursing those impacted by water curtailment. To this end, the 20/50 Drought Deficit Watering Strategy has been developed. It is driven by the logic that droughts in the Yakima Basin create a loss of ~600 KAF of water, so a drought relief strategy needs to reduce use or increase supply by this amount. Accordingly, in any year where a drought is declared, the following could occur:

a) **<u>All hay and wheat crops would immediately be prorated 50%.</u>** This would still allow a "first cutting" for hay, so the economic impact is significantly lessened to a 40% economic loss. Wheat farmers would simply need to plant half as much wheat. Farmers with senior water rights would be payed the full value of their economic loss. Junior water rights may be compensated depending on the funding mechanisms (see below). This creates a savings of 385 KAF of water.

b) **<u>All other crops would be immediately prorated 20%.</u>** This would still allow meaningful crop production with perhaps a 10% economic loss. It preserves water for our most valuable crops. Farmers with senior water rights would be payed the full value of their economic loss. Junior water rights may be compensated depending on the funding mechanisms (see c) below). This creates a savings of 221 KAF of water.

c) **<u>Introduce a Yakima Basin water usage tax to fund drought reimbursements:</u>** A simple $10 per AF tax would provide a significant base to provide reimbursement to farmers impacted by drought year curtailments. Given the approximate use of 1,800 KAF per year, this would generate ~$18M per year of tax revenue to be held in reserve for drought years. The cost of 100% net revenue reimbursement in a) and b) above is ~ $71M, so the $10 AF tax should cover the droughts that occur on a 4-5 year interval.

d) **<u>Implement the proration at the water district level (and they can manage the Senior Water rights holders as well):</u>** Since inter-district trading seems to be so challenging, this approach would provide a calculation up front for how much water each district will receive based on its recorded crop mix. The districts would also receive a lump payment based on the reimbursement strategy in c) above to reimburse farmers within each district appropriately. The districts would then coordinate and manage the process within their respective water districts. If the districts want to add additional intra-district trading, that would be their option.

e) **<u>In-Stream fish water use can also be accommodated:</u>** Since the above is based on a most severe drought status, in many years there would be additional water supply available for in-stream fish population management. Given the relatively modest needs for in-stream flows (~70 KAF), it should be possible for the USBR to determine the best balance between in-stream and out-of-stream water uses in any given drought year.

f) **<u>Fund Fish Passage as an Initial Step:</u>** While not directly related to the above, Fish Passage projects should be funded as an initial step in salmon reintroduction. Once Fish Passage has proven its ability to benefit salmon recovery, additional habitat restoration projects should be considered.

Based on the above strategy, there are two important economic foundations for the 20/50 Drought Deficit Watering Strategy. The first is based on broader groupings of crop types and shows the impact by crop. As the 4AA analysis shows an economic cost of ~$150M in a drought year, the 20/50 Drought Deficit Watering Strategy reduces this amount by over 50% to $71M, clearly presenting a compelling need for further analysis and review beyond that currently provided in the IP.

Alternative Approach for the YBIP: 20/50 Drought Deficit Watering Strategy

Crop Type	Net Revenue/ Acre	Net Rev/AF	Acres	A/F	Percent of AF	AF per Acre	Total Net Revenue	Gallons of Water per $ of Net Revenue	Percent of Total Net Revenue	Drought Deficit Watering Reduction	Water Savings with 20/50 Deficit Watering Strategy	Assumed Reduction on Total Net Revenue from Drought Deficit Watering Reduction	Reduction on Total Net Reveneu from Drought Deficit Watering Reduction
Fruit	$ 1,832.37	$ 339.02	83,504	451,332	24%	5.40	$ 153,009,872	961	31%	20%	90,266	10%	$ 15,300,987
Hops	$ 3,481.00	$ 876.16	29,845	118,575	6%	3.97	$ 103,890,445	372	21%	20%	23,715	10%	$ 10,389,045
Wine/Grapes	$ 1,813.18	$ 496.10	51,672	188,854	10%	3.65	$ 93,690,589	657	19%	20%	37,771	10%	$ 9,369,059
Hay/Wheat	$ 459.97	$ 93.80	157,409	771,897	41%	4.90	$ 72,402,773	3,474	15%	50%	385,948	40%	$ 28,961,109
Misc	$ 785.00	$ 175.30	49,211	220,374	12%	4.48	$ 38,630,635	1,859	8%	20%	44,075	10%	$ 3,863,064
Veg	$ 1,405.02	$ 289.38	25,621	124,397	7%	4.86	$ 35,997,962	1,126	7%	20%	24,879	10%	$ 3,599,796
Grand Total	$ 1,252.63	$ 265.34	397,262	1,875,429	100%	4.72	$ 497,622,276	1,228	100%	32%	606,655	14%	$ 71,483,060

The second analysis is of the impact by water district. Given the significant hay farming in Kittitas County, the primary economic issue for the IP is how to deal with hay farming in Kittitas County in particular and hay and wheat farming more generally within the Yakima Basin. Better water use strategies that limit hay and wheat water consumption are quite literally the crux of the issue.

Impact of 20/50 Deficit Watering Strategy

Water District	Total AF of Water	Hay/Wheat AF of Water	Percent Hay/Wheat of Total AF	Water Savings with 20/50 Deficit Watering Strategy	20/50 Drought Deficit Total Water Reduction	Total Net Revenue	Reduction on Total Net Revenue from Drought Deficit Watering Reduction	Percent Reduction in Total Net Revenue from Drought Deficit Watering Reduction	Projected Annual Water Use Tax at $10.00 per AF	Percent of Annual Total Net Revenue
KRD	287,369	277,664	97%	140,773	49%	$ 31,782,923	$ 12,033,126	38%	$ 2,873,686	9.0%
KSR (Kittitas Senior)	190,429	188,624	99%	94,673	50%	$ 20,011,692	$ 7,808,648	39%	$ 1,904,290	9.5%
Roza	322,496	27,840	9%	72,851	23%	$ 130,284,737	$ 13,672,199	10%	$ 3,224,958	2.5%
SVID	430,411	101,110	23%	116,415	27%	$ 129,077,002	$ 15,862,400	12%	$ 4,304,110	3.3%
WIP	565,949	172,845	31%	165,043	29%	$ 144,712,511	$ 17,829,929	12%	$ 5,659,488	3.9%
YTID	78,776	3,814	5%	16,899	21%	$ 41,753,411	$ 4,276,758	10%	$ 787,756	1.9%
Total	1,875,429	771,897	41%	606,655	32%	$ 497,622,276	$ 71,483,060	14%	$ 18,754,288	3.77%

Conclusion:

The IP process and Work Group have worked very hard over an extended period of time to develop the current approach. They are to be commended for exerting an extreme level of effort and bringing together organizations that typically are on opposite sides. Unfortunately, there is a deep and obvious truth that needs transparency and more thorough review. All of the special interests involved in the IP get something for their efforts. The irrigators get more water, the Yakama Nation gets fish passage and meaningfully revitalized sockeye population, land environmentalist get the Teanaway forest and other land conservation purchases, the river interests get substantial river fish habitat restoration and in-stream flow benefits and municipalities get a marginal benefit for long term water needs and security.

The key ingredient for all of this to work is that none of them have to pay a cost proportionate to their individual benefits. In all instances, the IP magic works to keep all of these groups together as long as US and WA taxpayers are willing to dramatically subsidize the costs. Knowing this, the Work Group has thus far been able to keep the "integrated only" view of the plan together, negating the insights, accounting, and due diligence required to truly evaluate the plan. Accordingly, the economic analysis has had to rely on a small number of key assumptions and constraints to generate its overall integrated B-C results. However, by simply adjusting a few parameters on future fish populations and starting points, correcting outright accounting & calculation errors, allowing for future climate change but not defaulting to the most severe and unlikely climate/economic outcomes and eliminating overly restrictive water trade assumptions, the economics of the 4AA and the corresponding B-C evaporates like water in the deserts of Eastern Washington . Specifically, this report identifies the following critical deficiencies:

- ***The 4AA B-C analysis is filled with outright errors and flawed assumptions.*** Correcting for these reduces the benefits approximately $6B to just over $1B while simultaneously the costs are at $3.8B and climbing ($4.4B with the recent cost updates). Only Fish Passage comes even close to passing B-C minimums. Given the magnitude of errors, flawed assumptions and cost increases, the B-C analysis according to the 4AA and cited in the proposals is inaccurate by orders of magnitude and therefore an updated B-C analysis must be mandated.

- ***Net...Net, the YBIP spends $2,794 per sockeye and $127,725 per non-sockeye fish.*** The IP benefits are fundamentally based on sockeye salmon (94% of fish benefits, 76% of total IP benefits), which primarily depend on Fish Passage for effective reintroduction. Non-sockeye require expensive habitat restoration and in-stream flow changes and represent only 6% of fish benefits. Clearly the place to start is with sockeye restoration, which can be accomplished without the inefficient non-sockeye restoration as proposed.

- ***Alternatives to draining lakes and building dams exist and should be objectively evaluated (not by USBR or the irrigators) before funding any projects.*** Hay and wheat use 41% of the water in the Yakima Basin. Combined, hay and wheat use nearly 3,500 gallons of water per $1 of net revenue, over 4x more than the average of 846 gallons for other Yakima Basin crops. These non-strategic, high water using, low economic value crops provide only 14% of Yakima Basin net revenue (most of it is exported as well) and are readily sourced from other regions in Washington.

Exploring drought year deficit watering strategies provides 600 KAF of water use savings and reduces the economic impact of droughts by over 50% ($71M vs $150M). The 4AA study and the USBR continue to ignore this option.

- ***The USBR must provide accurate long-term analysis of water levels for Lake Kachess.*** The USBR has not responded to requests for the 100 year analysis based on their drought assumptions. Models developed based on the YBIP assumptions suggest catastrophic impacts on Lake Kachess water levels with below current minimum pool levels occurring 50% of the time.

- ***Determine reimbursement responsibility and amounts before any funding is released or construction starts.*** The federal government mandates significant non-federal funding while WA State mandates significant non-state funding. The resulting confusion is unacceptable. Specific, detailed, significant and achievable irrigator financial responsibility should be clearly defined before any funding is released. Current cost projections indicate irrigators could not support profit or repayment.

In conclusion, the current IP approach and 4AA analysis do not provide the appropriate transparency and rigorous (and honest) analysis that the public deserves and it is the responsibility of taxpayer elected officials to ensure this occurs. Please correct this as the IP comes forward for additional funding, legislative and programmatic approvals.

Submitted on behalf of the Kachess Ridge Maintenance Association, Kachess Community Association, East Kachess Homeowner's Association and the Hyak Property Owners Association (representing over 700 directly affected homeowners), Kittitas County Fire District #8, Snoqualmie Pass Fire and Rescue and other interested parties in the Lake Kachess area. This economic analysis was prepared by James Schwartz with significant use of the WRC study. Mr. Schwartz earned a BBA in Finance from the University of Notre Dame and an MBA from The Stanford Graduate School of Business. He has over 15 years of strategy consulting and business analysis experience with firms like Bain & Company, McKinsey & Company and Lake Partners. He resides in Seattle and owns property and a home near Lake Kachess as well.

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Senate Bill S1694 – Key Questions - Updated

Yakima River Basin Water Enhancement Project Phase III Act of 2015

Senate Committee on Energy & Natural Resources Hearing Scheduled for July 7, 2015

1. ***Benefit-Cost Analysis:*** Please explain how and why the USBR 2012 Four Accounts Benefit-Cost analysis projects benefits of $6-7B while the 2014 benefit-cost analysis study completed by the Washington State Water Research Center and the 2015 economic analysis prepared by Lake Kachess homeowner associations & fire districts (as submitted for the hearing record) project benefits of $1-2B?
2. ***Project Costs:*** What is the USBR's current estimate for the total cost of the Plan? Given the recent 300% increase in two Phase I projects (Kachess Drought Relief Pumping Plant (KDRPP) and Keechelus to Kachess Conveyance (KKC) Total Costs increased from $276M in 2012 to $850M in 2015 [see March 2015 Draft Feasibility Studies]), as the Plan moves forward, what is the USBR's forecast for additional cost escalations from the 2012 cost projection of $3.5B? As costs increase, how and when will you reflect this in updated benefit-cost analysis? How much of total future costs would be federal costs? Of the federal costs, how much requires additional authorization?
3. ***CBO and OMB Review:*** When will CBO Score and OMB review this bill? What are the projected offsets?
4. ***Authorization Intent:*** Please clarify what is being authorized by this bill? Is it Phase 1 only of the Integrated Plan or does it also create a full authorization of the full Integrated Plan by making it the 2015 Phase III of the Yakima River Basin Water Enhancement Project (as the name of the bill suggests)?
5. ***Project Alternatives:*** Other than the "no-action" and full Integrated Plan as presented, were any other partial alternatives evaluated? Specifically, alternatives that include deficit watering (especially for hay and wheat) and unconstrained inter-district water trading?
6. ***Project Reimbursement:*** Federal guidelines mandate repayment for project costs whose purpose is agricultural use. What are the total costs USBR will require irrigators to reimburse, and what time frame and payment mechanisms will be used to ensure timely repayment?
7. ***FACA Exemption/Homeowner Participation:*** It appears that all of the Work Group participants are both direct beneficiaries and proponents of the Integrated Plan. Can you please explain why homeowners, small businesses and fire districts adversely impacted by Phase I (i.e. Lake Kachess area opponents) projects have not been included in the Work Group and why a FACA exemption should be supported for the Work Group?

July 3, 2015

From: Kerry Seguin <kerrylseguin@gmail.com>
Sent: Tuesday, July 07, 2015 11:37 AM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office

304 Dirksen Senate Building

Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely

Kerry Seguin

5327 219th ST. SE

Woodinville WA

98072

From: Jeanne Sheldon <jeannes@msn.com>
Sent: Thursday, July 02, 2015 7:14 PM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee:

The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am strongly opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are far from cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing natural lake water (or in their parlance, "inactive storage") from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation. Fewer than 30% of the farming land in Kittitas County is being irrigated with sound conservation methods such as drip and sprinklers yet their irrigation district leaders are in the forefront of the YRBWEP working group. Critics agree that this is not the win-win-win for irrigators, conservationists and the Yakama Nation that the working group would have you believe. The voodoo economics that you may hear in the testimony ("it is inappropriate to perform B-C analysis in the component parts of the YBIP" Garrity, et al, 2015) doesn't hold water. It is logically unsupportable.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Jeanne Sheldon
18810 NE 150th Ct
Woodinville WA 98072

From: Bob and Pauline <bpsidd@msn.com>
Sent: Friday, July 03, 2015 6:59 PM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694 in the Subject Line

(Robert & Pauline Siddoway 4069 E. Pinon Way Gilbert, AZ 85234)

Senate Energy and Natural Resources
Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project.
July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1694, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective. Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1694 is bad national water policy and bad national environmental policy. Please do not pass S. 1694, as introduced.

SIERRA CLUB
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Washington State Chapter
180 Nickerson St, Ste 202
Seattle, WA 98109
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TESTIMONY OF THE SIERRA CLUB
to the Energy and Natural Resources Committee
U.S. Senate
Washington, D.C.
On S. 1694

July 7, 2015

Madam Chair and Members of the Committee:

Thank you for the opportunity for the Sierra Club to provide comments on S. 1694. This bill concerns the Yakima River Basin Integrated Plan (Yakima Plan) in Washington State.

