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).

[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) **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) **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.

FLAWED ANALYSIS

The following sections provide in-depth details and analysis regarding the above Executive Summary points.

Benefit Calculation Errors

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, 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 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.

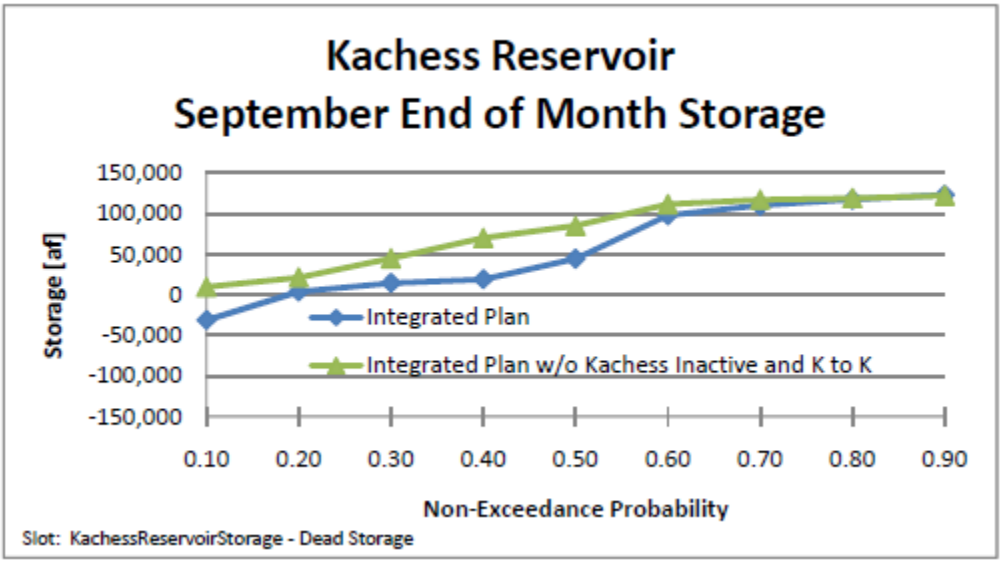
Water Supply Calculation Errors

4) The estimated impact to Lake Kachess is significantly understated, not fully communicated to stakeholders and includes a significant accounting/math error.

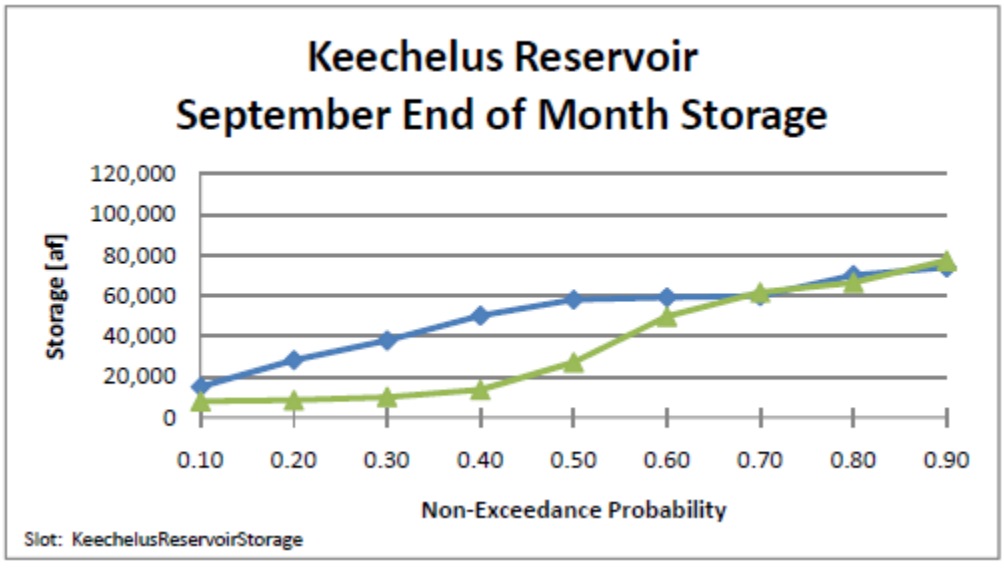
   a) There is already significant public feedback provided regarding the need for KDRPP and KKC DEIS to better address water levels and water supply issues. Items of significance include failure to address domestic water issues, NEPA/SEPA issues, and the impact on recreational benefits and home values. 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:

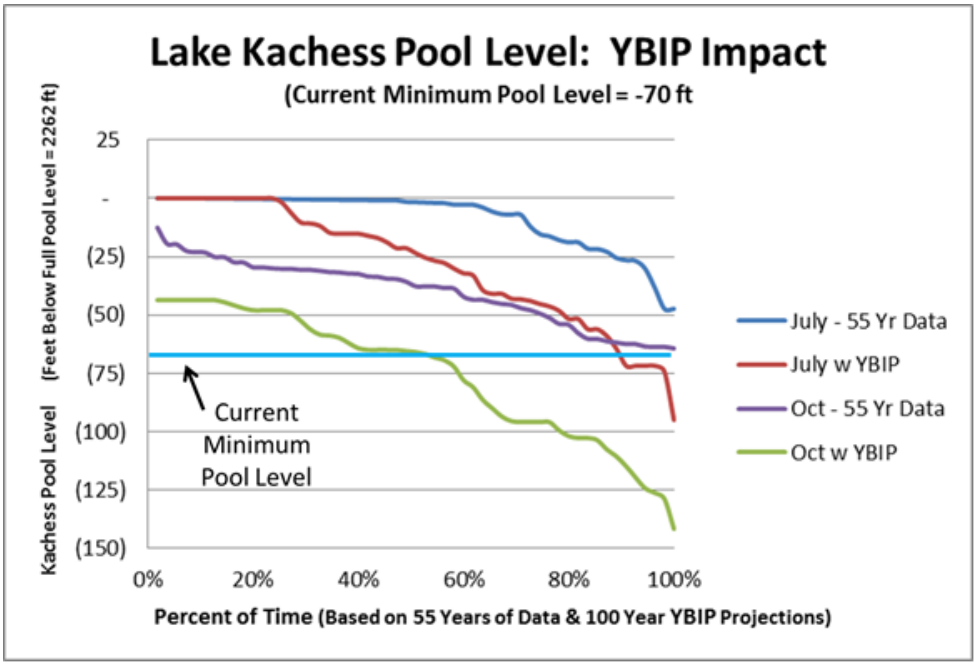
"the Keechelus target storage above which water is transferred into Kachess is critically important to maximizing the benefit to Keechelus Reach in terms of reducing summer high flows, while avoiding drawing Keechelus Reservoir down so low that adverse up-migration impacts occur to bull trout in the 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) **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 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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