FOR IMMEDIATE RELEASE:
August 24, 2016

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NEW ANALYSIS RAISES SERIOUS DOUBT ABOUT FINANCIAL VIABILITY OF THE TWIN TUNNELS PROJECT

Proposed Tunnels would provide only 23 cents worth of economic benefit for every dollar spent

SACRAMENTO, CA—The Delta Counties Coalition (DCC) recognized the need for a benefit-cost study and applauds recent work by Dr. Jeff Michael, Executive Director of the Center for Business and Policy Research at the University of the Pacific. Dr. Michael's work confirms that the Governor's proposed twin tunnels project is not a good investment for California or project proponents. The analysis raises serious doubts about the financial viability of the twin tunnels project.

Using a benefit-cost analysis model and methods prescribed by the California Department of Water Resources, Dr. Michael's benefit-cost analysis concludes that the WaterFix costs would be up to four times greater than its benefits. The WaterFix is likely to provide only 23 cents worth of benefits for every dollar of cost. Even in an optimistic scenario, project benefits are projected to provide only 39 cents worth of benefit. Given these findings, a public project of this magnitude cannot be reasonably justified to ratepayers or taxpayers.

This report also discredits claims that the twin tunnels would improve export water supply, water quality, or reduce physical risk in the event of a massive earthquake. It also explains that the project would negatively impact agriculture in the Delta by loss of land to facility construction and mitigation, and by water quality degradation.

The DCC was formed to better represent the nearly 4 million people throughout the Delta region and works collaboratively to give one voice to the Delta and better engage in the efforts to achieve three goals: improve the Delta ecosystem, provide a more reliable water supply for the state, and protect and enhance Delta communities.

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Delta Counties Coalition

Contra Costa County · Sacramento County · San Joaquin County · Solano County · Yolo County

"Working together on water and Delta issues"

August 24, 2016

The Honorable Edmund G. Brown, Jr.
Governor, State of California
State Capitol
Sacramento, CA 95814

Re: Benefit-Cost Analysis of the California WaterFix

Dear Governor Brown,

The Delta Counties Coalition (DCC) supports your efforts to develop solutions to California's long-term water supply needs. There are aspects of the California Water Action Plan that the DCC finds consistent with our principles. However, the DCC opposes aspects of the Plan that involve isolated conveyance as proposed by the California WaterFix Project.

Dr. Jeffrey Michael, Executive Director of the Center for Business and Policy Research at the University of the Pacific, prepared a report entitled "Benefit-Cost Analysis of the California WaterFix." The full text of the report is enclosed. Dr. Michael's report evaluated several scenarios considering factors that contribute to the project's overall costs and benefits. Under virtually all scenarios, the project's costs far exceeded potential benefits and the differential was significant.

The report also contradicts claims that the purported benefits of the WaterFix project will lead to increased export water supply, improved export water quality, and reduced physical risk resulting from a large earthquake. The report also provides a clear picture of how the WaterFix Project devastates agriculture in the Delta by water quality degradation and loss of high quality, productive Delta agricultural lands to facilitate construction and mitigation for the twin tunnel project.

In summary, the DCC highly recommends that Dr. Michael's report be given serious consideration as the California WaterFix and various alternatives are being evaluated. The DCC is available to meet with you or your staff to discuss impacts of the WaterFix on the Delta region and potential alternatives that may better meet statewide needs to improve the health of the Delta. If there is interest in further discussion, the DCC may be contacted through Coordinator Natasha Drane at (916) 874-4627 or at dranen@saccounty.net.

Thank you for considering this information and the DCC's concerns with the WaterFix project.

Sincerely,

Don Nottoli
Supervisor, Sacramento County

Skip Thomson
Supervisor, Solano County

Karen Mitchoff
Supervisor, Contra Costa County

Oscar Villegas
Supervisor, Yolo County

Chuck Winn
Supervisor, San Joaquin County

Enclosure

cc: Secretary John Laird
DCC Federal Delegation
DCC State Delegation

Benefit-Cost Analysis of The California WaterFix

August 2016

Dr. Jeffrey Michael

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The Center for Business and Policy Research is located at Pacific's Sacramento and Stockton campuses. The Center's mission is to perform independent research and analysis of economic issues and trends in the state and region. The Center has extensive experience analyzing the economic impact of water issues including reports on policy choices related to the Delta and droughts. The Delta Counties Coalition made a $10,000 grant to the Center for Business and Policy Research to support the development of this report.

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Executive Summary

This report is the first comprehensive benefit-cost analysis of the California WaterFix, a significant revision to the plan for water conveyance tunnels under the Delta originally proposed as part of the Bay-Delta Conservation Plan (BDCP). The WaterFix is the most costly water proposal in California history, so it is unusual that the California Department of Water Resources (DWR) has not followed its own planning guidelines and issued a benefit-cost analysis of the proposal. Thus, the benefit-cost analysis presented in this report fills a critical information gap so that the public and decision-makers can better assess the merits of the WaterFix proposal. This analysis is based on data and assumptions in the revised environmental documents produced by DWR to support the proposal's environmental review. The results show the WaterFix costs are four times larger than its benefits, and thus the project is not is not economically justified.

Background

The California WaterFix is the most expensive and arguably most controversial water infrastructure proposal in the state's history. It would add large water diversions to the Sacramento River and that would convey water through tunnels 35 miles in length under the Delta to the State Water Project (SWP) and Central Valley Project (CVP). The goal of the project is to secure water exports from the Delta by reducing the use of the current south Delta diversion that relies on the stability of Delta levees and causes reverse flows in Delta channels that harm endangered species such as Delta Smelt and Winter-run Chinook Salmon. In addition to its estimated $16 billion construction cost, the concerns of opponents include the risk of harming endangered fish at the new water intakes and degrading water quality in the Delta for human and environmental uses because of reduced freshwater flows from the Sacramento River.

This benefit-cost analysis includes base and optimistic scenarios that closely follow the project description and environmental analysis produced by project proponents, and makes a number of assumptions that are favorable to the WaterFix such as the use of a low-discount rate, a 100 year operating lifespan, and no environmental costs. The analysis does not include a pessimistic scenario, and thus does not consider the possibility of cost overruns or the risk of harm to endangered species. In addition, this analysis does not include financing costs of the bond debt that is expected to be used to pay construction costs.

Results and Conclusion

Although the study includes assumptions favorable to the WaterFix, the results clearly show that the WaterFix is not economically justified under both the base and optimistic scenarios. The base scenario finds a net present value of -$10.2 billion, and a benefit-cost ratio of 0.23. That means the WaterFix is estimated to provide only 23 cents of benefits for each dollar of cost. In the optimistic scenario, the net present value is -$7.8 billion and the benefit-cost ratio is 0.39.