The Sierra Club has been involved with and provided comments to the Yakima Workgroup since the formation of the Yakima Workgroup in 2009. We are opposed to passage of S. 1694, as written. Specifically, our objections can be categorized into the following five areas with relevant concerns noted. We have also drafted recommended changes to the bill that address these concerns:

1. Yakima Plan and National Environmental Policy Act (NEPA) Final Programmatic Environmental Impact Statement

The bill defines the "Management Plan" as the plan described in the document entitled "Final Programmatic Environmental Impact Statement and Integrated Water Resource Management Plan, Yakima River Basin, Water Enhancement Project, Benton, Kittitas, Klickitat, and Yakima Counties, WA." (2012 FPEIS). The bill should not reference or incorporate the 2012 FPEIS because the 2012 FPEIS did not include a range of alternatives as required by NEPA. *40 CFR Sec. 1502.14*. Instead the bill should reference the 2011 Workgroup Yakima Plan document.[1]

[1] http://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/plan/integratedplan.pdf

http://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/2012meetings/2012-01-04/wtrlandssubfinal.pdf

The Yakima Plan, as defined in the 2012 FPEIS, includes projects which are environmentally damaging and not cost effective such as a proposed new Bumping Lake Dam that would destroy ancient forest and endangered species habitat. The 2012 Plan also includes the proposed Wymer Dam that would flood sage grouse habitat and is also not cost effective.

It is requested that Congress require these projects be "cost effective measures" rather than "maximizing benefits." In 2013, the Washington State Legislature was so skeptical of the 2012 Yakima Plan that they required an independent analysis of the benefits and costs by the Congressionally-established State of Washington Water Resource Center (WRC). The WRC's benefit-cost analysis of the Yakima Integrated Plan Project, released in 2014, found that "*When implemented together as part of the IP, the major water storage projects as a group do not pass a B-C [benefit-cost] test.*"
(http://swwrc.wsu.edu/documents/2014/12/ybip_bca_swwrc_dec2014.pdf)

We suggest these revisions to the bill which address the problems mentioned above:

1.1 Authorization of the full Yakima Plan:

Page 4 (8) Lines 13-18 state:

"(8) to authorize and implement the Yakima River Basin Integrated Water Resources Management Plan as Phase III of the Yakima River Basin Water Enhancement Project, in a balanced approach to maximize benefits to the communities and environment in the Basin."

Amend to:

Page 4 (8) Lines 13-18:

"(8) to authorize projects listed in new Section 1214(a)(2)(A) that are cost effective to provide benefits to the communities and environment in the Basin."

1.2 Adoption of a flawed NEPA 2012 FPEIS:

Page 5 (3) Lines 10-17 state:

"(8) Management Plan – The term 'Management Plan' means the plan described in the document entitled, 'Final Programmatic Environmental Impact Statement and Integrated Water Resource Management Plan, Yakima River Basin, Water Enhancement Project, Benton, Kittitas, Klickitat, and Yakima Counties, WA' (77 Fed. Reg. 12076 (February 28, 2012)).

Amend to:

Page 5 (3) Lines 10-17:

"(8) Management Plan – The term 'Management Plan' means the Yakima River Basin Study (Yakima Plan) (08CA10677A ID/IQ) (April 2011), as amended by the Watershed Land Conservation Proposal (January 2012).

1.3 Authorization of Phase III as part of the Yakima Plan:

Page 7 (3) Lines 3-16 state:

"(18) Yakima Enhancement Project, Yakima River Basin Water Enhancement Project – The Terms 'Yakima Enhancement Project' and Yakima River Basin Water Enhancement Project' mean the Yakima River basin water enhancement project authorized by Congress pursuant to this Act and other Acts. . . . ."

Amend to:

Page 7 (3) Lines 3-16:

"(18) Yakima Enhancement Project, Yakima River Basin Water Enhancement Project – The Terms 'Yakima Enhancement Project' and Yakima River Basin Water Enhancement Project' mean the Yakima River Basin Water Enhancement Project authorized by Congress listed in new Section 1214(a)(2)(A) that are cost effective pursuant to this Act and other Acts. . ."

1.4 Implementation of the full Yakima Plan in its entirety:

Page 23 Sec. 1214(a)(1) Lines 21-23 state:

"(1) In General – It is the intent of Congress that the Management Plan shall be implemented in its entirety, in accordance with applicable laws."

Strikeout:

Page 23 Sec. 1214(a)(1) Lines 21-23

~~*"(1) In General – It is the intent of Congress that the Management Plan shall be implemented in its entirety, in accordance with applicable laws."*~~

2. New National Recreation Areas on National Forest lands

The process used to include National Recreation Areas (NRAs) called out in the 2012 FPEIS was deeply flawed. The Yakima Workgroup added a new proposal for two NRAs within the Okanogan-Wenatchee National Forest after the close of the public period on the Draft Programmatic Environmental Impact Statement (DPEIS). As proposed, the Yakima NRAs are highly deficient because 41,000 acres are dedicated damaging off-road vehicle (ORV) per the FPEIS. Additionally, an NRA boundary included in the FPEIS overlays part of the existing Alpine Lakes Wilderness.

Because this element of the Yakima Plan was adopted after the close of public comment period of the DPEIS, we request this element be deleted from the Yakima Plan.

Decisions on establishing new NRAs in the Okanogan-Wenatchee National Forest are best made after the Okanogan-Wenatchee National Forest completes its forest planning processes. These processes are now in work.

We suggest this bill revision to address the problems mentioned above:

2.1 Delete the Okanogan-Wenatchee National Forest NRAs from the Yakima Plan:
Add a new (E) on Page 27, after line 8:
"The Yakima Plan's designations for new National Recreation Areas (NRAs) within the Okanogan-Wenatchee National Forest with 41,000 acres of dedicated off-road vehicle use shall be deleted from the Yakima Plan. Any new NRA proposals shall be evaluated as part of the Okanogan-Wenatchee National Forest Plan revision process and Travel Management process."

3. Federal Advisory Committee Act and Public Participation

The Bureau of Reclamation (Bureau) has skirted the Federal Advisory Committee Act (FACA) by establishing the Yakima Workgroup as an advisory group without a FACA charter and now asks Congress to continue to insulate the Yakima Workgroup from FACA. In the interests of good open government, as well as facilitating communication with Yakima Valley residents, we believe the Workgroup and all subcommittees of the Workgroup should be subject to FACA. In addition, the Secretary should not be able to add any projects to the Intermediate and Final Development Phases without public participation and comment.

We suggest these bill revisions to address the problems mentioned above:

3.1 FACA
Page 6 (4) Lines 23-24 state the Workgroup:
"(C) is not subject to the Federal Advisory Committee Act (5 U.S.C. App.)";

Amend to:
Page 6 (4) Lines 23-24 state the Workgroup:
"(C) is subject to the Federal Advisory Committee Act (5 U.S.C. App.)";

3.2 Intermediate and Final Phases
Page 26 (3), lines 8-16 state:
"(A) In general. – During the Intermediate and Final Development Phases of the Management Plan, any project that is determined by the Secretary, in consultation with the State of Washington and Work Group, to be appropriate to meet the obligations of the Management Plan shall be designed and constructed, subject to authorization and appropriation."

Amend to:
Page 26 (3), lines 8-16:
"(A) In general. - Any project proposed by the Yakima Workgroup for Federal funding beyond the Initial Development Phase shall be subject to a 90-day public comment prior to a review by the Bureau. No additional project beyond the Initial Development Phase shall be authorized or funds appropriated, without National Environmental Policy Act compliance.

4. Kachess Drought Relief Pumping Plant Project and Keechelus to Kachess Conveyance Project

The Bureau is asking this Committee to authorize the Secretary to negotiate long-term agreements with participating proratable irrigation entities for the non-Federal financing, construction, operation, and maintenance of the Kachess Drought Relief Pumping Plant Project and Keechelus to Kachess Conveyance Projects. However, these sections do not prohibit continued Federal funding of design or feasibility studies of these projects. In addition, the Bureau has not completed reviewing comments on the Draft Environmental Impact Statement for the Kachess Drought Relief Pumping Plant or Keechelus to Kachess Conveyance projects or issued a Final Environmental Impact Statement.

We suggest this bill revision to address the problems mentioned above:

4.1 Proratable irrigation entities
Amend to:
Add a New (C) on page 26, beginning Line 8 as follows:
"(C) Other than NEPA compliance, no Federal funds shall be spent on the design or feasibility studies of inactive storage in Lake Kachess and a conveyance system to allow transfer of water between Lake Keechelus to Lake Kachess as set out in Sec. 2014 (a)(2)(A) (ii)(I) and (II). If non-Federal financing, construction, operation, and maintenance of these projects are carried out, the participating proratable irrigation entities in the Yakima Basin shall reimburse the Federal government for all Federal planning and study funds expended on these projects. Nothing in this Act shall circumvent the National Environmental Policy Act."

5. Yakima Plan Discretion

S. 1694 contains sections with ambiguous language and discretion. For example, Sec. 1213 authorizes the Secretary to make grants to irrigation districts to carry out this title. Section 1215 appears to reinforce a long-term bias of putting water supply for other purposes rather than benefiting fish. Since the purpose of the Yakima Plan is to benefit both fish and downstream uses, this section is a step back from that approach.

We suggest these bill revisions to address the problems mentioned above:

5.1 Phase III Grants
Page 22 Sec. 1213 Lines 15-21 state:
"The Secretary may make grants or enter into cooperative agreements with the Yakama Nation, the State of Washington, Yakima River basin irrigation districts, water districts, conservation districts, other local governmental entities, nonprofit organizations, and land owners to carry out this title under such terms and conditions as the Secretary may require including the following purposes:

Amend to:

Page 22 Sec. 1213 Lines 15-21:

"The Secretary may make grants or enter into cooperative agreements with the Yakama Nation, the State of Washington, Yakima River basin irrigation districts, water districts, conservation districts, other local governmental entities, nonprofit organizations, and land owners under such terms and conditions as the Secretary may require for the following purposes:"

5.2 Feasibility Contingency

Page 27 (D), lines 3-5 state:

"*(D) Feasibility contingency – The Intermediate and Final Development Phases of the Management Plan shall be contingent on feasibility, as determined by the Secretary, in consultation with the Workgroup and in compliance with applicable laws.*"

Amend to:

Page 27(D), lines 3-5:

"(D) Feasibility contingency – The Intermediate and Final Development Phases of the Management Plan shall be contingent on feasibility, cost-effectiveness, and a positive benefit-cost ratio."

5.3 Operational Control of Water Supplies

Page 36, lines 19 -24 and page 37, lines 1-2 state:

"Section 1215. Operational Control of Water Supplies

The Secretary shall retain authority and discretion over the management of project supplies to obtain maximum operational use and flexibility to meet all appropriated and adjudicated water rights. That authority and discretion includes the ability of the United States to store, deliver, conserve and reuse water supplies deriving from projects authorized under this title."

Strikeout:

Page 36, lines 19-24 and page 37, lines 1-2:

~~"Section 1215. Operational Control of Water Supplies~~

~~The Secretary shall retain authority and discretion over the management of project supplies to obtain maximum operational use and flexibility to meet all appropriated and adjudicated water rights. That authority and discretion includes the ability of the United States to store, deliver, conserve and reuse water supplies deriving from projects authorized under this title."~~

Summary

In conclusion, the Sierra Club remains concerned that:

- S. 1694 sets out the intent of Congress "that the Management Plan shall be implemented in its entirety";"
- That it seeks to create NRAs that were added after closure of the public comment period with a boundary that overlays part of existing Alpine Lake Wilderness;
- That it exempts the Yakima Workgroup from the Federal Advisory Committee Act;
- That it accepts a flawed 2012 Yakima Plan Final Programmatic EIS that failed to consider a range of alternatives;
- That it seeks to proceed with the Kachess Drought Relief Pumping Plant and Keechelus-to-Kachess Conveyance projects prior to a final EIS;
- And that has not incorporated benefit-cost analysis that would protect the Federal taxpayer.

The Sierra Club has provided comments to the Yakima Workgroup since its formation in 2009 and has a lengthy record of correspondence with the Workgroup, the Bureau of Reclamation, and various elected officials concerning this project. A listing of this correspondence can be found in Appendix A.

We also request that the attached Sierra Club's letters to Senator Murray, dated May 26, 2014, and April 27, 2015, be included in the hearing record.

Thank you for the opportunity to provide these comments.

Signed:

Margie Van Cleve

Margie Van Cleve
Washington State Chapter Chair
Sierra Club

APPENDIX A - Sierra Club Statements to the Yakima Workgroup and comments on the DPEIS:

- Comments of the Sierra Club, January 15, 2009, on the *Yakima River Basin Integrated Water Resource Management Alternative Supplemental Draft Environmental Impact Statement* reasserting its support of water conservation measures and opposition to new storage projects. We requested that conservation measures should be implemented before there is any further study or action on new water storage projects. In the face of climate change, aggressive water conservation, adoption of water efficiency standards and metering, water markets, low-impact storage projects (e.g., aquifer storage and recovery), forest and flood-plain restoration, and other strategies to promote natural storage are much more cost-effective than new dams, and could vastly improve the efficiency of water use in Washington State.

- Statement of the Sierra Club on the Yakima River Basin Water Enhancement Project 2009 Work Group – July 15, 2009, in which the Sierra Club raised concerns that the membership established by the Bureau and Ecology does not meet basic requirements for public participation and that nothing to date has demonstrated that additional dams in the Yakima River Basin are either-cost-effective or environmentally acceptable.

- Statement of the Sierra Club on the Yakima River Basin Water Enhancement Project 2009 Work Group – Discussion Draft Integrated Package, November 9, 2009, in which the Sierra Club reaffirms its opposition to an expanded Bumping Lake Dam and support of water conservation measures.

- Statement of the Sierra Club to the Yakima River Basin Water Enhancement Project Work Group – July 28, 2010, in which the Sierra Club supports conserving land in the Teanaway River watershed, but not as mitigation for an expanded Bumping Lake Dam or Wymer Dam.

- Comments of the Sierra Club on the Workgroup Agreement to Support Final Integrated Water Resource Management Plan, December 17, 2010, in which the Sierra Club raised specific concerns about the "Integrated Plan" and the Workgroup planning process.

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May 26, 2014

The Honorable Patty Murray
United States Senate
Washington, D.C.

RE: **Yakima Plan – fish passage funding**

Dear Senator Murray:

As you consider suggestions for federal contributions for the Yakima Basin, we want to provide you with our perspective on this complex set of issues as well as our strong support for funding fish passage while amending the troubling elements of the controversial Yakima Basin Integrated Plan (YBIP). The Yakima Basin is a huge and complex ecosystem. It has high natural values –forest, wildlife, rivers, sagebrush, mountains and canyons. The Yakima Basin also boasts a very productive agriculture economy, huge potential for salmon recovery, the rich traditions of the Yakama Nation, and opportunities for many forms of recreation as potential economic development. We believe that affordable solutions exist for meeting demands for water —both for fish and farmers—in the Yakima Basin that would respect the ecosystems, communities, and economic engines of the region and move to a more sustainable irrigation model.