Thus, even under optimistic assumptions, costs are still more than 2.5 times larger than benefits.

The primary economic problem for the WaterFix is its low water yield, that is the difference in water supply with and without the WaterFix, relative to its $16 billion construction cost. The results of the base scenario analysis show that it could only be economically justified if its construction and mitigation costs were below $2 billion or if its water yield could be increased from an annual average of 225,000 acre feet per year to about 2 million acre feet per year without negatively impacting the environment or causing any additional harm to other water users.

The WaterFix has the physical capacity to increase water exports more than the constrained operations assumed in the current proposal, and many project opponents fear that the economic demands created by project financing could result in much higher exports that harm the environment and other water users. This report shows the concern of project opponents is well justified, and raises questions as to why state and federal water agencies are seeking environmental approval for the WaterFix without a benefit-cost and financial feasibility analysis consistent with the operating assumptions it is using to obtain regulatory approval.

Present Value of Benefits and Costs of the California WaterFix.
2014 dollars, 3.5% real discount rate, 15 years of construction, and 100 years of operation.

	Base scenario	Optimistic Scenario
Benefits		
Export Water Supply	$1,319,521,208	$2,822,409,124
Export Water Quality	$1,677,361,307	$1,677,361,307
Earthquake Risk Reduction	$0	$435,796,554
Total Benefits	*$2,996,882,515*	*$4,935,566,984*
Costs		
Construction and Mitigation	$11,676,474,531	$11,676,474,531
Operation and Maintenance	$591,658,075	$591,658,075
Ecosystem	$0	$0
In-Delta Municipal	$111,279,332	$37,093,107
In-Delta Agriculture	$682,807,143	$293,953,421
In-Delta Transportation	$132,205,755	$132,205,755
Total Costs	*$13,194,424,836*	*$12,731,384,889*
Net Benefit	($10,197,542,281)	($7,795,817,905)
Benefit/Cost ratio	**0.23**	**0.39**

Introduction

The WaterFix is the most costly and arguably the most contentious and controversial water infrastructure proposal in California history. The tunnels would divert water from the Sacramento River and convey it around the Delta to state and federal water projects serving southern California rather than continuing to convey the fresh water through Delta channels. The goal of the project is to increase water supply reliability for water contractors south of the Delta who receive deliveries from the State Water Project and the Central Valley Project, and to reduce fish mortality associated with the operation of the current pumps in the south Delta. In addition to its costs, other concerns with the WaterFix include new problems for endangered species created by operating the three new intakes, water quality degradation for municipal and agricultural users in the Delta who would be downstream of the new intakes, and environmental and community impacts from a 15-year construction process.

Surprisingly, the WaterFix proposal does not include a benefit-cost analysis that is commonly part of the planning for major water infrastructure despite its estimated $16 billion construction cost and billions more in interest and operating costs that will be paid over time. This report is the first comprehensive benefit-cost analysis of the WaterFix proposal, and fills a critical information gap so that the public and decision-makers can better assess the merits of the Water Fix proposal.

This benefit-cost analysis is based on the project description and environmental analysis in the environmental impact report and other documents produced by the California Department of Water Resources (DWR) or the U.S. Bureau of Reclamation (BOR) to support the WaterFix proposal. The values to various benefits and costs are derived directly from the findings in these environmental documents and other reports that have been generated or referenced by DWR and BOR for similar projects. It follows benefit-cost principals accepted by these agencies, and adopts a number of assumptions that favor large infrastructure expenditures like the tunnels such as tabulating benefits over a 100-year period and using a relatively low 3.5% discount rate.

The results clearly show that the WaterFix is not economically justified under both a base and optimistic scenarios. The base scenario finds a negative net benefit of nearly $11 billion, and a benefit-cost ratio of 0.23. That means the WaterFix is estimated to provide only 23 cents of benefits for each dollar of cost. Using an optimistic set of study assumptions where all values of benefits and costs are taken from reports produced to advocate for the WaterFix, net benefits are still a negative $7.8 billion and the benefit-cost ratio only increases to 0.39. Thus, under optimistic assumptions, costs are still more than 2.5 times larger than benefits.

The report begins with a brief history and background of the WaterFix proposal and its origins in the Bay Delta Conservation Plan, followed by a review of benefit-cost principles and previous economic analysis done when the tunnels were part of the BDCP. The next section estimates the value of the WaterFix benefits in three categories: 1) export water supply to cities and farms south of the Delta, 2) export water quality, and 3) earthquake risk reduction. WaterFix costs are

estimated in six categories: 1) capital costs for construction and mitigation, 2) operating and maintenance costs, 3) ecosystem costs, 4) in-Delta municipal water supplies, 5) costs to in-Delta agriculture, and 6) impacts to transportation in the Delta. The report ends with a summary and conclusion and an appendix that briefly discusses some practical financial challenges that could impact construction of the WaterFix that go beyond the scope of a benefit-cost analysis.

History and Background of the WaterFix Proposal

The California WaterFix is a slightly modified version of the Delta tunnels that were originally the center piece of the Bay Delta Conservation Plan (BDCP). The BDCP planning process began in 2006. In addition to the tunnels, the BDCP included twenty additional conservation measures, including over 100,000 acres of habitat restoration, with a total estimated cost of both the tunnels and habitat conservation measures of $25 billion. The BDCP was a habitat conservation plan (HCP) under section 10 of the U.S. Endangered Species Act, and a natural community conservation plan (NCCP) under California law. Approval of an HCP/NCCP requires a finding that the plan will improve the overall condition of the endangered and threatened species covered by the plan such as salmon and delta smelt. In return for investing in the plan to help the recovery of species, regulated entities such as the water contractors that receive water exported from the Delta would receive assurance that no additional money, water or other resources would be required from them under state and federal laws protecting species covered by the plan. Water contractors who receive water exported from the Delta were to pay for the construction, mitigation, and operation of the tunnels, and public funds were to pay for the other conservation elements.

After years of planning and evaluation, it became clear that the BDCP was falling short of its goal to improve the overall condition of covered species and was not going to receive approval as an HCP/NCCP. Despite the advantages of reducing reverse flows in the Delta associated with the south Delta pumps, the BDCP raised new concerns about the negative effects of the new intakes on the Sacramento River on migrating salmon and other fish, the impacts of degraded water quality in the Delta south of the intakes, and the effectiveness of the planned habitat restoration. In 2015, the California Department of Water Resources decided to abandon the BDCP and split the tunnels from the other conservation measures in a more focused proposal called the California WaterFix.