Sierra Club supports fish passage in line with the Yakama Nation's vision of restoring the great salmon runs of central Washington. The Bureau of Reclamation dams in the Yakima Basin have blocked fish passage since their construction in the early 1900s. We ask that you fund the completion of the Cle Elum fish passage along with moving towards fish passage at Keechelus and/or above the Tieton/Rimrock over the next decade. Returning salmon and steelhead runs to the Tieton River would be a huge ecological step for the entire region. Of course all fish passage construction should be shown to have a very high likelihood of fish passage effectiveness through the pre-construction planning process.

As you know, we are strongly opposed to any Bumping Lake enlargement. The destruction of 2,000 acres of native forest, including spectacular groves of ancient forest and critical habitat for northern spotted owls and bull trout, is an unmitigatable impact for the region. The Bumping Lake forest is a rare treasure on the east slopes of the Cascades and the groves of giant Douglas firs are marvelous destinations for the many hikers along the lakeside trail. Sierra Club has proposed that the existing National Forest roadless area around Bumping Lake be added to the adjacent William O. Douglas Wilderness.

Fish need water; we support the Yakama Nation in their goal to restore the salmon runs, and adequate in-stream flows are essential to achieve salmon recovery. We believe that an expanded emphasis on water conservation will be a huge boon to the Yakama Nation's salmon efforts and should be highlighted as a major component of any early action plan. We want to help farmers and orchardists in achieving the highest level of conservation possible. We recommend an additional $85 million for water conservation and education within the first 10 year phase of Federal funding for the YBIP. The calculation for water conservation under the integrated plan should be additional water conservation above the funding included in the current YRBWEP to secure 10 million acre-feet of conserved water per year over the next decade. Water conservation "hard" targets and timelines should be adopted in the Yakima River Basin to ensure improved water efficiencies. Currently, the Yakima Basin lacks hard targets for mandatory municipal and irrigation water conservation. Conservation and other demand-supply strategies should be pursued before turning to costly and environmentally destructive

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water projects, including new dams. The Yakima Valley's irrigation of urban green lawns during August does not indicate a responsible sharing of water conservation

We believe that in the face of climate change, we need strategies such as aggressive water conservation, adoption of water efficiency standards and metering, water markets, low-impact storage projects (e.g., aquifer storage and recovery), forest and flood-plain restoration, and other strategies to promote natural storage. These strategies are much more cost-effective than new dams, and could vastly improve the efficiency of water use in Washington State. The historic, massive hydrologic re-engineering of Washington's rivers using dams and irrigation projects has caused historic environmental damage. We strongly urge decision-makers to focus on future water projects that fix existing problems, not cause new ones.

We support inclusion of several rivers within the Yakima Basin in the National Wild & Scenic Rivers System. Among these are the Cle Elum River and its major tributaries the Waptus and Cooper Rivers. Also the three forks of the Teanaway within the National Forest should be included. We also believe a study of the segments of these rivers in the new Teanaway Community Forest would demonstrate their eligibility for protection under the national system.

The Bureau of Reclamation and Department of Ecology are also preparing environmental impact statements and State Legislation-mandated cost-benefit analyses on three projects: Kachess inactive storage, Keechelus-to-Kachess Pipeline, and the Cle Elum Pool Raise. We strongly urge that Congress wait until the conclusion of the NEPA process and state-mandated cost-benefit analysis in order to determine if these projects have merit and include a strong water user cost-share, avoid impacts to bull trout, and focus on normalizing flows in the upper Yakima River. Additional surface water storage via Wymer Dam (on Lmuma Creek) or Bumping Dam enlargement is neither prudent nor necessary: the proposed dams are incredibly expensive, there is continuing skepticism about their ability to refill in consecutive drought years, and they generate substantial adverse impacts to the native ecosystems and endangered species habitat.

In the headwaters of the Teanaway and Cle Elum Rivers are National Forest roadless areas that not only provide the best source of clean, cold water, but security habitat for wary wildlife with magnificent forests and meadows to roam. In 2000, you recognized these values for the Cle Elum and Keechelus headwaters, by including the Alpine Lakes Wilderness Study Area (WSA) as part of the Plum Creek land exchange bill. The U.S. Forest Service (USFS) recommended 11,000 acres for Wilderness during that study. As part of the Forest Plan revision, USFS recommended an additional 10,000 acres in their proposed action two years ago. We believe there are another 50,000 acres in the Teanaway that deserve and need Wilderness protection. That proposal has been sent to USFS, and they will incorporate it in one of the alternatives in the Forest Plan Draft EIS due out in Summer 2014. We hope to see these Wilderness additions become a reality someday, but in the interim, this plan should do nothing to make these roadless lands unsuitable for Wilderness or frustrate efforts to achieve that protection. The National Recreation Area proposed by the YBIP report would emphasize motorized off-road recreation for these National Forest wildlands, in total opposition to the Wilderness proposals that Sierra Club and others have supported for over 40 years. The proposal for NRAs promoting off-road vehicles has been temporarily deferred during the National Forest Plan Revision process, but it remains a troubling component of the Yakima Plan, opposed by dozens of local, state, regional and national environmental and conservation organizations.

Land acquisition and conservation is also a key element of the plan. We fully support the acquisition of lands in the Little Naches watershed, along Manastash Ridge, and around I-90 west of Easton. We recommend an additional $75 million for watershed protection and restoration within this phase of Federal funding for the YBIP.

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As noted above, protection of the watershed through the preservation of forests and natural sagebrush, rather than the proliferation of exurban sprawl and ranchette development, is a critical component of YBIP and one we strongly support. The state's recent acquisition of the lower Teanaway valley was a great conservation accomplishment. A planning process through the state Department of Natural Resources and state Department of Fish & Wildlife, the two agencies given co-management responsibility, is underway to determine how logging and grazing can co-exist with recreation.

In closing, Sierra Club does support funding for fish passage to help restore salmon to the Yakima River Basin. However, we do not support the overall Yakima Plan as proposed, and we remain opposed to funding for expansion of Bumping Lake and Wymer dams. The public is awaiting results of a cost-benefit study of these two storage projects, mandated by 2013 state legislation. The public and decision-makers deserve to know the full economic and environmental consequences of funding these types of storage projects.

Thank you for your commitment and hard work on behalf of our environment. We would welcome an opportunity to discuss the Yakima Basin plan further with you.

Sincerely,

Margie Van Cleve

Margie Van Cleve
Washington State Chapter Chair
Sierra Club

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April 27, 2015

The Honorable Patty Murray
United States Senate
Washington, D.C. 20510

RE: **Yakima Plan – Federal Funding Concerns**

Dear Senator Murray:

Thank you very much for your efforts in Congress to add 22,000 acres to the Alpine Lakes Wilderness in the Snoqualmie watershed, as well as Wild and Scenic River designations for the Middle Fork Snoqualmie and Pratt Rivers.

On May 26, 2014, Sierra Club sent you a letter (attached) conveying our support for federal fish passage and water conservation funding in the Yakima River Basin. We noted that, "We believe that affordable solutions exist for meeting demands for water —both for fish and farmers—in the Yakima Basin that would respect the ecosystems, communities, and economic engines of the region and move to a more sustainable irrigation model." Sierra Club supports funding for fish passage to help restore salmon to the Yakima River Basin. However, we do not support the current Yakima Plan, particularly because it funds the destruction of ESA critical habitat for Northern spotted owls and bull trout through expansion of Bumping Lake as well as destruction of important sage-grouse habitat through construction of Wymer Dam. The Water Research Center (WRC) report required by the State Legislature now confirms that a new Bumping Lake dam would return only 18 cents for every dollar spent, and the proposed Wymer dam would return only 9 cents for every dollar spent.
WRC Report, pages iii and iv.
http://swwrc.wsu.edu/documents/2014/12/ybip_bca_swwrc_dec2014.pdf

We are currently reviewing the DEIS for the Keechelus-Kachess portion of the Yakima Plan. Initially we have our concerns: according to the DEIS, "Bull trout will be adversely affected [in Keechelus tributaries] for approximately 115 days in 81 percent of years." The DEIS also acknowledges that bull trout passage between Box Canyon Creek and Kachess Reservoir will be impeded due to habitat destruction (reduction of water flow) with resultant decline in population. We are concerned about loss of bull trout, which are protected by the Endangered Species Act. Additionally, the cost-benefit ratio for this portion of the plan is similarly low and given the potential environmental issues, causes us to further question whether this is appropriate stewardship of the public's resources.

Sierra Club continues to support fish passage in line with the Yakama Nation's vision of restoring the great salmon runs of central Washington. We continue to ask that you fund the completion of the Cle Elum fish passage along with moving towards fish passage at Keechelus and/or above the Tieton/Rimrock over the next decade. We request that you support inclusion of several rivers within the Yakima Basin in the National Wild & Scenic Rivers System. Among these are the Cle Elum River and its major tributaries the Waptus and Cooper Rivers. Also, the three forks of the Teanaway within the National Forest should be included.

We want to help farmers and orchardists in achieving the highest level of conservation possible. We recommend an additional $85 million for water conservation and efficiencies within the first 10-year phase of Federal funding for the Yakima Plan. The calculation for water conservation under the integrated plan should be additional water conservation above the funding included in the current Yakima Plan to secure 10 million acre-feet of conserved water per year over the next decade. Water conservation "hard" targets and timelines should be adopted in the Yakima River Basin to ensure improved water efficiencies. Conservation and other demand-supply strategies should be pursued before turning to costly and environmentally destructive water projects such as new or expanded dams.

Thank you for your commitment and hard work on behalf of our environment. We would welcome an opportunity to discuss the Yakima Basin plan further with your office.

Sincerely,

Margie Van Cleve

Margie Van Cleve
Washington State Chapter Chair
Sierra Club

State of Washington
DEPARTMENT OF FISH AND WILDLIFE
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Main Office Location: Natural Resources Building, 1111 Washington Street SE, Olympia, WA

July 6, 2015

The Honorable Lisa Murkowski
Chair, Senate Energy and Natural Resources Committee
304 Dirksen Senate Building
Washington, DC 20510

The Honorable Maria Cantwell
Ranking Member, Senate Energy and Natural Resources Committee
304 dirksen Senate Building
Washington, DC 20510

Subject: S.B. 1694 Authorizing Phase 3 of the Yakima River Basin Water Enhancement Project (YRBWEP – Phase 3)

Dear Members of the Senate Energy Committee:

The Washington State Department of Fish and Wildlife (Department) is writing today as an initial and continuing member of the Yakima Basin Integrated [Water Management] Plan (YBIP) Workgroup, deeply involved in all parts of the YBIP. YRBWEP - Phase 3 legislation is a critical step forward in authorizing the YBIP, and it provides the essential companion piece to similar legislation passed by the Washington State Legislature and signed into law by Governor Inslee in 2013. The U.S. Congress previously authorized YRBWEP – Phase 1 in 1979, which was signed into law by President Carter, and YRBWEP – Phase 2 in 1994, which was signed into law by President Clinton. The YBIP is intended to be a partnership first and foremost between the state of Washington and the federal government. Without that foundational partnership embodied in S.B. 1694, the YBIP cannot be successful.

The fundamental reason that the YBIP Work Group has been successful at bringing forward such a broadly supported plan is its holistic, integrated and balanced approach to the issues and challenges concerning water supply in the arid West. The plan and its broad support are directly related to equal consideration of out-of-stream water supply for agriculture, industry and municipal use <u>and</u> fish and wildlife protection and restoration. YBIP is equally protective of the local and state economy <u>and</u> the environment, and is equally supported by economic <u>and</u> environmental stakeholders. We urge the Senate to maintain both the spirit and the substance of that crucial balance.

The Executive Committee of the YBIP Work Group has reviewed every Washington State budget proposal to ensure that agricultural, environmental, tribal, local government, and fish and wildlife interests are balanced and remain intact. That balanced approach has been the recipe for a level of active, energetic and passionate support that does not often spring from the grass roots of local communities.

The signature fish and wildlife components of YRBWEP – Phase 3/YBIP are the construction of juvenile and adult fish passage at two of the U.S. Bureau of Reclamation (USBR) dams on the upper Yakima River. When the USBR impoundments were built in the early 20th century, they did not include fish passage. The Yakima Basin was one of the strongest salmon producers in the Columbia Basin before development by non-Native American settlers and USBR. The Yakima Basin was likely only surpassed by the Snake River Basin as a salmon producer. This strong salmon production was in large part due to the natural lakes in the upper Yakima River basin that allowed the life history of sockeye salmon (*Oncorhynchus nerka*) to succeed. Sockeye were of the most numerous of the salmon in the Yakima Basin and were entirely extirpated by the construction of the USBR's Yakima Project.

Restoring fish passage at Cle Elum Dam and Tieton Dam will be a "game changer" for the Yakima Basin and even at the entire Columbia Basin scale. Success will be measured in tens of thousands, possibly hundreds of thousands of additional adult sockeye salmon entering the Columbia River. Traditional tribal fisheries in the Columbia and Yakima River will be enhanced and robust non-tribal sport fisheries at the mouth of the Yakima River and in Lake Cle Elum and Rimrock (Tieton Reservoir) Lake will develop as the Yakima Basin sockeye run increases. Currently, most of the high elevation portion of the Yakima Basin is blocked by the impassable USBR storage dams. As climate change reduces snowpack and warms our rivers, it will become increasingly important for salmon, steelhead and bull trout to access the coldest, most pristine part of the watershed. We predict significant survival and productivity improvements for many of the anadromous fish species in the Yakima Basin (sockeye, spring chinook, steelhead, and coho salmon) by allowing them to access the entire available habitat, especially the coldest, highest portions of the watershed where they can seek thermal refuge.

Finally, allowing large numbers of salmon and steelhead to access the full range of habitats restores the "marine-derived nutrient pump" that salmon represent to inland ecosystems. Historically, the overall productivity of these watersheds was driven by the salmon's life history. Returning adult salmon bring back marine-derived nutrients that were the foundation of the entire food web in most Washington watersheds. The reduction of that nutrient source as salmon runs declined during the 20th century, particularly the loss of large quantities of sockeye salmon biomass upstream of the impassable USBR storage dams, impaired the productivity of these watersheds for a wide range of fish and wildlife. Restoring that connectivity and restoring the prolific sockeye salmon back into the ecosystem will greatly improve biodiversity and productivity, as well as providing an economic boost to the Yakima Basin from sport fisheries.
In closing, we want to restate the Department's strong support for the YBIP and its federal implementing legislation, S.B. 1694 authorizing YRBWEP - Phase 3. More important to the Department than any specific project is retaining the short, mid and long-term balance in this effort. It is worth noting that it was the Yakama Nation and Roza Irrigation District that came

together after decades of conflict to propose a holistic, balanced and integrated approach to solving our water issues in the Yakima Basin. We thank the Washington Department of Ecology and USBR for following their lead. We strongly urge Congress to take advantage of that collective, focused effort to enact legislation that enables a productive, balanced future for all Yakima Basin's stakeholders and natural resources.

Sincerely,

James Unsworth, Ph. D.
Director

John Storch

801 E First St – B128
Cle Elum, WA 98922

jstorch@uw.edu

Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

John A Storch
801 E First St B-128
Cle Elum, WA 98922

From: Kathie Stratton <strattonenterprises@outlook.com>
Sent: Tuesday, July 07, 2015 1:24 AM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office

304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Kathie E. Stratton
PO Box 84
Easton, WA 98925

From: Vern and Kathie Stratton <vandkstratton@hotmail.com>
Sent: Tuesday, July 07, 2015 1:18 AM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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Sincerely,

Vern Stratton
PO Box 84
Easton, WA 98925

Energy and Natural Resources Committee Office

304 Dirksen Senate Building

Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Alex Swart

14120 NE 183rd St #108
Woodinville, WA 98072

Energy and Natural Resources Committee Office

304 Dirksen Senate Building

Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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Sincerely,

Heidi Swart

428 289th Place NE
Carnation, WA 98014

From: Joel Thomas <joelthom@live.com>
Sent: Friday, July 03, 2015 1:22 PM
To: Ripchensky, Darla (Energy)
Subject: S.1694

Joel Thomas, 4271 Kachess Lake Rd, Easton, WA 98925
Senate Energy and Natural Resources
Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project.
July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

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S. 1694 is bad national water policy and bad national environmental policy. Please do not pass S. 1694, as introduced.

Sent from Windows Mail

From: Kelli Thomas <kel7290@gmail.com>
Sent: Monday, July 06, 2015 11:07 AM
To: Ripchensky, Darla (Energy)
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office

304 Dirksen Senate Building

Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Kelli Thomas

15918 288th St. E.

Graham, WA 98338

From: Lynne Thomas <lynnebeckerthomas@gmail.com>
Sent: Friday, July 03, 2015 1:42 PM
To: Ripchensky, Darla (Energy)
Subject: S. 1964

Senator Murkowski (Chair) and members of the Committee.

The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

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S. 1694 is bad national water policy and bad national environmental policy. Please do not pass S. 1694, as introduced.

Thank you.

Lynne Thomas
PO Box 624
Easton, WA 98925

Trout Unlimited: America's Leading Coldwater Fisheries Conservation Organization

Written Testimony of Lisa Pelly
Director, Washington Water Project
Trout Unlimited
United States Senate Committee on Energy and Natural Resources
Hearing to Receive Testimony on S. 1694, a bill to authorize Phase III of the Yakima River Basin Water Enhancement Project to Improve Water Management in the Yakima River Basin
July 7, 2015

Chair Murkowski, Ranking Member Cantwell and Members of the Committee, thank you for the opportunity to provide you with written testimony for the hearing record.

Trout Unlimited (TU) is the nation's largest coldwater fisheries conservation group dedicated to the protection and restoration of our nation's trout and salmon resources, and the watersheds that sustain those resources. TU has over 155,000 members nationwide. Our members generally are trout and salmon anglers who give back to the resources they love by voluntarily contributing substantial amounts of their personal time and resources to fisheries habitat protection and restoration efforts. The average TU chapter donates 1,000 hours of volunteer time on an annual basis.

Working with our members, TU's Western Water Project staff completes on-the-ground restoration and reconnection work in storied watersheds all across the West. They partner with landowners, state governments and federal agencies to encourage efficient water use and improve stream flows for the benefit of people and fish.

And when the situation on the ground calls for a measured federal response, TU works with its partners to help forge federal legislation. S. 1694, and the Yakima Basin Integrated Plan which it supports, are some of the finest examples of helpful federal legislation and basin scale water resource projects that TU has ever worked on, leading the nation in a new model of water management. TU strongly supports the bill, and we salute Senator Cantwell and the diligent work of all of the partners who have made possible the Plan and the bill.

Washington Water Project
103 Palouse, Suite 14, Wenatchee, WA 98801 and 115 S. Glover Street, Twisp, WA 98856
(509) 888-0970 • Fax: (509) 888-4352 • www.tu.org

Water in the Yakima Basin is a valuable resource. With adequate water, the Yakima Basin contributes over $3 billion to the state's economy in the form of fish, hops, wine, fruit, and outdoor recreation. Without the water, the Yakima Basin contributes significantly less to the state's economy and careful decisions are necessary to meet demands using the available water.

In March 2015, Governor Inslee declared a drought for several areas in Washington, including the Yakima Basin. This drought foreshadows climate uncertainty models because the Yakima Basin received near normal amounts of precipitation. However, the mid-elevation precipitation fell as rain rather than snow. Without the mid-level snowpack, often called the '6^{th} reservoir', the Yakima Basin lacks sufficient water storage to meet demands during the summer months.

Fortunately, TU, the Kittitas Reclamation District ("KRD"), and the Washington Department of Ecology ("Ecology") worked together to create a model water supplementation practice to help Yakima River tributaries. Several years ago, TU, KRD, Bureau of Reclamation, Ecology, and the Kittitas County Conservation District capitalized on available conveyance capacity through KRD's water delivery system to spill water into Manastash Creek for instream flow benefits.

In past years, KRD delivered water to Kittitas Valley customers via a network of open canals and lateral ditches which often lost water during conveyance. Recent piping and lining projects increased conveyance efficiency, thus reducing the amount of water KRD needed to meet customer demands. Through carefully crafted agreements, the partners found a way to deliver a portion of the conserved water to Manastash Creek—a tributary containing over 20 miles of steelhead critical habitat—to re-wet the channel and provide fish passage.

The result: 3 cubic-feet per second of supplemental flow for Manastash Creek. This is in addition to multiple irrigation efficiency TU and Kittitas County Conservation District projects with willing Manastash water users that have put over 15 cfs instream permanently.

In 2015, KRD is going a step further and wheeling water through its system to deliver an additional 11 cfs (for a total of 14 cfs) to keep Manastash Creek flowing. Moreover, KRD uses this model to spill water at six (6) additional creeks intersecting KRD's delivery system and containing critical habitat for steelhead. KRD is now supplementing tributary flows with additional water split between Big, Tucker, Little, SpexArth, Taneum, and Tillman creeks. This effort serves as a pilot program for the greater Yakima Basin Integrated Plan and exemplifies the types of project TU-WWP achieves to help fish. We fully expect S. 1694 and the Plan to engender a host of new projects similar to this one, with similar large benefits for the basin and its communities.

TU and KRD are not resting on this success. Rather, TU is working with KRD and other partners to find additional opportunities for water conservation projects to help ensure flows are available when fish and farms most need water. These projects truly demonstrate the positive outcomes possible when TU and KRD work together for fish and farms.

The water wheeling is just one part of a major fish and farm effort occurring in the Basin. S. 1694 will improve water management and long-term water security in the Yakima Basin. This landmark legislation will help Basin partners address water supplies for fish, agriculture, and communities. As importantly, the bill sets a precedent for innovative water management—and the collaboration needed to successfully bring interests together.

Chair Murkowski, thank you very much for holding a hearing on S. 1694. We look forward to working with the Committee to advance this excellent legislation.

From: Scott Walker <scottwalker253@comcast.net>
Sent: Thursday, July 02, 2015 6:09 PM
To: Ripchensky, Darla (Energy)
Cc: scottwalker253@comcast.net
Subject: Testimony for July 7, 2015 Hearing on S. 1694

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

Senator Murkowski (Chair) and members of the Committee. The following are my comments on S. 1694 in opposition to this version of the bill. Please include these comments as part of the hearing record of July 7, 2015 on S. 1694.

I am opposed to authorizing S. 1695, as introduced. The Yakima Plan includes environmentally damaging water storage projects that are not cost-effective, per the report commissioned by the Washington State Legislature by the Washington State Water Resource Council http://swwrc.wsu.edu/2014ybip/ .

Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach when irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely

Scott A. Walker
scottwalker253@comcast.net
253-224-6844

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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Building new water storage projects and withdrawing more water from existing reservoirs is not the right approach. These projects pose serious threats to the local environments and are of questionable value. The irrigation districts have yet to carry out hundreds of thousands of acre-feet of water conservation.

S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

Jerry Watts 7-3-2015

Jerry Watts
P.O. Box 186
Easton, WA 98925-0186

From: Callie Webster <callie.r.webster@gmail.com>
Sent: Sunday, July 05, 2015 4:40 PM
To: Ripchensky, Darla (Energy)
Subject: Water Enhancement

Energy and Natural Resources Committee Office
304 Dirksen Senate Building
Washington, DC 20510

Senate Energy and Natural Resources Committee;

Referencing: Hearing on S. 1694 - to amend Public Law 103-434 to authorize Phase III of the Yakima River Basin Water Enhancement Project. July 7, 2015

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S. 1695 is bad national water policy and bad national environmental policy. Please do not pass S. 1695, as introduced.

Sincerely,

--
Callie Webster
MA Sport and Performance Psychology
8912 229th pl sw
Edmonds, WA 98026
callie.r.webster@gmail.com
206.226.2058

Janine Blaeloch, Director
Western Lands Project

TESTIMONY BEFORE THE
COMMITTEE ON ENERGY AND WATER RESOURCES
U.S. SENATE ON
S.1694

July 7, 2015

The Western Lands Project is a non-profit, membership organization conducting research, outreach, and advocacy for reform in federal land exchange policy. We also scrutinize a broad range of projects that propose to sell, give away, or relinquish public control of public lands. We submit this testimony in opposition to the above-named legislation. Please include the following testimony of the Western Lands Project on S. 1694.

We are opposed to passage of this bill, as introduced.

The Western Lands Project provided scoping comments on the Yakima Plan Draft Programmatic Environmental Impact Statement (DPEIS) on June 7, 2011, as well as detailed comments on the DPEIS on January 1, 2012. We remain disappointed that the Bureau of Reclamation failed to provide a range of alternatives in the DPEIS and did not adequately respond to our comments. In addition, we remain very concerned that after the close of comments on the DPEIS, the Yakima Workgroup adopted a new Yakima Plan element that was not included in the DPEIS for public comment to create two new National Recreation Areas within the Okanogan-Wenatchee National Forest with 41,000 acres to be dedicated to off-road vehicle use.

The Yakima Plan contains environmental damaging projects such as a new Bumping Lake dam, which would flood ancient forest road-less area adjacent to the William O. Douglas Wilderness Area, and endangered species habitat for Northern spotted owls and bull trout and a Wymer dam, which would flood shrub-steppe habitat for sage grouse.

We urge you to oppose S. 1694. Thank you.

Idaho Office
PO Box 2863
Boise, ID 83701
tel: (208) 429-1679
fax: (208) 475-4702
email: ken@westernwatersheds.org
web site: www.westernwatersheds.org

Western Watersheds Project

Working to protect and restore Western Watersheds and Wildlife

Testimony of the Western Watersheds Project

Submitted to the
Committee on Energy and Water Resources
U.S. Senate
on S.1694

July 7, 2015

Senator Murkowski and members of the Committee. Please include the following testimony of the Western Watersheds Project on S. 1694.

On June 7, 2011, the Western Watersheds Project provided scoping comments on the Yakima Plan Draft Programmatic Environmental Impact Statement (DPEIS). We also provided comments on the DPEIS. However, the Bureau of Reclamation failed to provide a range of alternatives in the DPEIS as required by the National Environmental Policy Act.

After the deadline for DPEIS comments, the Yakima Workgroup included a new proposal for the Okanogan-Wenatchee National Forest to create two new National Recreation Areas with 41,000 acres dedicated to off-road vehicle (ORV) use.

We are also concerned that the Yakima Plan proposes a new Wymer dam that would flood sage grouse habitat, and a new Bumping Lake dam that would flood endangered species habitat for bull trout and Northern spotted owls.

Finally, we note that the Bureau of Reclamation has not completed the Draft EIS for the Kachess Drought Relief Pumping Plant or Keechelus Reservoir to Kachess Reservoir Conveyance projects, even though these projects are included in S. 1694. Therefore, we remain opposed to the passage of S. 1694.

Kenneth Cole

Ken Cole

Idaho Director
Western Watersheds Project
P.O. Box 2863
Boise, Idaho 83701
208-429-1679

Naturam Expellas Furca *Tamen Usque Recurret*

WISE USE MOVEMENT

P.O. Box 17804, Seattle, WA 98127

TESTIMONY OF THE WISE USE MOVEMENT
ON S.1694

SUBMITTED TO THE
COMMITTEE ON ENERGY AND WATER RESOURCES
U.S. SENATE

July 7, 2015

Sen. Murkowski (Chair, U.S. Senate Energy and Natural Resources Committee) and members of the Committee. The following testimony of the Wise Use Movement is submitted in opposition to the introduced version of S. 1694, a bill to amend Public Law 103-434. We request that this Committee not approve Phase III of the Yakima River Basin Water Enhancement Project (Yakima Plan), as proposed.

Amendments to P.L. 103-434 (1994)

***The Wise Use Movement recommends that the Senate Energy and Natural Resources Committee review the effectiveness of P.L. 103-434, enacted in 1994, over twenty years ago, before giving the Bureau of Reclamation new authorizations and authorizations of appropriations.**

P.L.103-434 was passed by Congress in 1994 to, among other things, protect, mitigate, and enhance fish and wildlife through improved instream flows, creation and enhancement of wetlands; to improve the reliability of water supply for irrigation; to authorize a Yakima River basin water conservation program; to encourage voluntary transactions among public and private entities; and provide for an irrigation demonstration project on the Yakama Reservation using water savings from system improvements to the Wapato Irrigation Project and a Toppenish Creek corridor enhancement project. *Sec. 1201(1)-(6).*

More specifically, the purpose of the Yakima River Basin Water Conservation Program was to realize "not less than 40,000 acre-feet of water savings per year are achieved by the end of the fourth year of the Basin Conservation Program, and not less than 110,000 acre-feet of water savings per year by the end of the eighth year of the program, to protect and enhance fish and wildlife resources; and not less than 55,000 acre feet of water savings per year are achieved by the end of the eighth year of the program for availability for irrigation." *Sec. 1201(4).*

***The Wise Use Movement recommends that the Committee request the Bureau to verify that not less than 40,000 acre-feet of water savings per year have been achieved by the fourth year of the Basin Conservation Program; that not less than 110,000 acre-feet of water savings per year by the end of the eighth year of the program to protect and enhance fish and wildlife resources; and that not less than 55,000 acre feet of water savings per year are achieved by the end of the eighth year of the program for irrigation.**

Sec. 1201. Purposes. S. 1694 amends this section by adding a new purpose (8): "to authorize and implement the Yakima River Basin Integrated Water Resources Management Plan as Phase III of the Yakima River Basin Water Enhancement Project, in a balanced approach to maximize benefits to the communities and environment in the Basin."

Together, with New Section 1214(a)(1), this new purpose leaves no doubt that it is the intent of S. 1695 to authorize and implement the entire Yakima Plan. The costs of the Yakima Plan likely exceed $5 billion, and yet the Bureau of Reclamation has not costed out the entire plan, including new environmentally damaging water projects, or pumping water from the Columbia River to the Yakima Basin.

The Wise Use Movement recommends that the Committee delete this language. The Committee should not authorize the proposed elements in the initial development phase (S. 1694, pages 23-26) at this time. It is bad National Water Policy to accept the Bureau's request for authorization of an insufficiently detailed plan. It is also bad NEPA (National Environmental Policy Act) policy, to request legislation from Congress when the Bureau has not completed a Final EIS on either the Kachess Drought Relief Pumping Plant or Keechelus Reservoir to Kachess Reservoir Conveyance projects.

Sec. 1202 Definitions. S. 1694 amends this section by adding a new definition of the "Work Group" that is not subject to the Federal Advisory Committee Act (FACA). (S.1694, page 6, lines 23-24.) Despite the fact that the Bureau of Reclamation established the Yakima Workgroup in 2009, as an advisory group, the Secretary of Interior refused to establish the Yakima Workgroup as a Federal Advisory Committee. This has allowed the Yakima Workgroup to establish committees that are closed to the public.