While the stated goals of the WaterFix remain the same as the BDCP, the tunnels-only WaterFix proposal is not an HCP/NCCP and is seeking approval under section 7 of the Endangered Species Act. The environmental standards under section 7 consultation are lower than section 10. Specifically, WaterFix requires a finding that it is not likely to jeopardize the continued existence of listed species, whereas the BDCP required improvement to the overall condition of listed species. The lower environmental requirements of section 7 improve the likelihood of the tunnels receiving regulatory approval, and were the primary reason for the

change to WaterFix. However, the lower environmental bar comes with a cost to water exporters who lose the 50-year permit and no-surprises regulatory assurance under section 10. Thus, the shift from BDCP to WaterFix significantly increases the long-term economic risk to water contractors since investing in the tunnels would not come with any assurance that limited future reductions to water supplies or other financial obligations to protect endangered species.

In a July 2015 press call promoting the revised WaterFix proposal, the Director of the Department of Water Resources answered a reporter's question about the change from BDCP to WaterFix, and how the resulting loss in a 50-year permit and regulatory assurance would impact benefit-cost analysis as follows,

> "A 50-year permit term would have been something that any investor in this project would have liked to have been able to obtain, no doubt about that. And the business decision that remains without that as a benefit is going to cause some reconsideration…
>
> We'll have more detail on that through improved benefit-cost ratio soon, perhaps August, if things go well for us, so yes, we will have another revised cost benefit ratio economic analysis of these benefits in that kind of time frame." [1]

It is now a year later, and the Department of Water Resources has still not released the promised economic analysis of the benefits and costs of the WaterFix. This report fills the information void to provide the public and policymakers with relevant information to evaluate the WaterFix proposal.

Benefit-Cost Analysis Principles

Benefit-cost analysis of large infrastructure projects is common practice, and broadly considered to be an essential part of good public policy analysis of large capital projects. The agencies proposing the WaterFix, the California Department of Water Resources and the Bureau of Reclamation, routinely perform benefit-cost analysis in the planning process for large water infrastructure projects. For example, the two largest current reservoir proposals in California, Sites and Temperance Flat, both contain benefit-cost analysis within their draft feasibility studies. High-speed rail, the other California mega-project in the news, has included multiple benefit-cost assessments as the business plan has evolved. However, there has been limited economic analysis done for the Delta tunnels throughout a decade of planning.

[1] https://mavensnotebook.com/2015/07/13/media-call-director-mark-cowin-on-the-revised-environmental-documents-for-california-water-fix/.

The Department of Water Resources (DWR) has an Economic Analysis Guidebook that provides a comprehensive description of DWR's approach to benefit-cost analysis and its importance to project planning and assessment.[2]

> Economic analysis is a critical element of the water resources planning processes because it not only evaluates the economic justification of alternative plans but it can assist in plan formulation. (p. 1)
>
> The economic analysis should answer questions such as, Should the project be built at all? Should it be built now?, Should it be built to a different configuration or size? Will the project have a net positive social value for Californians irrespective of to whom the costs and benefits accrue? (p. 5)
>
> Benefit-cost analysis is the procedure where the different benefits and costs of proposed projects are identified and measured (usually in monetary terms) and then compared with each other to determine if the benefits of the project exceed its costs. Benefit-cost analysis is the primary method used to determine if a project is economically justified. A project is justified when:
>
> - estimated total benefits exceed total estimated economic costs;
> - each separable purpose (for example, water supply, hydropower, flood damage reduction, ecosystem restoration, etc.) provides benefits at least equal to its costs;
> - the scale of development provides maximum net benefits; and
> - there are no more-economical means of accomplishing the same purpose. (p. 13)

The benefits and costs of an investment occur at different points in time, and can extend for very long time horizons. Benefit-cost analysis examines a full stream of costs and benefits over the expected life of the project. This analysis examines 100 years of operations of the WaterFix tunnels after a 15 year construction period is complete in 2031.

The long streams of benefits and costs are compared using a present discounted value in current dollars. A discount rate, comparable to an interest rate, is used to account for the time value of money or the opportunity costs of using funds for a public investment. Public investment has opportunity costs, because it competes with and crowds out funding for private consumption, investment or alternative public investments.

Benefit-cost results can be sensitive to the level of the discount rate, and the choice of discount rate is sometimes controversial in benefit cost analysis. Federal government guidelines recommend the use of a 7% discount rate.[3] The DWR Economic Analysis Guidebook endorses a 6% discount rate. In recent years, many economists have recommended using lower discount rates that reflect current financial conditions, especially when looking at very long-lived investments or regulations to combat long-run, global issues such as climate change. This analysis uses a real discount rate of 3.5%, consistent with recent guidelines for evaluating

[2] http://www.water.ca.gov/pubs/planning/economic_analysis_guidebook/econguidebook.pdf
[3] See Office of Management and Budget, Circular No A-94. http://www.whitehouse.gov/omb/circulars_a094#7

public benefits of water storage projects approved by the California Water Commission.[4] These assumptions of a long time horizon and relatively low discount rate are very favorable to the WaterFix.

Previous Benefit-Cost Analysis of the Bay Delta Conservation Plan

In July 2012, the University of the Pacific Business Forecasting Center released a benefit-cost analysis of the tunnels as described as part of the BDCP.[5] The report assumed 600,000 acre feet of average annual yield from constructing the tunnels, more than double the level in the current WaterFix proposal, and calculated a benefit-cost ratio of 0.3 to 0.5 indicating that the tunnels were not economically justified. The report also pointed out that the tunnels were not a necessary component of a habitat conservation plan in the Delta, and thus it focused exclusively on the tunnels as a separable component of the BDCP. While the exclusive focus on the tunnels was consistent with DWR's economic analysis guidelines, the primary criticism of the report was that it failed to quantify environmental benefits from the habitat enhancements in the BDCP. The second major criticism was that it did not value the regulatory assurance water exporters' received from the habitat conservation plan under section 10 of the Endangered Species Act. The report argued that this benefit to water exporters was inappropriate to include in statewide benefit-cost analysis since the regulatory assurance does not reduce the physical risk of the project, but merely shifts risk away from water exporters and onto the environment and other statewide interests.

In August 2013, the DWR released its first comprehensive economic analysis, the *Draft Bay Delta Conservation Plan Statewide Economic Impact Report*. [6] Unlike the University of the Pacific report, it was not focused specifically on the tunnels and found an overall benefit-cost ratio for the BDCP of nearly 1.4. However, this conclusion rested on a critical assumption that water yields of the project were actually much higher than reported in the BDCP's environmental impact report (EIR/EIS). It assumed that without the BDCP, water exports to the state and federal water projects would be cut by more than additional one million acre feet due to

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[4] For a good current discussion of selecting a discount rate and justification for the California Water Commisions' selection of a 3.5% real discount rate, see pages 8-10 of the "Working paper for WSIP common assumptions – economics"
https://cwc.ca.gov/Documents/2015/08_August/August2015_Agenda_Item_12_Attach_5_ProposalforEconomicCommonAssumptions_Final.pdf

[5] The July 2012 report is similar in structure and has the same primary author as this report.
http://www.pacific.edu/Documents/school-business/BFC/BenefitCostDeltaTunnel_7%202012.pdf
This report can be a seen as an update to that initial report that reflects new information and the change in the proposal from BDCP and WaterFix.