***The Wise Use Movement recommends that the Committee require that any Yakima Workgroup including the existing Workgroup be fair and balanced and subject to the Federal Advisory Committee Act. It is bad National Public Participation Policy to allow the Yakima Workgroup to avoid FACA.**

Sec. 1203 established a Yakima River Basin Water Conservation Program and a Conservation Advisory Group charged with submitting a draft basin conservation plan to the Secretary within 2 ½ years after the date of enactment. The Conservation Advisory Group was also charged with providing annual review of the implementation of applicable water conservation guidelines of the Secretary. *Sec. 1203(a)(1); (c)(1)(3);(f).* In addition, Congress authorized the appropriations (at September 1990 prices) of the following amounts for the development of water conservation plans:

$1,000,000 for development of water conservation plans;
$4,000,000, for investigation of specific potential water conservation measures identified in conservation plans;
up to $67,500,000 for design, implementation, post-implementation monitoring and evaluation of measures, and addressing environmental impacts;
up to $10,000,000 for initial acquisition of water from willing sellers or lessors specifically to provide instream flows for interim periods;
and $100,000 annually for the establishment and support of the Conservation Advisory Group.
Sec. 1203(j)(1)-(4).

***The Wise Use Movement recommends that the Committee request that the Bureau of Reclamation document:**

- if it has spent $1,000,000 for development of water conservation plans;
- if it has spent $4,000,000, for investigation of specific potential water conservation measures identified in conservation plans;
- how much of the $67,500,000 authorized has been spent for design, implementation, post-implementation monitoring and evaluation of measures, and addressing environmental impacts;
- how much of the $10,000,000 for initial acquisition of water from willing sellers or lessors specifically to provide instream flows for interim periods has been spent; and
- how much of the $100,000 authorized annually for the establishment and support of the Conservation Advisory Group has been spent.

<u>Sec. 1203(d) is amended by a new subsection (4)</u> allowing the State or Federal Government to fund not more than 17.5 percent local share of the costs of the Basin Conservation Program.

***The Wise Use Movement recommends that the local share of any costs of the current or modified Yakima Project be paid as local shares. It is bad National Water Policy to allow local sponsors to meet their local cost share by raiding state and federal taxpayers.**

<u>Sec. 1204</u> authorized not more than $49,000,000 for the plans, investigation of measures and implementation of system improvements to the Wapato Irrigation Project; $8,500,000 for the design and construction of the Yakama Indian Reservation Irrigation Demonstration Project and such sums as may be necessary for the operation and maintenance of the Irrigation Demonstration Project; and $1,500,000 to develop a Toppenish Creek corridor enhancement project and such sums as may be necessary for the operation and maintenance of the Toppenish Enhancement Project. *Sec. 1204(a)-(c).*

<u>Sec. 1204(d)</u> requires the Secretary, in consultation with the Yakama Indian Nation, to report to the Senate and House Committees and the Governor within 5 years of implementation of the Irrigation Demonstration Project and the Toppenish Enhancement Project, on the effectiveness of the conservation, training, mitigation, and other measures implemented. *Sec. 1204(d).*

A 2009, Bureau fact sheet reported:

> Demonstration Project – still in beginning stages to improve irrigation efficiencies; will apply for a planning grant in fiscal year 2010 or fiscal year 2011.

Toppenish Creek – construction to separate creek from irrigation canals and restore floodplain habitat; planning work in process, so no estimate yet on costs.
http://www.usbr.gov/pn//programs/yrbwep/reports/phase2/factsheet.pdf

***The Wise Use Movement recommends that the Committee review this report and make it part of this hearing record. It is bad National Water Policy to authorize millions of dollars of Bureau projects that are not carried out in a timely fashion. The Committee should determine why the Irrigation Demonstration Project and Toppenish Enhancement Project had not been undertaken as of 2009.**

Sec. 1206(a)(1) authorized $2,934,000 (at September 1990 prices) for several projects including modifying the radial gates at Cle Elum Dam to provide an additional 14,600 acre-feet of storage capacity in Lake Cle Elum, shoreline protection for Lake Cle Elum, and constructing juvenile fish passage facilities at Cle Elum Dam. *Sec. 1206(a)(1)(A)-(C)*. Sec. 1205(b) provides that water from additional Lake Cle Elum storage shall not be part of the Yakima River basin's water supply as provided in subsection (a)(1)(A). The Bureau of Reclamation's FEIS for the Cle Elum Pool Raise Project (May 2015), interpreted this section as authorizing the accrued stored water for instream flows and not to be included as part of the Yakima Basin's Total Water Storage Available (TWSA) as defined by Civil Action No. 21 (1945 Consent Decree) Article 4, 1st Paragraph.

Over 20 years later, the Cle Elum Dam radial gates have still not been modified. The Wise Use Movement recommends that the Committee review whether P.L. 103-434 amended the 1945 Consent Decree without approval of the Federal District Court or the parties to the 1945 Consent Decree.

Over 20 years later, juvenile fish passage facilities at Cle Elum Dam have still not been carried out. Because Cle Elum Reservoir is used for irrigation district withdrawals, the reservoir water level fluctuates throughout the year. No downstream fish passage has ever been attempted at a reservoir with such a wide range of water levels. The Bureau's 2011 Record of Decision (August 2011) did not disclose a project cost. http://www.usbr.gov/pn/programs/eis/cle-elum/signedROD.pdf
The FEIS for the Cle Elum Fish Passage Facilities estimated project costs of $84 million (in 2008 dollars) and annual OMR&P costs of $300,000, far higher than estimated in 1994 due to the never-before engineered helix design of the fish passage facility.

***The Wise Use Movement recommends that the Committee review the likelihood that the untried and untested fish passage facility design will cost far more than the Bureau has estimated. The Committee should reject the amendment to Sec. 1206(a)(1), which appears to strike the $2,934,000 authorization and inserts "such sums as are necessary." (S.1694, page 15, lines 14-18). It is bad National Water Policy to grant the Bureau of Reclamation a blank check.**

In addition, Sec. 1206(a)(1)(B) (concerning the construction of juvenile fish passage facilities at Cle Elum) is stricken and replaced with generic authority to conduct feasibility studies, design,

construct, and operate fish passage facility, *in addition to any fish passage facilities authorized by section 109 of the Hoover Power Plant Act of 1984.* (S.1694, page 16, lines 1-9). Section 109 of the Hoover Power Plant Act already gives the Secretary authority to design, construct, and operate fish passage facilities in the Yakima River Basin and to accept funds for those purposes.
http://www.gpo.gov/fdsys/pkg/STATUTE-98/pdf/STATUTE-98-Pg1333.pdf

***The Wise Use Movement recommends that the Committee require the Bureau of Reclamation to explain what additional fish passage facilities the Bureau intends to pursue beyond the broad authority provided to it in 1984.**

Sec. 1207 concerns enhancement of water supplies for Yakima Basin Tributaries. S. 1694 makes several amendments to this section related to "improvements in irrigation system management or delivery facilities." (S. 1694, page 19, lines 8-20). However, S. 1694 continues a major flaw with P.L. 103-434 by allowing such improvements to be voluntary. The Yakima Project is a Federally authorized Bureau of Reclamation project. As such, our country cannot afford to cement into place the failed policies of the past century that allowed irrigation districts to waste water.

***The Wise Use Movement recommends that the Committee take water conservation, water banking, water efficiency and other water conservation measures seriously by requiring irrigation districts to undertake such efforts before Congress spends additional taxpayer money in the Yakima River Basin.**

Sec. 1209 authorized $20,000,000 to convey flows of Cabin Creek and Silver Creek to Kachess Reservoir and such sums as may be necessary to carry out a feasibility study. *Sec. 1209(a)(1) and (2).*

***The Wise Use Movement recommends that the Committee review any Cabin Creek and Silver Creek feasibility study produced by the Bureau of Reclamation as authorized under Sec. 1209 and determine whether authorizing $20,000,000 was a credible proposal from the Bureau of Reclamation.**

New Additions to P.L. 103-434 (1994)

In addition to amending P.L. 103-434 (1994), S. 1694 includes several flawed new sections.

New Sec. 1213 states that "The Secretary may make grants or enter into cooperative agreements with . . .Yakima River basin irrigation districts. . .to carry out this title. . ." (S.1694, page 22, lines 15-21). New Sec. 1214(a)(2)(A) allows the Secretary to negotiate long-term agreements with participating proratable irrigation entities for the non-Federal financing, construction, operation and maintenance for the Lake Kachess inactive storage project and the Keechelus Reservoir to Kachess Reservoir (K-K) project (S. 1694, page 24, lines 22-25, and page 25, lines 1-13). These two projects, neither of which have completed EISs, are merely "insurance policies" in the case of drought, and presumably would not be used during non-drought years. In addition, the Lake Kachess inactive storage project would have a significant adverse impact on the Lake Kachess reservoir by allowing the water level to drop up an addition 84 feet during a drought year. The Bureau has failed to explain how downstream fish passage can be accomplished at the Lake Kachess Dam with an additional 84 foot drawdown. Lake Keechelus is bordered by I-90 along most of its northern shoreline. Lake Kachess reservoir would also be impacted by transporting polluted Lake Keechelus water to Lake Kachess via the K-K pipeline project. In addition, the Bureau has failed to explain how returning fish will be able to find the Keechelus River if Lake Keechelus water will be mixed and released with Lake Kachess water.

However, the combination of new Secs. 1213 and 1214 appears to allow the Secretary to make grants for any project that would carry out this title, including the Lake Kachess and K-K projects, while merely giving the Secretary passive power to enter into agreements for non-Federal financing of these projects.

***The Wise Use Movement recommends that the Committee clarify that no federal taxpayer dollars are authorized for the construction, operation and maintenance of the Lake Kachess and K-K projects. The Committee should also review past irrigation district claims that they would only be responsible for irrigation benefits and that any fish or wildlife benefits from these projects should be assigned as Federal government costs. The Committee should require any irrigation districts seeking to construct, operate, and maintenance these two projects be required to pay the Federal government for the millions of dollars of project design work already spent.**

<u>New Sec.1214(a)(1)</u> (S.1694, page 23, lines 20-23) states, "It is the intent of Congress that the Management Plan shall be implemented in its entirety." Amended Section 1202 new (8) (S. 1694, page 5, lines 10-17) defines the "Management Plan" as the plan described in the FPEIS and Integrated Water Resource Management Plan, Yakima River Basin, Water Enhancement Plan, Yakima River Basin, Water Enhancement Project, Benton, Kittitas, Klickitat, and Yakima Counties, WA.

***The Wise Use Movement recommends that the Committee not adopt the FPEIS for the Yakima Plan because it would be bad NEPA policy. The FPEIS violated the National Environmental Policy Act by failing to provide a range of alternatives. *40 CFR Sec. 1502.14.* In addition, as noted previously, the Yakima Workgroup has requested Congressional authorization of the Yakima Plan, even though no Final EIS under NEPA has been completed or public comments reviewed on the Kachess Drought Relief Pumping Plant and Keechelus Reservoir to Kachess Reservoir Conveyance projects. This is also bad NEPA policy.**

S. 1694 is fatally flawed by stating that it is the intent of Congress for the Yakima Plan, as defined in Sec. 1201 new (8) to be implemented **in its entirety**.

***The Wise Use Movement recommends that the Committee not approve a Yakima Plan that is:**

- **Bad National water policy**
  - A 2014 analysis by the Water Resource Center found that "*When implemented together as part of the IP, the major water storage projects as a group do not pass a*

B-C test." The Yakima Plan violates both the past water projects principles and standards and recently adopted CEQ principles, standards and regulations.
  - The Yakima Plan is a prototype of the Bureau of Reclamation's "WaterSMART" Program to support the BuRec's goal of constructing over 100 new water storage projects throughout the west to respond to climate change.
- **Bad National Forest policy**
  - Would flood 1,000 acres of ancient forest roadless area in the Okanogan-Wenatchee National Forest that should be added to the William O. Douglas Wilderness area
- **Bad National recreational policy**
  - Would designates two new National Recreational Areas within the Okanogan-Wenatchee National Forest with 41,000 acres dedicated to off-road vehicle use
- **Bad National ESA policy**
  - Would flood critical habitat for ESA listed bull trout and Northern spotted owls, as well as sage-steppe habitat for greater sage grouse
- **Bad National Environmental Policy Act policy**
  - The Yakima Plan Final Programmatic EIS included only the BuRec's preferred alternative and the required no-action alternative. The BuRec failed to consider a range of alternatives as required by NEPA. *40 CFR Sec. 1502.14*
- **Bad Public Participation policy**
  - The Yakima Plan was developed by a Yakima Workgroup, handpicked by the BuRec and WA Department of Ecology. The Yakima Workgroup's Implementation Committee remains closed to the public.
  - Although the Yakima River Basin Conservation Advisory Group was authorized in 1994 by Congress and established under the Federal Advisory Committee Act, the Yakima Workgroup would be specifically **excluded** from FACA under this bill. (S. 1694, page 6, lines 23-24).

New Sec. 1214(a)(2)(A)(iii)(I) allows the Secretary to participate and provide funding for water conservation projects not subject to the provisions of the Basin Conservation Program by providing 85,000 acre-feet of conserved water to improve tributary and mainstem stream flow (S. 1694, page 25, lines 17-25). This section, as well as the Basin Conservation Program, remains voluntary.

***The Wise Use Movement recommends that the Committee take water conservation, water banking, water efficiency and other water conservation measures seriously by requiring irrigation districts to undertake such efforts before Congress spends additional taxpayer money in the Yakima River Basin.**

New Sec. 1214(a)(2) – (3) implements the Yakima Plan in its entirety in an (2) "Initial Development Phase" (S. 1694, page 23, line 24) and (3) "Intermediate and Final Phases" (S. 1694, page 26, line 8). The initial development phase has been discussed above. Subsection (3)(A) provides that "any project" determined by the Secretary that meets the objectives of the Yakima Plan shall be designed and constructed, subject to authorization and appropriation.

***The Wise Use Movement recommends that the Committee strike this provision as there is no public participation built into the Intermediate and Final phases and S. 1694 would also**

exclude the Yakima Workgroup from the Federal Advisory Committee Act. It is bad National Public Participation Policy to allow the Yakima Workgroup to avoid FACA.

New Sec. 1214(a)(2)(A)(i) allows the Secretary to plan, design, and construct upstream and downstream fish passage facilities at a Yakima Project reservoir, in addition to the Cle Elum Reservoir project, pursuant to the Hoover Power Plant Act of 1984. No further identification of this project is provided.

***The Wise Use Movement recommends that the Committee strike this provision, unless the reservoir is identified.**

New Sec. 1214(a)(3)(D) requires the Intermediate and Final Phases of the Yakima Plan to be contingent on "feasibility," as determined by the Secretary, in consultation with the Workgroup.

***The Wise Use Movement recommends that the Committee require that the Bureau of Reclamation present projects with a positive Benefit/Cost ratio, not just on engineering feasibility. The lack of Benefit/Cost analysis is bad National Water Policy.**

New Sec. 1214(a)(4) requires the Secretary to prepare a progress report not later than five years from the date of enactment. Under subsection (B)(ii), the report must assess, "through performance metrics measured throughout implementation of the Yakima Plan, the degree to which the Initial Phase addresses the objectives and all elements of the Yakima Plan. (S. 1694, page 28, lines 1-6). This section does not provide for any public participation opportunities.

***The Wise Use Movement recommends that the Committee clarify what the Bureau means by "performance metrics." The Committee should require that any progress report be subject to public participation, review, and comment.**

New Sec. 1214(a)(4)(B)(iii) requires the Secretary to identify additional projects and activities proposed for inclusion in any future phase of the Yakima Plan. There is no provision for any public involvement in identifying additional projects.

***The Wise Use Movement recommends that the Committee require that any identification of additional projects and activities be subject to public participation, review, and comment. The lack of public involvement is bad National Public Participation Policy.**

New Sec. 1214(b)(1)(B) seeks to overturn the definition of Total Water Supply Available in Civil Action No. 21 (1945 Consent Decree) Article 4, 1st Paragraph.

***The Wise Use Movement recommends that the Committee review whether Sec. 1214(b)(1)(B) of S. 1694 amends the 1945 Consent Decree without approval of the Federal District Court or the parties to the 1945 Consent Decree.**

New Sec. 1214(c)(1) provides that any aquifer storage project shall not be considered to be a part of the total water supply available if it complies with subsections (A) – (D). This implies that without this legislation, aquifer storage is considered part of the total water supply available.

***The Wise Use Movement recommends that the Committee review whether Sec. 1214(c)(1) of S. 1694 amends the 1945 Consent Decree without approval of the Federal District Court or the parties to the 1945 Consent Decree.**

New Sec. 1214(c)(1)(D) provides that any aquifer storage project shall not be considered to be a part of the total water supply available if the project is approved by the Workgroup. Again, there is no public participation opportunity, and the Workgroup has been elevated from an advisory committee to a decision-making committee.

***The Wise Use Movement recommends that the Committee strike this subsection.**

New Sec. 1214(d)(2) provides that federal cost-share for the Initial Development Phase under subsection (a)(2) including the reimbursable share to be repaid by non-Federal project contractors, shall not exceed 50 percent of the total costs of the initial development phase.

***The Wise Use Movement recommends that the Committee clarify why this subsection allows 50 percent federal cost-share for the Initial Development Phase (which includes the Kachess inactive storage and K-K pipeline projects).**

Conclusion

In summary, the Wise Use Movement is opposed to S. 1694. We find that it includes Congressional intent to support and authorize the entire Yakima Plan, which is likely to exceed $5 billion in costs. Most of the costs of the Yakima Plan are devoted to an "insurance policy" for irrigators in the Yakima Basin during a drought year. These are the same irrigators that have not paid off the costs of the existing Bureau of Reclamation's Yakima Project. The State of Washington's Water Research Center concluded that the Yakima Plan was not cost-effective. This is because it contains many "bridges-to-nowhere" projects that do not pencil out. In addition, the Yakima Plan includes analysis of projects to transfer water from the Columbia River to the Yakima Basin.

We also request that the attached Cato Institute article, "Cutting the Bureau of Reclamation and Reforming Water Markets," by Chris Edwards and Peter J. Hill (February 2012), be included in the hearing record. As the article concludes:

> "The era of major federal dam building is over, but Reclamation continues to provide water to the western states at artificially low prices. Without reforms, that policy will exacerbate the major water challenges facing the western states. About four-fifths of water supplied by Reclamation goes to farm businesses, and the agency provides the largest subsidies to those users. As a consequence, agriculture must be at the center of efforts to reform federal water policies."
>
> "Reforms are also needed with regard to water rights, water transfers, and water pricing in the West. Reducing restrictions on water transfers and allowing water prices to better reflect market supply and demand would promote efficiency and benefit the environment.

> In the West, new supplies of water have been generally exhausted, so avoiding shortages in the future will depend on greater efficiency in water allocation and consumption."

Thank you for the opportunity to provide these comments.

Sincerely,

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CATO INSTITUTE downsizing THE FEDERAL GOVERNMENT

Cutting the Bureau of Reclamation and Reforming Water Markets

by Chris Edwards and Peter J. Hill*

February 2012

Overview
History of Federal Irrigation
The Poor Economics of Federal Irrigation
Dams, Irrigation, and the Environment
Reforming Water Markets
Reducing the Federal Role in Water Infrastructure

Overview

For more than a century, the Bureau of Reclamation has built and operated dams, canals, and hydroelectric plants in the 17 western states. The bureau is the largest wholesaler of water in the nation, and it is the second largest producer of hydroelectric power, with 58 plants. It owns about 250 dams and 350 reservoirs, which are used for power, irrigation, flood control, and recreation.[1]

In 2011 the Bureau of Reclamation's net budget outlays were $1.9 billion. Its gross outlays were larger at about $2.9 billion, but about $1 billion of the bureau's annual spending is offset by receipts from various sources.[2]

Many cities and farm businesses in the West have become dependent on water from Bureau of Reclamation projects. However, the agency's policies have created economic distortions and environmental damage. Numerous Reclamation dams have not made any economic sense because the costs of the dams have outweighed the benefits gained from irrigation farming and other marginal uses of water. Farmers have been the largest beneficiaries of federal water infrastructure in the West, and they generally receive water at a small fraction of its market value.

The era of major federal dam building is over, but Reclamation continues to provide water to the western states at artificially low prices. Without reforms, that policy will exacerbate the major water challenges facing the western states. About four-fifths of water supplied by Reclamation goes to farm businesses, and the agency provides the largest subsidies to those users.[3] As a consequence, agriculture must be at the center of efforts to reform federal water policies.

Constructing dams for irrigation and hydropower makes sense in some locations. But in the 20th century, the Bureau of Reclamation was an agency run amok with grand engineering plans that ignored economic and environmental logic. The bureau aggressively sought to dam nearly every major river in the West at multiple locations. Dams have harmed wetlands and salmon fisheries, and federal irrigation has generated ongoing problems such as heightened salinity levels in rivers.

Looking ahead, Congress should consider transferring Reclamation dams and other facilities to state and local governments and the private sector. The bureau's mission to reclaim arid lands in the West by constructing irrigation projects has long been complete. Today, water policy issues—which are increasingly contentious—would be better handled within states that control their own infrastructure and solve their own unique demand and supply problems.

Reforms are also needed with regard to water rights, water transfers, and water pricing in the West. Reducing restrictions on water transfers and allowing water prices to better reflect market supply and demand would promote efficiency and benefit the environment. In the West, new supplies of water have been generally exhausted, so avoiding shortages in the future will depend on greater efficiency in water allocation and consumption.

This essay examines the history of the Bureau of Reclamation, describes the poor economics of federal water projects, and discusses some of the environmental problems caused by federal irrigation. It then discusses reforms to water markets, particularly allowing greater water transfers. The final section discusses transferring Reclamation assets to state and local governments and the private sector, which would reduce federal taxpayer costs and allow for more diversity and innovation in water policy solutions.

History of Federal Irrigation

In the 19th century the federal government accumulated vast land holdings in the West as a result of the Louisiana Purchase of 1803, the Texas annexation of 1845, the Oregon treaty of 1846, and the Mexican Cession of 1848. While the federal government gained huge territory, it also had a general policy for more than a century of transferring its land holdings to state governments and the private sector.

Republican president Abraham Lincoln signed the Homestead Act in 1862, which allowed western settlers to receive title for up to 160 acres of free land if they lived on the land for five years and made improvements. The Republican Party strongly supported homesteading, and passage of the legislation was made possible by the secession of the southern states from the union during the Civil War.

That important law facilitated the privatization of hundreds of millions of acres of federal lands in subsequent decades. However, the 160-acre homestead size limit was too small to meet the needs of many settlers in the arid lands in the West. Viable ranching operations needed much larger acreages, and it took Congress decades to revise homesteading rules to make them more suitable for western settlement.

However, the relatively small tracts available under the Homestead Act did make sense in the West if irrigation was available, and private efforts to increase water for agriculture began early on. The Mormons, for example, arrived in Salt Lake Valley in 1847 and within a year had created an irrigation system covering 5,000 acres.[4] By 1900 there were about 7.5 million irrigated acres in the 17 western states, with almost all of the irrigation stemming from private efforts.[5] By 1910 private irrigation had expanded to 13.5 million acres.

All over the West, mutual irrigation companies (or "ditch" companies) were created. These companies issued stock to members who used irrigation water on the basis of their share of water received. In addition, investors from all over poured funding into corporations that built some quite impressive canals, dams, and other water infrastructure in Colorado, Wyoming, Idaho, and other states.[6]

Many of the speculative corporate irrigation investments failed, as did some early state government irrigation efforts.[7] These failures, and a feeling that private efforts weren't moving quickly enough, led some settlers, businesses, and government officials to begin advocating for federal help. Special interest groups started lobbying for federal aid to western irrigation in the 1870s. Irrigation enthusiasts from across the western states held regular conferences to gin up support for funding.[8]

In 1891 William Ellsworth Smythe launched *Irrigation Age,* which promoted federal intervention. Elwood Mead, a Wyoming irrigation engineer, and Francis E. Warren, a U.S. senator from Wyoming, were also leading advocates of federal aid.[9] These leaders helped organize national irrigation congresses in Salt Lake City, Denver, Albuquerque, Phoenix, and other cities during the 1890s. The National Irrigation Association was founded in 1899 to press for federal legislation.[10]

In 1896 Senator Warren secured a federal reservoir survey in order to provide support for federal flood control. The survey was led by Captain Hiram Martin Chittenden of the Army Corps of Engineers.[11] Chittenden visited many areas in the West to examine potential reservoir sites, and he met with leaders of the reclamation movement. His report to Congress in 1897 provided support for federal dams in some locations but not others.

Irrigation advocates used a variety of arguments in favor of federal aid for dam-building. Crittenden believed that federal aid was necessary because "private enterprise can never accomplish the work successfully."[12] Other advocates argued that federal dams were needed to control floods in the West. That argument was pressed after major floods occurred, such as when the Imperial Valley in California flooded in 1891.[13]

Another argument for federal support was the view that irrigation would spur western population growth, which would be good for the whole nation. Irrigation would provide opportunities for poor Americans to gain access to land, which would decrease social unrest. This "safety valve" thesis was an important part of the 19th century political debate. Wesley Jones, a representative and later a senator from Washington, for example, posited that putting people on small farms in the West was good for social order because wage laborers in the East could be subject to "anarchist disorder and revolution."[14]

There were some very dubious arguments in favor of federal irrigation aid. One widely believed theory was that irrigated farming would increase rainfall in formerly arid regions—rain would "follow the plow" it was said. That theory turned out to be false. Another argument, made by Frederick Newell, the chief hydrologist for the U.S. Geological Survey and later the first director of the Reclamation Service, was that there would be spillover effects from irrigation—irrigation from surface water would create increases in western groundwater.[15] That idea is no longer supported.

In 1901 Francis Newlands, a representative and later a senator from Nevada, introduced the first major legislation for federal construction of dams. The bill failed to pass, but the national mood was changing. All of the major political parties—the Democrats, Republicans, and the short-lived Silver Republicans—included support for federal irrigation in their platforms.[16] And by this time, the Geological Survey was preparing plans for reclamation projects at 147 specific sites.[17]

In 1902 another reclamation bill was introduced and President Theodore Roosevelt provided his strong support. The act passed easily in the Senate, but there was opposition in the House, with 146 voting in favor and 55 against it.[18] Representative William Hepburn from Iowa called federal irrigation "larceny" because it benefited private property owners at the expense of the general public.[19] Others resisted federal dam building as a step towards socialism.

Historically, it would have been cheaper to bring additional land into cultivation in the Southeast than in the dry West.[20] However, advocates of federal irrigation subsidies for the West gained the upper hand in the political arena. The Reclamation Service was established in 1902 within the U.S. Geological Survey. In 1907 the service was established as a separate agency within the Department of Interior. Then, in 1923, it was renamed the Bureau of Reclamation.[21]

Supporters of federal aid for western dams had political advantages. They argued that the Army Corps of Engineers had long invested in river and harbor improvements in the East, and the West had been left out of these federal subsidies.[22] Also, the West was slowly increasing its representation and influence in Congress. In 1895 only 2 of 8 members of the Senate committee responsible for the Reclamation Act were from west of Colorado. By 1902, the numbers had increased to 9 of 13.[23]

The railroads were major supporters of federal irrigation legislation, and they financed lobbying efforts in favor of passage.[24] The railroads were supporters because irrigation would increase the value of the western land they held. It would also increase immigration to the West, which would boost the number of railroad passengers.

Note that if the federal government had not stepped in to provide irrigation in the West, the railroads might have been important backers of private irrigation projects for those same reasons. But federal intervention ended opportunities for private development of western water infrastructure. The federal government secured for itself the best dam locations in the West, and the Commerce Clause of the Constitution allowed it to aggressively assert control over all navigable rivers and their tributaries.[25]

The Poor Economics of Federal Irrigation

The 1902 Reclamation Act required the full repayment of irrigation project costs by the beneficiaries. Initial funding for reclamation projects was to come from the sale of federal land in the western states. As projects were completed and revenues were raised from water users, the government could then fund new projects.

Reclamation projects were supposed to involve no direct costs to federal taxpayers, but Congress soon reneged on that promise and began to increase subsidies in various ways. One reason was that "early on, it was discovered that the costs of establishing irrigated farming . . . were much higher than expected, and the costs of building water projects were much higher than originally estimated," noted the Government Accountability Office.[26]

Despite the high costs, Reclamation was eager to build dam after dam. One strategy it employed for many decades was to fudge its analyses of proposed projects to make the costs look lower, and the benefits higher, than they really were. The agency would paint a rosy economic picture to gain project approval, and then it would allow the full information to trickle out later. For example, Reclamation began constructing the Grand Coulee Dam with $63 million in funding from Congress, but it later became clear that the agency had a $270 million project in mind.[27]

This strategy has long been employed on government infrastructure projects.[28] The Army Corps of Engineers, for example, has a history of distorting its analyses of water projects in order to secure project approval.[29] Or consider that in pushing for approval of the huge State Water Project in California in 1959, Gov. Pat Brown kept throwing out a bogus cost estimate of $1.75 billion, even though he knew it would cost far more, as he later admitted.[30]

From the beginning, political factors undermined the possibility that Bureau of Reclamation investment decisions would be made in a rational economic manner. As Marc Reisner noted in his history of the agency, *Cadillac Desert*, "Every Senator still wanted a project in his state; every Congressman wanted one in his district; they didn't care whether they made economic sense or not."[31]

To secure support from the western states, the 1902 legislation required that 51 percent of the revenue from federal land sales in each state be spent on Reclamation projects within that state.[32] However, there wasn't necessarily a relationship between land-sale revenues and the locations of the best projects. This requirement "seriously compromised the ability of government engineers to select projects objectively."[33]

After the Reclamation Act passed, the Republican Party saw political advantage in quickly proposing a large number of projects in as many states as possible.[34] This rush to launch projects for political reasons reduced efficiency. By 1907 Reclamation had requested and received congressional approval for 24 projects, with every western state receiving at least one.[35] "Most of the projects were begun in great haste with little attention paid to 'economics, climate, soil, production, transportation, and markets.'"[36]

Reisner noted that "by building so many projects in a rush, the Reclamation Service was repeating its mistakes before it had a chance to learn from them."[37] Indeed, many early Bureau of Reclamation projects were failures.[38] The bureau gained experience, and went on to build some tremendous dams in subsequent decades. Still, there were boondoggles and disasters, such as Reclamation's Teton Dam in Idaho, constructed in 1975. The dam was built on the basis of a flawed economic analysis, and the dam's engineering was so poor that it collapsed catastrophically in 1976.[39]

Private companies often make mistakes, but they systematically aim to make the investments that have the highest net returns. By contrast, government projects are often chosen on the basis of factors such as political pull, which often results in projects with low or negative returns. The history of Reclamation reveals that it systematically followed poor policies regarding its infrastructure investments, decade after decade.