[6] [6] Draft Bay Delta Conservation Plan Statewide Economic Impact Report. August 2013. Jonathan Hecht, ICF International and David Sunding, The Brattle Group.
http://baydeltaconservationplan.com/Libraries/Dynamic_Document_Library/Draft_BDCP_Statewide_Economic_Impact_Report_8-5-13.sflb.ashx

deteriorating environmental conditions, and that BDCP's regulatory assurance under section 10 of the Endangered Species Act would protect water exporters from further reductions in water exports. This assumption added over $10 billion to water supply benefits compared to using the scenario used in the BDCP EIR/EIS. Other notable criticisms of the 2013 *Draft BDCP Statewide Economic Impact Report* included a) an overestimate of future water shortage costs due to the use of outdated, high population growth projections, b) an assumption that no additional conservation or alternative water supplies would be put in place over the next several decades, and c) it used much different water yield assumptions for environmental benefits than water supply benefits, an inconsistency that greatly inflated the benefits of the BDCP.[7] While the consultants said a final revised report was being developed that considered feedback on the draft, no revision to the draft report was ever released. Despite these problems, the *Draft BDCP Statewide Economic Impact Report* was valuable in that it supported an organized, structured economic discussion around the tunnels proposal, showed the critical assumptions underpinning its conclusions, and highlighted the essential role of securing the regulatory assurance of the habitat conservation plan under section 10 of the ESA to the BDCP approach.

Benefits of the WaterFix

The delta water supply tunnels would provide three types of economic benefits: higher export water supply, improved export water quality, and reduced physical risk from a massive earthquake or flood that could disrupt water exports from the Delta.

For the optimistic scenario, values for these three types of benefits are derived directly from the Public Draft Bay Delta Conservation Plan, Appendix 9A, Economic Benefits of the BDCP and Take Alternatives[8] referred to hereafter as Public Draft BDCP Economic Benefits Report. For the Base Scenario, values for water supplies are derived from a broader range of recent reports from the Department of Water Resources and other state agencies. According to the WaterFix biological assessment from January 2016, the average annual water yield for the tunnels is 225,432 acre feet.[9] This is the most up to date estimate in any of the WaterFix official planning documents, and is in the middle of the range of water yields from the RDEIR/SDEIS released in summer 2015.

[7] For a detailed review, see http://www.pacific.edu/Documents/school-business/BFC/BDCP%20economic%20impact%20report%20review%20final.pdf

[8] http://baydeltaconservationplan.com/Libraries/Dynamic_Document_Library/Public_Draft_BDCP_Appendix_9A_-_Economic_Benefits_of_the_BDCP_and_Take_Alternatives.sflb.ashx

[9] For detailed estimates by month and type of water year, see page 605 of the biological assessment, https://s3.amazonaws.com/californiawater/pdfs/n5upr_Appendix_5.A_DraftBA.pdf

Export Water Supply:

The optimistic scenario value for water supply is derived from the Public Draft BDCP Draft Economic Benefits Report. As discussed earlier, this report provides a high value of water supplies because it exaggerates the severity of water shortages by overestimating future demand and assuming little future development of alternative water supplies. Nevertheless, it is an appropriate source to use for the optimistic scenario since it is the most recent value of water supply from the Delta Tunnels put forward by project proponents, and accounts for the possibility that the value of water grows faster than overall inflation. The BDCP presents the value of various levels of water supply as a present value over 50 years using a 3% discount rate. We fit a regression model to the value for each of the "high outflow scenario" models in the report to derive an average value of incremental water supply resulting from the Delta tunnels at $761 per acre foot in 2012 dollars ($785 in 2014 dollars). This represents the weighted average value of the tunnels' incremental water supply across both agricultural and urban users over a 50-year period.

The base scenario values incremental water supply from the delta tunnels for urban users with the cost of alternative water supplies. The Department of Water Resources' Water Plan Update 2013[10] provides cost estimates and potential water supply from alternatives as shown in the table. A weighted average based on the midpoint cost of each alternative and the potential supply is $633 per acre foot. However, the base analysis uses a higher value, the midpoint cost of municipal recycled water at $800 per acre foot to represent the value of urban water supplies since this is by far the largest potential supply of non-conservation sources.

Table 1. Cost of Urban Water Supply Alternatives (source: California Department of Water Resources Water Plan 2013 Update)

	Low Cost ($ af)	High Cost ($ af)	Midpoint Cost ($ af)	Potential Supply by 2030 (million af annually)
Brackish Groundwater Desalination	500	900	700	.1-.2
Ocean Desalination	1000	2500	1750	.1-.2
Municipal Recycled Water	300	1300	800	1.8-2.3
Surface Storage	300	1100	700	.1-1.1
Urban Water Use Efficiency	223	522	372.5	1.2-3.1

The base scenario values for agricultural water supplies are derived from California Department of Food and Agriculture's Agriculture Statistics Review for 2014-15.[11] It reports the rental rate of irrigated cropland in California was $405 per acre in 2014, whereas the rental rate for nonirrigated cropland was $32. The difference between irrigated and non-irrigated rental rates was $373. Given that 3 feet of water per acre is a typical irrigation supply in California, this

[10] California Department of Water Resources. California Water Plan Update 2013. http://www.water.ca.gov/waterplan/cwpu2013/final/index.cfm

[11] California Department of Food and Agriculture. Agricultural Statistics Review 2014-15. https://www.cdfa.ca.gov/Statistics/PDFs/2015Report.pdf

implies the value of agricultural water supply averaged $124 per acre foot in 2014. However, we adjust the value up to $150 per acre foot for the base scenario. Assuming roughly 2/3 of the incremental water supply from the tunnels is utilized by agriculture and 1/3 goes to urban users, the base scenario values incremental water supplies from the tunnels at $367 per acre foot in 2014 dollars.

Thus, the water supply values in the base scenario can be seen as favorable to the WaterFix as the value is adjusted upwards by about 20% from levels clearly derived from current reports by state agencies. While the calculations assume the inflation adjusted value of water is constant over the analysis period, this upward adjustment provides a reasonable buffer to account for the possibility that the value of water in California could grow faster than inflation. This analysis does not include a pessimistic scenario, even though a lower value to average incremental water supplies could be easily justified, and the WaterFix water supply benefits are skewed towards wet years when incremental water supplies have below average values.

Using the estimated yield from the WaterFix biological assessment and the value described above, the annual water supply value of the WaterFix is $176.9 million in the optimistic scenario and $82.7 million in the base scenario. Using a 3.5% discount rate, the present value of water supply benefits from 2031 to 2131 is $2.8 billion in the optimistic scenario and $1.3 billion in the base scenario.