One early decision by the Bureau led to large investment inefficiencies for much of the 20th century. The 1902 legislation stated that "charges shall be determined with a view of returning to the reclamation fund the estimated cost of construction of the project."[40] In interpreting this, the Bureau decided to exclude interest costs, so that project beneficiaries would be required to pay back only the original project costs over time. The effect was to greatly reduce the real value of repayments, thus creating large subsidies on Reclamation projects.

Congress further increased subsidies by extending required repayment periods. The original repayment period of 10 years was extended to 20 years in 1914 and to 40 years in 1926.[41] Some later projects, such as the Central Arizona Project, had even longer repayment periods. In 1939 Congress increased subsidies further by instituting a 10-year grace period before project repayments had to begin.

Economists Price Fishback and Randall Rucker estimated that Reclamation projects with 40-year repayment periods and 10-year grace periods had interest-related subsidies of 57 percent with a 3 percent discount rate and 91 percent with a 10 percent discount rate.[42] Economist Richard Wahl finds similar high levels of interest subsidies on Reclamation projects.[43]

Congress increased reclamation subsidies in other ways. In 1910 it added $20 million of taxpayer money to the Reclamation Fund. In the 1920s and 1930s, Congress passed numerous deferrals of repayment because of economic hardships in agriculture.[44] The secretary of Interior was also given discretion to reduce repayment obligations on the basis of reassessments of land productivity.[45]

With the approval of Hoover Dam construction in 1928, "large appropriations began to flow to Reclamation from the general funds of the United States."[46] In the 1930s, the New Deal ushered in a huge expansion in taxpayer-financed dam building. The idea was to spend money to create government jobs, not to spend money efficiently.

In the mid-20th century, the federal government went on a massive dam-building binge. Looking at Reclamation's full list of dams today, 85 were built between 1902 and 1930, and 203 were built between 1930 and 1970.[47] Meanwhile, the agency's bureaucracy jumped from a few thousand employees in the 1920s to nearly 20,000 by the 1940s.[48]

Politics, not economics, continued to be the driving force of Reclamation projects. For example, a whole series of dams forming the Colorado River Storage Project, including the Glen Canyon Dam, were authorized in 1956. These dams made little sense from an economic or environmental point of view. Sen. Paul Douglas of Illinois—a PhD economist—lambasted these projects relentlessly when they were being considered in Congress. But in the end, the economics of the projects didn't matter, only the political drive for Reclamation to spend money in certain states did. As Reisner notes, California had won a series of big projects from Reclamation, so now it was the turn of the Upper Basin region of the Colorado River to win some. So the projects were approved, even though power production and irrigation didn't make much sense in the region.[49]

That sort of political logic was then transferred to Arizona. If California, Colorado, and other states got big projects, why shouldn't Arizona? Arizona is one of the driest states in the nation, but it has groundwater sources that had long provided water for irrigation in the state. However, by the 1960s the groundwater was becoming harder to get and Arizonans were looking for new sources of water.

In 1922 the Colorado River Compact divided Colorado River water between adjacent states. It allocated 7.5 million acre-feet to the lower Colorado basin, which includes Arizona, California, and Nevada. In 1928 Congress subdivided that water among the three states, with Arizona receiving 2.8 million acre-feet. To use the Colorado River water, Arizona would have to transport it from the western part of the state to the southern part, but at the time that was considered to be too costly—even the Bureau of Reclamation said it was a "mad man's dream."[50]

By the 1960s, however, the situation had changed. For one thing, the Bureau of Reclamation was eager to find big new projects to keep the agency's large workforce employed. The Central Arizona Project (CAP) fit the bill since it would be hugely expensive to construct the needed pumps to lift water up great elevations and to deliver it more than 300 miles through aqueducts to Phoenix, Tucson, and surrounding areas. The bureau seized on the opportunity and "refused to believe any expert who told it what it didn't want to hear."[51] Dan Dreyfus was the Bureau of Reclamation official in charge of providing benefit-cost estimates at the time, and he later confessed: "I had to fly all the way out to Denver and jerk around the benefit-cost numbers to make the [CAP] look sound."[52]

In 1968 after years of political infighting, Congress authorized the Central Arizona Project within a broader bill that included numerous other projects.[53] The bill exemplified the power of congressional logrolling—new projects were spread across many different states and congressional districts. Dreyfus later said that some of projects in the bill were "pure trash," but stubborn members of Congress, defending their states, wanted them in the bill.[54]

The Central Arizona Project was completed in 1993 at a cost of about $5 billion. Economists Steve Holland and Michael Moore completed a detailed analysis of the benefits and costs of CAP.[55] They found that rather than provided net benefits to society, it resulted in imposing deadweight losses on society of more than $1 billion. Like numerous prior Bureau of Reclamation projects, the CAP was a net waste of resources.

Advocates for government infrastructure spending seem to imagine that well-meaning officials will rationally weigh the costs and benefits of projects, and then make decisions with the broad public interest in mind. But it hasn't worked that way with the Bureau of Reclamation. The agency was headed by a series of leaders fixated on building just about every project that any important politician wanted. As with leaders of the Corps of Engineers, Reclamation had an engineering mindset, and it was eager to conquer nature with huge concrete facilities.

Michael Strauss headed Reclamation from 1946 to 1953. He was a New Deal liberal and a "public power ideologue" who hated private utilities.[56] He wanted to build as many huge power dams as he could, and he didn't seem to care whether they made any economic sense. Floyd Dominy, who headed Reclamation from 1959 to 1969, was another liberal public-power advocate, and he was apparently a zealous anti-environmentalist. He saw little if any value in free-flowing rivers or wildlife-supporting wetlands.[57] He manipulated Congress, ignored laws that were inconvenient, and used his office and staff to arrange liaisons with young ladies.

To a remarkable degree, both Reclamation and the Corps were insulated during the 20th century from control by presidents, their opponents in Congress, and critics outside of the government. Leaders of these agencies simply needed to stay tight with the few key members of Congress who controlled their funding. The two bureaucracies competed to outspend each other. In California, for example, "their rivalry was a wonderful opportunity for the state's irrigation lobby; the growers could sit back and smile coyly as they were madly pursued by rival suitors in hard hats."[58]

Since the 1950s, the Bureau of Reclamation has been required to perform benefit-cost analyses of its projects. There is a strong incentive for the bureau to underestimate costs and overestimate benefits, and for decades independent economists have argued that the bureau distorts its analyses for political reasons.[59] One trick the bureau has used is to count the total value of irrigated crops as project benefits, even though a sounder analysis would only count the net increase in crops.[60] The tendency of the bureau to exaggerate project benefits is exacerbated by the fact that its analyses are not reevaluated once a project has been completed to ensure accountability.[61]

Agriculture has received by far the largest subsidies from Reclamation projects. In calculating repayment requirements, Reclamation allocates substantial costs related to irrigation to other project beneficiaries, such as power customers and urban water customers. Also, a law change in 1939 allowed the bureau to reduce costs to irrigators on the basis of "ability to pay," which has saved farmers billions of dollars over the decades.[62] A 2006 CBO report found that irrigators have been required to repay only about 37 percent of total original costs allocated to them over the decades.[63]

Most independent studies find that 15 percent or less of project costs are typically repaid when interest costs are included.[64] Looking at projects built between 1902 and 1980, for example, Richard Wahl found that irrigators only paid back 14 percent of total project costs.[65] The Congressional Budget Office concurred that "the federal government's contribution to the cost of constructing and financing irrigation projects amounts to about 85 percent to 90 percent of the total cost allocated to irrigation."[66]

Even these estimates don't take into account the full costs of federal water infrastructure and irrigation subsidies. An additional cost is that the government spends taxpayer money to mitigate the environmental damage done by federal dams and irrigation systems, as discussed next.

Dams, Irrigation, and the Environment

The large subsidies built into many Reclamation projects indicate that they have been a loss to taxpayers and the economy. But Reclamation projects have also harmed the environment, which has prompted Congress to burden taxpayers with further spending aimed at mitigating the damage. Historically, the bureau was mainly focused on building dams to increase farm production, and it generally ignored the harm it was doing to in-stream uses of water. Losses to salmon fisheries, wetlands, and other natural habitats were of little concern to the agency.

With the rise of the environmental movement since the 1970s, the bureau has been forced to be more environmentally friendly. Indeed, public sentiment has shifted so much that some dams today are considered to cause overall harm, not create public benefits.[67] The environmental group American Rivers describes 10 sorts of harm done to rivers, and the use of rivers, by dams.[68] The issue is not just the harm done by dams to nature, but the harm to the human benefits of free-flowing rivers, such as recreational activities and the fishing industry.

President Jimmy Carter was an early anti-dam crusader and he famously tried to terminate 19 major projects of the Bureau of Reclamation and the Corps of Engineers. Carter examined the environmental and economic effects of these projects, and he concluded that they were boondoggles. However, Carter misplayed the politics of the issue, and his spending cuts to water infrastructure projects went nowhere in Congress.[69] Carter's skepticism of dams is more widespread today, and a movement has developed to remove dams where the costs seem to outweigh the benefits.[70]

Many federal dams do provide substantial benefits, but the benefits are sometimes exaggerated. For example, Reclamation has often claimed large flood control benefits from projects. However, some water resource experts argue that the infrastructure of the Bureau of Reclamation and the Corps of Engineers has tended to eliminate the natural floodplains of rivers, confining them to narrow passages, which can concentrate water flows and exacerbate flooding. The damage to wetlands caused by federal water infrastructure can also encourage flooding. Looking at the big picture, we've had huge federal spending on water infrastructure over the last century, and yet floods cause more damage today than in earlier decades, when measured in constant dollars.[71]

In the West, federal irrigation has created a mix of benefits and costs. One ongoing environmental problem stemming from irrigation is salt build-up in soils. "Salinity is a worldwide threat to the sustainability of irrigated agriculture [but] both the accumulation of salt and the extent of salt-affected soils are more prevalent in the West," noted a recent study by the National Academy of Sciences.[72]

Irrigation also causes salinity problems in river systems. As irrigation waters run through fields and flow back into rivers, they pick up salts and other minerals from the land. Western rivers that are heavily tapped for irrigation become very saline downstream. The Colorado River, for example, is notoriously saline by the time it reaches the Mexican border. Indeed, because of Mexican concerns, Reclamation built an expensive desalting plant—the Yuma Plant in Arizona—at a cost of $245 million to treat irrigation water before it reached the border.[73] As it turned out—after that large taxpayer cost—the plant hasn't been used since it was completed in 1993. Maintenance costs at the plant are piling up at $6 million a year, or more than $100 million over the last two decades.[74] These sorts of costs related to environmental cleanup are an additional negative factor that policymakers should consider when debating federal irrigation policies.

Contaminated runoff from irrigation is a huge and costly problem in the Westlands Water District of California's San Joaquin Valley.[75] The area receives irrigation water from Reclamation's Central Valley Project (CVP), San Luis Unit, which was built in the 1960s. Land in this area contains high concentrations of selenium and other chemicals, which are picked up by irrigation waters and poison downstream ecosystems. Furthermore, without proper drainage in the area, salts are apparently building up and destroying about 200,000 acres of irrigated farmlands.

Reclamation spent $55 million to build a drainage system to fix the problem, but that project was abandoned as a failure in the 1970s.[76] Since then, the bureau, landowners, courts, and politicians have battled over how to fix the problem. A more sophisticated water treatment system for the region could cost more than $2 billion—a cost about three times larger than the original cost of the area's irrigation infrastructure.[77] It appears that Reclamation's entire project to irrigate this area of California was a huge blunder, and the former leader of the bureau admitted it in an interview.[78]

The Environmental Working Group (EWG) argues that federal irrigation to this area of California should be ended because the area is inherently unsuited to farming.[79] That could save millions or even billions of dollars for a new treatment system, and it would allow a huge volume of irrigation water to be diverted to higher-valued uses in the state. The Westlands District contains just a few hundred very large farm businesses, and they have become wealthy from federal water and farm subsidies. It makes little sense for taxpayers to pay for a huge new treatment system for these businesses, especially when irrigated agriculture in this area makes such little economic and environmental sense.

Environmental problems caused by federal subsidies have followed a similar pattern in the Florida Everglades as they have in California. First, the federal government provides large subsidies to agriculture—in Florida that has included sugar subsidies and Army Corps of Engineers water infrastructure.[80] Second, substantial environmental damage is caused, which in Florida includes damage to wetlands and the contamination of water systems by irrigation runoff. Third, the federal government steps in with billions of dollars of taxpayer funds to try and fix the environmental problems.[81] This funding has been called "green pork."[82] Fourth, the federal subsidies that caused the underlying problems remain in place!

The lesson is that the costs of federal water infrastructure are often more than just the original construction costs. The EWG has tallied up the costs of the various types of federal subsidies received by farm businesses in California's Central Valley Project. The CVP is Reclamation's largest irrigation project, providing roughly 6,800 farmers irrigation water for about 3 million acres of land. The farmers receive the water at roughly 10 percent of its market value, which in 2002 worked out to an annual subsidy of about $416 million a year, according to EWG.[83] Another way to illustrate the magnitude of the subsidies to CVP water users is to look at the costs of the project. In 2006 the CBO found that CVP farmers had paid back only 14 percent of the project's construction costs thus far, even though water from the project has been flowing for decades.[84]

On top of the irrigation subsidy, about one-fifth of CVP farmers who receive federal irrigation water also receive crop subsidies from the U.S. Department of Agriculture (USDA).[85] Put another way, about one-third of federal irrigation water in the CVP went to crops receiving USDA subsidies. Those subsidies total about $90 million a year and mainly go to cotton and rice farmers.[86] This subsidized production of often water-intensive crops in the arid West competes with more efficient production of the same crops in other regions of the country. Federal farm subsidies encourage overproduction of crops in all parts of the nation, and so the government is exacerbating the overproduction with irrigation subsidies in the West.

CVP farmers also receive electricity subsidies. In the CVP, farmers receive discounted prices for the electricity that is used to pump water in irrigation operations.[87] The CVP uses massive pumps to push water through 1,400 miles of canals. The EWG found that low-cost power creates a subsidy of about $100 million a year to CVP farmers.

In sum, many western farmers receive irrigation subsidies, farm subsidies, and electricity subsidies. In the CVP, those subsidies add up to roughly $600 million per year, according to the EWG. Furthermore, taxpayers get hit paying the additional costs of cleaning up the environmental problems created by federal irrigation.