Table 2. Export Water Supply Benefits of the WaterFix.

Scenario	Tunnels' Annual Water Yield	Average Value of Water Supply	Annual Value	Present Value over 100 years
Optimistic	225,432 af	$785	$176.9 million	$2,822.4 million
Base	225,432 af	$367	$82.7 million	$1,319.5 million

Export Water Quality Benefits:

The WaterFix would improve water quality for the SWP and CVP, because it would add new intakes to a stretch of the Sacramento River between Clarksburg and Courtland where water quality is better than the current intakes. The Public Draft BDCP Economic Benefits Report estimated the present value of water quality benefits over 50 years at $1.819 billion using a 3% discount rate. This equates to $102 million in annual benefits to delta water exporters in 2012 dollars or $105.2 million in 2014 dollars. Using the assumptions of this study, 15 year construction period followed by 100 years of water quality benefits discounted at a 3.5% real interest rate, the present value of water quality benefits to exporters is $1.677 billion. This value of water quality benefits is reasonable and we were unable to identify any recent alternative sources. Thus, this valuation of export water quality benefits is utilized for both the optimistic and the base scenarios.

Earthquake Risk Reduction:

A massive earthquake that floods dozens of Delta islands and disrupts water conveyance is frequently cited by political and business leaders who support the WaterFix as the most important economic justification for the project. This argument is inaccurate. It overstates the economic risk posed by a low-probability temporary loss of Delta water exports, inaccurately suggests that the disruption of water exports is the primary risk to the state economy from a massive earthquake-induced failure of delta levees, and inaccurately portrays the WaterFix as the only option to reduce the risk.

This was confirmed by the Public Draft BDCP Economic Benefits report which found relatively modest earthquake risk-reduction benefits to the tunnels. The report assumed a 2% annual probability that an earthquake would cause twenty or more Delta islands to flood and interrupt water exports for a year. While using high estimates of both the probability of the earthquake and the duration of the resulting water export interruption, the Economic Benefits report found the present value of earthquake reduction benefits over 50 years were only $364 million to $470 million dollars. This equates to an expected average annual benefit of $27.4 million in 2014 dollars. We use this annual value from the BDCP for the optimistic scenario, and calculate a total present value of $436 million over 100 years of tunnel operation. Even in an optimistic scenario, the earthquake risk reduction benefits are only equal to 2.5% of the tunnels' construction cost.

This relatively low value of the tunnels for flood-risk reduction is surprising to many people given the emphasis on this risk in public discussion. Thus, it is important to make a simpler explanation of why the lower this lower than expected benefit makes economic sense. First, it is important to remember that people use about 40 million acre feet of water in California in an average year and only one-eighth (5 million acre feet) of that is exported from the Delta. Furthermore, the tunnels only protect a portion of this supply from flood risk. For the earthquake flood scenario, the Draft BDCP Economic Benefits report estimated the tunnels would increase water exports by 2.8 million acre foot over an entire year compared to no tunnels, protecting a little more than half of normal water exports from the flood.

For perspective on the value of preventing a low-probability risk of a 2.8 million acre foot surface water shortage, consider that UC researchers estimate that the current drought reduced surface water supply in California by over 11 million acre feet in both 2014 and 2015. Although costly, these much larger shortages due to drought were not devastating to the California economy. In fact, the California economy grew robustly throughout the drought. The protection provided by the WaterFix from a hypothetical loss of water supply due to a very severe Delta earthquake is only one-fourth the loss of surface water supply experienced during a single year of the recent drought. While the water supply disruption from a Delta flood would be very costly to water exporters, it is apparent from the state's recent experience with much larger water shortages that claims of statewide economic devastation are greatly overstated in the media and political discourse.

In addition, the likely duration of an earthquake-induced interruption of Delta exports is now described as "weeks or months" by the Director of the Department of Water Resources and other water agency officials, not years.[12] New information shows that Delta levees are in better condition than assumed in the estimates used for the Draft BDCP Economic Benefit report. Thus, a more realistic assumption that could be used for the base scenario is a 1% probability of a flood-induced outage lasting 3 months. This would lead to an estimate of annual average benefits from earthquake risk reduction that are one-eighth the level of the optimistic scenario, or about $3.5 million in expected annual benefits. However, even this may be too high a value for earthquake risk reduction benefits of the WaterFix. When considering the full economic and public safety impacts of this massive flood and the alternative approaches to reduce the risk, a reasonable argument can be made that the earthquake protection value of the WaterFix is zero or negative.

If a massive earthquake were to cause ten or more Delta islands to simultaneously flood, the human and economic losses that would result are much larger than the impact on water supplies. According to the Delta Risk Management Strategy (DRMS) reports, hundreds of people in the Delta would drown in such a catastrophic flood. In addition, the DRMS reports found that interruptions of export water supply would be only 20% of the economic loss of such an event.[13] Much larger economic losses would come from disruptions to natural gas systems, electricity transmission and generation, state highways, ports, railroads, and significant losses of in-Delta businesses, homes, and farmland. Given the scale of these potential losses to multiple types of economic infrastructure, it makes sense to consider seismic upgrades to the Delta levee system that protect all economic values in the Delta, including water exports. Unlike a tunnel, seismic levee upgrades could also save hundreds of lives and prevent environmental destruction from a massive flood.

Two reports by state agencies have identified seismic levee upgrades as a viable earthquake risk reduction strategy in the Delta.[14] The Delta Protection Commission Economic Sustainability Plan estimated the cost of 300 to 600 miles of seismic levee upgrades at between $2 billion and $4 billion, including riparian habitat enhancements on the enlarged levees. The Department of Water Resources' January 2008 AB 1200 found an "Improved Levees" scenario with 100 miles

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[12] https://mavensnotebook.com/2015/07/13/media-call-director-mark-cowin-on-the-revised-environmental-documents-for-california-water-fix/.

[13] See phase 1 summary report of the Delta Risk Management Strategy for a summary of public safety and economic consequences of a flood. Total economic consequences include interruption to water exports and flood losses to in-Delta property and other infrastructure such as transportation.
http://www.water.ca.gov/floodsafe/fessro/levees/drms/docs/drms_execsum_ph1_final_low.pdf
The finding that water exports are only 20% of the economic loss from the massive Delta flood can be derived from the technical appendices to the DRMS Phase 1 report and has been confirmed in the Delta Protection Commission Economic Sustainability Plan and its review under the auspices of the Delta Stewardship Council. The result is also clear by examining Table 18-2 in the DRMS Phase 2 report.
http://www.water.ca.gov/floodsafe/fessro/levees/drms/docs/DRMS_Phase2_Report_Section18.pdf

[14] "Economic Sustainability Plan for the Sacramento-San Joaquin River Delta." Delta Protection Commission. January 2012. "Risks and Options to Reduce Risks to Fishery and Water Supply Uses of the Sacramento/San Joaquin Delta." Department of Water Resources and Department of Fish and Game. January 2008. http://www.water.ca.gov/floodmgmt/dsmo/sab/drmsp/docs/AB1200_Report_to_Legislature.pdf.

of seismic upgrades to eight islands in the south Delta was the lowest cost of three promising risk reduction strategies, including a peripheral canal.[15] In addition, a 2007 PPIC report estimated the cost of a similar Dutch style, "Fortress Delta" strategy at $4 billion.[16] Seismic levee upgrades are 1/6 to 1/3 the cost of the proposed water conveyance tunnel, and provide a much larger and broader range of risk reduction benefits to the economy.

Understanding the larger picture of earthquake risk is essential because benefit-cost analysis is based on "with and without" comparisons to the next best alternative. If a significant positive value is given to seismic-risk reduction from the WaterFix as in the optimistic scenario, it means that there is an implicit assumption that there will be no action to reduce the seismic risk to human life and other economic assets in the Delta. If the WaterFix is a substitute for Delta levee upgrades as some advocates of the tunnels have suggested, then it could have a negative seismic risk reduction value since the WaterFix could result in unnecessary loss of life of property compared to a less costly levee upgrade alternative. In addition, it is important to recognize that California voters approved more bond funding to further strengthen Delta levees in 2014, and the California Water Plan and the Delta Stewardship Council's Delta Plan both support the creation of an assessment district for delta levees that will generate financial contributions to upgrade and maintain the system from a much larger group of beneficiaries than currently contribute. Since the WaterFix only provides partial protection of water exports from earthquake, it is very possible that a levee upgrade strategy could provide even more earthquake protection for water exports than the tunnels.

As shown in the above discussion, it isn't clear that the WaterFix adds significant seismic protection benefits over what can be reasonably expected to occur if the tunnels are not constructed. Thus, the base scenario estimates zero value for the earthquake risk reduction benefits of the WaterFix.

Costs of the WaterFix

The costs of the WaterFix include the construction, mitigation, operating and maintenance costs that state and federal water contractors are expected to pay, as well as negative impacts that could accrue to other water users and the environment. This report makes some initial estimates of the value of negative impacts on in-Delta municipal and agricultural users, and the environment. These costs are likely conservative as these initial estimates do not include any

[15] The seismic upgrade of only 8 islands was found to reduce the cost of water export interruptions from the largest Delta earthquake by 2/3, and the strategy had the largest overall economic risk reduction because it also protected other economic assets from flood in the case of an earthquake.

[16] The PPIC ruled out a "fortress Delta" solution in 2007, because its $4 billion cost was too high compared to a peripheral canal they assumed would cost only $3 billion. The PPIC also ignored or downplayed public safety and the risk to non-water supply infrastructure. See "Envisioning Futures for the Sacramento-San Joaquin Delta" Public Policy Institute of California, February 2007. http://www.ppic.org/main/publication.asp?i=671

costs on water users upstream of the Delta, or non-water user impacts in the Delta such as negative impacts on Delta recreational values or construction impacts on Delta residents.

Construction and Mitigation Costs:

Construction and mitigation costs are taken from the California WaterFix Design and Construction Enterprise Budget and Schedule.[17] It estimates $ 795,952,611 in mitigation costs over 25 years with most actions complete in the first ten years. The construction budget is $ 14,943,458,684 in 2014 dollars with a 15 year construction period, for a total cost of over $15.7 billion. The budget states "At this level of project definition, the corresponding level of accuracy is +30% to -20%." For this report, we distributed the construction and mitigation costs evenly over a 15 year construction period, $1,049,294,086 in annual costs from 2017 to 2031. The present value of these costs using a 3.5% discount rate is $11,676,474,531. While water contractors will finance construction with bonds, benefit-cost analysis does not consider financing costs.

Operating and Maintenance Costs:

The estimate of operation and maintenance costs is taken from chapter 8 of the Public Draft Bay Delta Conservation Plan.[18] The BDCP estimated these costs in 2012 dollars at $25.1 million for the first five years, and $38.1 million annually after the first five years. For this analysis, these costs were adjusted to 2014 dollars and applied to 100 years of operations. Using a 3.5% discount rate, the present value of these operating and maintenance costs is $591,658,075.

Environmental Effects:

There has been significant debate about the environmental effects of the WaterFix. While there would be some environmental benefits from less use of the south Delta intakes that cause reverse flows in the Delta, there would be offsetting environmental harms from the construction and operation of the north Delta intakes. However, there is no basis to argue for overall environmental benefits from the WaterFix when the Bay Delta Conservation Plan – which

[17] See Exhibit E of Design and Construction Enterprise documents on the WaterFix webpage. http://cms.capitoltechsolutions.com/ClientData/CaliforniaWaterFix/uploads/Draft_Final_DCE_Agreement_Combined.pdf

[18] http://baydeltaconservationplan.com/Libraries/Dynamic_Document_Library/Public_Draft_BDCP_Chapter_8_-_Implementation_Costs_and_Funding_Sources.sflb.ashx

included much more extensive habitat restoration – could not demonstrate that it would lead to overall improvement of endangered species to meet the standards of an HCP/NCCP under section 10 of the Endangered Species Act. The WaterFix is attempting to meet a lower regulatory standard for a section 7 consultation under the ESA. In contrast to Section 10's standard of improvement, a Section 7 consultation only requires a finding that the WaterFix is not likely to jeopardize the continued existence of listed species or adversely modify critical habitat. The revised biological assessment prepared by DWR and BOR to support the WaterFix proposal finds that the project is "likely to adversely affect" Delta Smelt, Chinook Salmon and other threatened and endangered species.[19] However, DWR and BOR argue that the harm is insignificant and point to other potential environmental benefits of the project.[20]

Given the section 7 standard and the findings of the biological assessment, it would be reasonable to assign an environmental cost to the WaterFix for benefit-cost analysis. However, both the optimistic and base scenario in this analysis assigns zero environmental cost to the WaterFix, and thus accepts the conclusion of WaterFix proponents that the impacts are insignificant. The assumption of zero environmental costs used in this benefit-cost analysis is favorable to the WaterFix, but maintains this analysis' consistency with environmental documents produced by DWR and BOR to support the proposal. It is important to recognize that the finding of zero environmental cost depends critically on the relatively small water yields in these documents.