Who benefits from all these federal subsidies? Generally, it's a small number of large farm businesses and landowners. In the CVP the subsidies are heavily slanted toward the largest farms. The largest 10 percent of farms (roughly 700 farms) in the CVP receive about two-thirds of the project's entire water supply.[88] This group received average subsidies worth $349,000 each in 2002. Major petroleum and railroad companies—as landowners—have historically been some of the largest beneficiaries of irrigation subsidies in California.[89] The USDA's farm subsidies are also notoriously slanted to the very largest farms and landowners.[90] Thus, to a substantial extent, subsidized irrigation farming in the West is "corporate welfare," which comes at the expense of average taxpayers, citizens, and the environment.

Reforming Water Markets

The Bureau of Reclamation's original function of building major water infrastructure in the West has been largely completed. Today, its main function is being the largest wholesaler of water in the nation.[91] It diverts a vast amount of water from rivers, and delivers it to farmers, industries, and cities. Interestingly, about one-quarter of the water it diverts from rivers is lost through spills and transportation even before it reaches any customers.[92]

About four-fifths of Reclamation water is directed to agriculture.[93] The bureau generally sells the water to local irrigation districts under long-term contracts. The contracts specify the water allotments and applicable prices. The bureau's water pricing on each project depends on original construction costs, calculations of irrigators' "ability to pay," the allocation of costs among different water users, and other factors. Generally, the higher prices paid by urban water users and power customers subsidize the much lower water prices paid by irrigators. Prices vary widely in the West, but farmers often pay no more than 10 percent of the water's market value.

Despite Reclamation's huge investments to increase supply over the decades, many areas in the West face a looming water crisis. Groundwater levels are falling and surface sources of water are tapped out. Major river systems in the West have been engineered by federal and state water infrastructure to maximize water consumption. Even if new water supplies could be developed, accessing those sources would be likely blocked by environmental concerns. Governments have responded to tightening water supplies with a wide range of bureaucratic and regulatory initiatives.

However, the underlying problems of water in the West relate to inefficient policies regarding water prices and water transfers. Governments have kept prices artificially low for so long that it has encouraged water waste and water usage in low-value activities. The Bureau of Reclamation charges users only a fraction of the full costs of water, as we have discussed. Also, local irrigation districts partly rely on taxes to finance their activities, and that reduces their incentive to efficiently price water. Water prices in most districts do not reflect the opportunity costs of the water.[94]

The prices for Reclamation water are not set by market supply and demand. Prices are set far below the marginal costs of new supplies, which would be the efficient level in normal competitive markets. For example, in 2003 California's Imperial Water District proposed to sell a portion of the Reclamation water it receives at $15 per acre-foot to the City of San Diego for $225 per acre-foot.[95] That indicated that the irrigation district was receiving federal water at a price that is a small fraction of the market value. Water prices vary widely across the West, but such large differentials between prices paid by irrigators and prices that other users would be willing to pay are typical.[96]

If Reclamation charged higher prices, it would encourage a range of conservation efforts. For example, it would induce farmers to reduce leakage in irrigation systems and to switch to less water-intensive crops. Research has shown that irrigation water use is quite sensitive to water prices, such that price increases would induce substantial reductions in demand. One estimate found that a 10 percent increase in water prices would bring about a 6.5 percent reduction in irrigation water use in California.[97]

The problem of artificially low water prices is compounded by restrictions on water transfers between users. Surface water in the West is generally allocated by government rules, not by markets. Farmers who receive Reclamation water usually don't have the option to resell it, so it gets locked into current uses. Reclamation doesn't have an across-the-board ban on water transfers, but current rules do not facilitate easy transfers.[98] If water cannot be resold, it gets stuck in lower-valued uses while higher-valued uses go undersupplied. Water "shortages" are usually caused by restrictions on transfers, not from overall shortages in a region.

In most places in the West, agriculture is central to the challenges facing water. Because irrigation represents such a large portion of western water use, increased efficiency of water use in agriculture would free up large amounts of water for other uses. Allowing farmers to freely sell water would encourage them to conserve and to reduce irrigation on their least productive lands. The value of marginal water use in agriculture is low, according to the Congressional Budget Office, while the value of water to growing cities is higher.[99] Thus, allowing greater water transfers could be a win-win for all interests.

The water industry in the West operates within a complex web of water rights, water legislation, and court rulings enforced by the federal and state governments. At the federal level, Reclamation projects create entitlements to the water supplies from its facilities. The federal government also asserts control over navigable waterways, a power derived from the Commerce Clause of the Constitution. And since the 1970s, federal environmental laws have imposed rules on water systems regarding endangered species, wetlands, and other items.

At the state level, water law in the West developed in the 19th century based on the principle of "prior appropriation." Those people who first diverted water from a river and put it to a beneficial use had a priority right to it in the future. This doctrine separated water rights from land ownership, which allowed water to be diverted to the place of use at a distance from the source. Under prior appropriation rules, the ownership of water rights can also be transferred.

In market economies, strong property rights are essential to encouraging the efficient allocation and use of resources. Property rights allow individuals to plan ahead and make long-term investments, or to sell their resources to others who may have a higher-valued use. Unfortunately, water markets have suffered from increasingly complex and restrictive rules layered on top of original prior appropriation rights, and these layers of rules have often encouraged inefficient water consumption.

Water rights in the West today are generally "usufructuary," meaning that they confer the right to use water in certain ways, but they don't confer absolute ownership. "Beneficial use" rules in the states allow governments to confine water use to certain activities, sometimes at the expense of other higher-valued uses. "Use-it-or-lose-it" rules require that those people with rights to water use their full allocations currently, else they risk losing them in the future. These rules and others create disincentives for water conservation.[100] If farmers and other end users risk losing their water rights if they don't consume their allocations, and if they can't profit from selling any excess water, they will have little incentive to use water efficiently.

Another way to describe the problems is that when governments assert public water rights through various laws and regulations, it often erodes private water rights, and it is those private rights that generally promote efficiency in use. Some people have a knee-jerk response with respect to water policy—they think that because it is an important resource, it should be owned by the government. But that's exactly backwards notes water expert James Huffman: "Because water is such a critical resource it should be allocated under a regime that will assure its efficient use," and that regime is open markets based on private rights.[101]

Given the pressing need to use water supplies more efficiently in the West, policymakers need to reexamine the rules that discourage conservation, block transfers, and keep prices artificially low. Given the resistance by farmers to large and sudden price increases in water, many experts think that near-term reforms should focus on allowing increased water transfers. Wahl argues that "voluntary exchanges can be as effective as appropriate pricing in leading to efficient water use."[102] Water demands change over time, for example, as demands for certain types of crops change. Allowing greater water transfers would allow water to move between areas to meet changing market conditions.

Reducing barriers to water transfers would create broad benefits. Cities and industries that have growing demands would be able to access new sources of water. Farmers would be able to sell their excess water and earn profits. Some people might view such profits as unfair, but they would drive increased efficiency in water use to everybody's benefit. Currently, farmers earn profits from crop production based on artificially low water prices. Allowing farmers to earn profits on water transfers merely changes the form of profits that stem from low-price federal water.[103]

Allowing more water transfers could ease increasingly contentious water conflicts in the West. The San Joaquin Valley, for example, has been one battleground in recent years, stemming from federal decisions to reduce water deliveries to farmers and to leave water instream to benefit fish.[104] Some members of Congress are furious that environmental laws are trumping irrigation water use and putting the livelihoods of farmers in jeopardy.[105] Indeed, there can be a high cost to humans of overzealous federal environmental laws. But the basic cause of water conflicts in the West is that allocations are being made on legal and political grounds, which are typically zero-sum decisions. If, instead, water was allocated by market transfers, it could create win-win solutions because competing claims could be met through voluntary agreements.[106]

To sum up, moving toward water trading and market pricing would encourage more efficient water use. In a 2006 report on federal water policies, the CBO endorsed the "broader use of markets in deciding how scarce water resources are allocated" and suggested that Congress "reconsider subsidies that support the use of water at prices that do not reflect opportunity costs."[107] There have been some moves in the direction of market reforms in recent decades, such as changes to the Central Valley Project in 1992. Some nations have moved toward freer markets in water. Chile, for example, has established secure and transferable water rights, which allow farmers and cities to buy, sell, or lease water with prices set by supply and demand.[108] Thus, as federal and state policymakers try to avert water crises in coming years, there are some real-world market models for them to consider.

Reducing the Federal Role in Water Infrastructure

A century ago, proponents of irrigating the West argued that federal involvement was crucial because the job was simply too big for state, local, and private efforts. Those arguments have no relevance today because the western states are populated by tens of millions of people with the incomes and resources to handle their own water supply needs.

Today, all the goods and services provided by the Bureau of Reclamation—water, electricity, and recreation facilities—could be provided by state governments, cities, local irrigation districts, investor-owned utilities, and nonprofit groups. As such, federal policymakers should explore how Reclamation facilities could be transferred to state, local, and private ownership.

The single largest Reclamation project is the Central Valley Project (CVP), and its dams, canals, and other facilities are all located within California. The CVP was originally supposed to be a state project, and only became a federal project by "historical accident."[109] The project was approved by the California legislature and by a state referendum in 1933.[110] But then the state decided to lobby Washington for funding and was successful, so the federal government took it over. Today, California has its own large water infrastructure project, the State Water Project, which could be the home for CVP assets if they were transferred to the state.

In the 1990s there were efforts to transfer some Reclamation facilities to nonfederal owners. Under its "reinventing government" initiative, the Clinton administration sold some federal projects to local irrigation districts.[111] In 1996 Reclamation sold 141 miles of canals, 462 miles of lateral channels, and 457 miles of drains to the Elephant Butte Irrigation District in New Mexico. The same year, Reclamation transferred its Vermejo Project in New Mexico to the Vermejo Conservation District. In 1997 Reclamation transferred irrigation facilities to the Oroville-Tonasket Irrigation District in Washington State. And, at the time, there were proposals to transfer the CVP to either private owners or the State of California, but those reforms did not come to fruition.[112] Nonetheless, 19 Reclamation projects had been transferred to nonfederal owners by 2006.[113]

Acts of Congress were required to facilitate these ownership transfers. However, Reclamation has standing authority to move the responsibility for operation and maintenance of its projects to local irrigation districts, and it has done so hundreds of times.[114] Indeed, about two-thirds of Reclamation facilities are "transferred facilities," which are operated and maintained by end users such as irrigation districts.[115] That is a step in the right direction, but transferring the ownership of facilities would have further advantages, such as making it easier for irrigation districts to borrow funds for capital investment and using owned facilities as loan collateral.[116]

Local control of irrigation infrastructure would likely reduce costs. One estimate found that local control of operations and maintenance reduces costs by about 25 percent from "cheaper labor costs, less paperwork, [and] faster decisionmaking."[117] In 2008 a western farm organization that was testifying to the House in favor of Reclamation facility transfers noted: "Experience throughout the West demonstrates that when control of projects is assumed by local interests, the projects are run more effectively and with far fewer items of deferred maintenance."[118]

In 1995 legislation to encourage facility transfers was introduced in the House and Senate, but it made no headway.[119] In 2008 the Commissioner of Reclamation, Robert Johnson, supported legislation (H.R. 6992) that would have authorized the Department of the Interior to transfer ownership of smaller-scale facilities to nonfederal entities.[120] Congress should move ahead with such legislation to give Reclamation the authority to sell or transfer assets to willing buyers, subject to certain general parameters established in law.

Policymakers should recognize that many Reclamation facilities are more than a half a century old, and they may need costly repairs or replacement in coming decades. The Congressional Research Service estimates that the replacement value of all Reclamation assets is more than $100 billion.[121] Because of today's huge federal deficits and the advanced age of federal water infrastructure, the CRS says that there will be increasing conflicts over funding the maintenance of these assets if they remain under federal control.[122]

State and local officials are in a better position to make decisions on water infrastructure investments that will be needed in the future. The Bureau of Reclamation says that investments in water conservation—such as reducing water losses on irrigation canals—can generate high returns.[123] That's the type of investment opportunity that local owners of infrastructure would be eager to pursue. But if water investment decisions are left to Washington, good opportunities may be foregone because of the general fiscal mess.

Congress should consider privatizing some of the Bureau of Reclamation's 58 hydroelectric power plants. Perhaps the first step would be to transfer plants to the two federal power utilities in the West—Bonneville Power Authority (BPA) and the Western Area Power Administration (WAPA). The second step would be to privatize BPA and WAPA.

Federal ownership of BPA and WAPA is an anomaly. The bulk of U.S. power generation is by investor-owned utilities. Even just considering hydropower, more than two-thirds of the roughly 2,400 plants in the nation are owned by the private sector, although about three-quarters of the capacity is in publicly-owned plants.[124] While federal facilities are dominant in some western states, other states have substantial private hydropower, such as New York and North Carolina. Note that the Clinton administration privatized the Alaska Power Administration in 1996, and it also studied how to transfer other federal power assets to nonfederal owners.[125]

Privatizing Reclamation dams as part of BPA and WAPA would save taxpayers hundreds of millions of dollars a year in taxpayer-funded appropriations. In addition, billions of dollars could be raised by selling these utilities to investors, which would help reduce the federal debt. In 1997 the CBO estimated that private businesses would be willing to pay $23 billion or more for the power assets of BPA, WAPA, and two smaller federal utilities.[126] That figure includes the sale of generating plants owned by Reclamation and the Corps of Engineers.

Privatizing BPA, WAPA, and federal hydropower plants would likely improve operational efficiency. The Congressional Budget Office found that "private operators of hydropower facilities would generally produce electricity at a lower cost than the federal operators currently do."[127] The CBO further noted that "the managerial structure of the federal power program ... makes it hard to operate efficiently."[128] As examples of inefficiency, the CBO pointed to the inadequate maintenance of federal power assets and the low utilization rates of facilities.

Reforming federal water policies and downsizing the Bureau of Reclamation would be challenging.[129] But avoiding such reforms will probably deepen the water crisis in the West. The Bureau of Reclamation noted in its report "Water 2025" that without reforms, rising population in the West could lead to frequent water shortages and growing political battles in the southwestern states from Texas to California.[130]

The Water 2025 report noted that current regulatory approaches to water allocation problems were causing angry conflicts in the West, but that market-based solutions have worked well where they have been tried.[131] So the sooner we can substitute local water markets for government central planning of water the better. Indeed, "it is unlikely that the institutions necessary for a well-functioning [water] market can be imposed through a central government," note Terry Anderson and Pamela Snyder. [132]

By decentralizing the infrastructure and decisionmaking for water, the states would be the "laboratories of democracy" for meeting their water needs. The states have different legal structures for water rights, different types of farming, and different access to groundwater, and so they may evolve different responses to their water challenges. The "Water 2025" report found that water stakeholders across the West favored water policy decisions being made at the local level.[133]

Aside from the reforms discussed above, there are other ways that Congress could alleviate pressures on water supplies. One reform would be to repeal the large farm subsidies handed out by the USDA, which provide an extra incentive for western irrigation farmers to put low-value lands into production.[134] Another reform would be to repeal federal ethanol subsidies, which encourage the building of water-glutton ethanol refineries. And yet another reform would be to repeal federal import barriers and regulations that support the production of sugar beets, which are "one of the most water-intensive crops grown in the West."[135]

A recent report by the National Academy of Sciences concluded that "the capacity for water to support cities, industry, agriculture, and ecosystems in the U.S. West is near its limit under current management practices."[136] We need new "management practices" in water, and a growing number of economists, environmentalists, and resource experts believe that the answer is to pursue market-oriented reforms to federal and state water policies.

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