While this analysis does not include a pessimistic scenario, it is important to recognize that many fishery experts have stated that the adverse risks to salmon are much larger than reported in the WaterFix environmental documents on which this reports' estimates are based. For example, David Vogel, who has been a principal scientific investigator on dozens of studies of salmon in the Central Valley and Delta for the U.S. Fish and Wildlife Service, Bureau of Reclamation and other agencies, summarized the impacts of the Delta tunnels as follows:

> "the proposed north Delta water diversions are an unprecedented, extremely high-risk experiment with a very high probability of failure for fish protection and an irreversible commitment of resources. Adverse impacts to anadromous fish could potentially be catastrophic."[21]

[19] See Table 7-1, page 7-36 of the Biological Assessment for a summary. http://cms.capitoltechsolutions.com/ClientData/CaliforniaWaterFix/uploads/Ch_7_Effects_Determinations.pdf

[20] See News Release for the Biological Assessment. http://cms.capitoltechsolutions.com/ClientData/CaliforniaWaterFix/uploads/FIX_eBlast_BioAssessment_8216_Rev.pdf

[21] Quote from page 1 of Dave Vogel's comments on the Public Draft BDCP EIR/EIS available at http://www.norcalwater.org/wp-content/uploads/BDCP_Comments-Vogel.pdf

In-Delta Municipal Water Supply Costs

While the WaterFix would improve water quality for South of Delta exporters, the WaterFix would move much of their diversions upstream of some significant existing drinking water intakes in the Delta, including the Contra Costa Water District, City of Stockton, and the Barker Slough intake to the North Bay Aquaduct that serves Solano and Napa counties. As a result of the WaterFix, water quality will be degraded at these municipal intakes. The most frequent concerns raised by these water users are that reduced freshwater flows from the Sacramento River will result in increased salinity, and greater proliferation of biological contaminants such as the bacteria, Microcystis.[22]

On March 29, 2016, the Contra Costa Water District reached a settlement with the Department of Water Resources regarding the water quality impacts of the WaterFix.[23] As a result of the settlement, the export water contractors who benefit from the tunnels will pay the costs of building an intertie between the Contra Costa Water District and the tunnels or allow diversion at another location upstream of the WaterFix intakes. The settlement does not include a cost estimate for these actions to protect water quality for Contra Costa Water District. To get an estimate of implementing the settlement, we spoke to two individuals with knowledge of the Water District facilities and the cost of building similar infrastructure and identified a cost range of $50 million to $150 million.

Solano County estimates moving the Barker Slough intakes to a location upstream of the WaterFix intakes would cost $550 million, a proposal that has been developed independent of the WaterFix effort due to existing water quality challenges at Barker Slough.[24] WaterFix would increase these water quality issues, and therefore increase the need for the new intake. While it would be inaccurate to attribute all of this $550 million cost to the WaterFix, a significant portion of it could be used to represent additional municipal water quality costs. We are unaware of any cost estimates for mitigating water quality impacts to the City of Stockton or other municipal and industrial intakes. Thus, we used the high-end range for Contra Costa Water District settlement costs in the base scenario to represent all in-Delta municipal water supply costs although this would be an understatement if any more than one-fifth of the cost of moving Barker Slough intakes was attributed to the Waterfix. The low-end $50 million cost estimate for the optimistic scenario was spread over the 15 year construction period, resulting in a present value of $37 million. The $150 million cost estimate for the base scenario was modeled as $10 million over 15 years for a present value of $111 million.

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[22] For example, see the Contra Costa Water District on the WaterFix RDEIR/RDEIS http://www.ccwater.com/DocumentCenter/Home/View/1495, and the City of Stockton's protest of the WaterFix to the State Water Resource Control Board http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/noi_protests/docs/cityofstockton_protest.pdf

[23] http://www.ccwater.com/317/Bay-Delta-Conservation-Plan-Comments

[24] http://www.scwa2.com/home/showdocument?id=918

Delta Agriculture Costs

The WaterFix will negatively impact agriculture in the Delta in two primary ways: loss of land to facility construction and mitigation, and water quality degradation. Other potential impacts on Delta agriculture have been identified but are not quantified in this report, including disruption of transportation, dewatering groundwater for construction, and a drop in river levels below intakes.

The estimate of Delta agriculture land lost due to construction of the tunnels comes from the BDCP RDEIR/SDEIS, Table 14-8, which estimates 3,909 acres permanently lost to the facilities and 1,495 acres where production is temporarily disrupted during construction for a total of 5,404 acres of farmland in which production in permanently or temporarily lost. The vast majority of this land is prime farmland in the north and south Delta where agricultural productivity is high. In 2009, these areas averaged $1,949 per acre in revenue according to the Delta Protection Commission Economic Sustainability Plan which equates to $2,150.67 per acre in 2014 dollars. Both the optimistic and base scenarios assume $11.618 million in annual lost revenue during the construction period, and $8.404 million in annual lost revenue after construction is complete in 2031. The present value of these costs for the optimistic scenario is $293,953,421.

Water quality impacts for the optimistic scenario are taken from the Draft Bay Delta Conservation Plan Statewide Economic Impact Report.[25] In this report, BDCP consultants estimated $1.86 million in annual revenue loss due to water quality degradation using water quality modeling conducted for the BDCP that showed salinity increases of a few percentage points in select locations and model of salinity impacts on Delta crop production developed for the Delta Protection Commission Economic Sustainability Plan. When combined with the decline in revenue from land loss, the total Delta agricultural revenue loss in the optimistic scenario after the construction period is $10.324 million annually in 2014 dollars.

Similar to the case of in-Delta municipal water quality impacts, opponents of the WaterFix are strongly contesting the water quality predictions made in the WaterFix environmental documents for Delta agriculture. In addition, it should be noted that while the California Department of Water Resources has told the State Water Resource Control Board (SWRCB) that the project will comply with water quality regulations in the Delta, in a separate application before the SWRCB, the Department of Water Resources is proposing a 41% increase in growing season salinity standards in the Delta from 0.7 mS/cm to 1.0 mS/cm.[26] At this point, there is no generally accepted prediction of water quality impacts, but it is reasonable to assume that WaterFix proponents will take advantage of at least some of the relaxation in agricultural water

[25] Draft Bay Delta Conservation Plan Statewide Economic Impact Report. August 2013. Jonathan Hecht, ICF International and David Sunding, The Brattle Group.

[26] Review of the San Joaquin River Flow and Southern Delta Water Quality Objectives and Program of Implementation (Phase I of the Bay-Delta Effort) http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/index.shtml

quality standards they are seeking. Thus, the base scenario assumes only a 25% increase in salinity of Delta irrigation water over historical conditions even though the standards proposed by the Department of Water Resources would allow for even larger increases. Using the model of salinity impacts on Delta crop production developed for the Delta Protection Commission Economic Sustainability Plan, the base scenario predicts a $26.301 million decline in agricultural revenue in 2014 dollars. When combined with the declines from land loss, the base scenario projects $11.619 million dollars in annual agricultural revenue losses during the construction period, and a total of $34.705 million in annual agricultural revenue losses after tunnel construction is complete in 2031. The present value of these costs for the base scenario is $682,807,143.

Transportation Disruption Costs

The $15 billion tunnels construction project will have substantial impacts on the Delta's rural road network, significantly altering other commercial activity and the quality of life over an estimated 15 year construction period. The Draft BDCP Statewide Economic Impact Report quantified some of these effects by estimating the cost of traffic delays on state highways in the Delta. It estimates construction generated traffic delay costs could reach $28 million in some years. In particular, the report estimates large increases in vehicle counts on State Route 4 in San Joaquin County and State Route 160 in Sacramento County. Vehicle counts on State Route 4 at 7 A.M. are estimated to increase 50%, and vehicle counts for SR 160 at 7 A.M. are estimated to more than double. State Route 4 accounts for most of the delay costs as it is a busy road that includes the main access for trucks into the Port of Stockton from I-5, as well as the movement of people and equipment for local agricultural operations, movement of people between Stockton and Contra Costa County communities such as Discovery Bay and Brentwood. SR 160 is not as busy as SR 4, but is a scenic route connecting most of the Delta's legacy communities, and heavy construction traffic will not only cause local delays but disrupt the Delta's recreation and tourism economy. Both the optimistic and base scenarios apply the delay costs from the Draft BDCP Statewide Economic Impact Report from 2013 to the updated construction scenario in this report, and find the present value of costs of $132.2 million. This is a conservative estimate that does not account for transportation impacts on local roads in the Delta.

Other Unquantified Costs

There are several other costs to the project that are not quantified in this analysis. Among the most important of these are negative impacts on Delta recreation and tourism, and risks to water supplies for upstream water interests. Some of the most significant costs on Delta recreation are described in the following excerpt from Steamboat Resort's protest to the WaterFix.

> "Construction of the intake facilities will result in barge traffic and restricted boating zones that will directly conflict with recreational uses for the duration of the construction period, an estimated 14 years. Continuous barge traffic will essentially make boating recreation dangerous. A significant amount of boaters utilize the Sacramento River near to and downstream of the intakes along the proposed barge routes in the summer and peak fishing periods. Barge traffic will make the river extremely congested to the point where it will turn people away from recreating in the areas of the Delta where construction is taking place for a significant amount of time. The noise impacts from construction, primarily pile driving, will also deter tourism and recreational users."[27]

Water users upstream of the Delta in the Sacramento and San Joaquin Valleys are also protesting the WaterFix, because they believe their upstream water diversions could be reduced to provide greater freshwater flows into the Delta to compensate for the WaterFix reducing incoming freshwater flows from the Sacramento River. For example, the North State Water Alliance representing water users in the watershed of the Sacramento River states:

> "The California Water Fix appears to be designed to require additional flows into the Delta that would directly reduce available water supplies, both surface and groundwater, for the north state's economy and environment."[28]

San Joaquin Tributaries Association and Friant Water Users have also protested the WaterFix, because of the potential impact on water supplies for their members upstream of the Delta in the watershed of the San Joaquin River.

Benefit-Cost Results and Conclusion

Table 2 summarizes the benefits and costs detailed in the previous section. The results clearly show that the WaterFix is not economically justified under both the base and optimistic scenarios. The base scenario finds a net present value of less than -$10 billion, and a benefit-cost ratio of 0.23. That means the WaterFix is estimated to provide only 23 cents of benefits for each dollar of cost. Using an optimistic set of study assumptions where all values of benefits and costs are taken from reports produced to advocate for the WaterFix, the net present value is -$7.8 billion and the benefit-cost ratio only increases to 0.39. Thus, under optimistic assumptions, costs are still more than 2.5 times larger than benefits.

This report does not include a pessimistic scenario, and many key assumptions were structured in ways that benefit the Water Fix. This analysis uses a long 100 year operation period for benefits, does not consider the possibility of construction cost overruns, uses a low discount

[27] WaterFix Protest of Steamboat Resort to the State Water Resource Control Board Division of Water Rights. http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/noi_protests/docs/sbr_protest.pdf

[28] http://northstatewater.org/assets/nemethwaterfix.lettercommentsoct2015.pdf

rate, and does not consider the potential for environmental damage. The analysis does not quantify several important costs such as negative impacts on Delta recreation, upstream water users, and transportation impacts on local roads, or include all in-Delta municipal water supply impacts. Third party impacts to the Delta region are conservatively estimated.

Table 3. Present Value of Benefits and Costs of Delta Tunnels Through the Year 2131. Includes 15 years of construction, and 100 years of operation. Values are in 2014 dollars, using a 3.5% discount rate consistent with recommendations of California Water Commission.

	Base scenario	Optimistic Scenario
Benefits		
Export Water Supply	$1,319,521,208	$2,822,409,124
Export Water Quality	$1,677,361,307	$1,677,361,307
Earthquake Risk Reduction	$0	$435,796,554
Total Benefits	*$2,996,882,515*	*$4,935,566,984*
Costs		
Construction and Mitigation	$11,676,474,531	$11,676,474,531
Operation and Maintenance	$591,658,075	$591,658,075
Ecosystem	$0	$0
In-Delta Municipal	$111,279,332	$37,093,107
In-Delta Agriculture	$682,807,143	$293,953,421
In-Delta Transportation	$132,205,755	$132,205,755
Total Costs	*$13,194,424,836*	*$12,731,384,889*
Net Benefit	($10,197,542,281)	($7,795,817,905)
Benefit/Cost ratio	**0.23**	**0.39**

The primary economic problem for the WaterFix is its low water yield relative to its $16 billion construction cost. The results of the base scenario analysis show the WaterFix could only be economically justified if its construction and mitigation costs were below $2 billion or if its water yield could be increased from an annual average of 225,000 acre feet per year to about 2 million acre feet per year without negatively impacting the environment or causing any additional harm to other water users.

The WaterFix has the physical capacity to increase water exports more than the constrained operations assumed in the current proposal, and many project opponents fear that the economic demands created by project financing could result in much higher exports that harm the environment and Delta communities. This report shows the concern of project opponents is well justified, and raises questions as to why state and federal water agencies are seeking environmental approval for the WaterFix without a benefit-cost and financial feasibility analysis consistent with the operating assumptions it is using to obtain regulatory approval.

Appendix: Financing Challenges

This benefit-cost report is not a financial feasibility analysis, but the results have important implications for financial feasibility. For instance, the benefit-cost results can be focused to look only at the benefits and costs to the water exporters to analyze their return on investment. If only the benefits and costs to water exporters who would pay for the tunnels are considered (all the benefits and the first two cost categories in Table 3) the costs still exceed benefits by more than $7 billion in the most optimistic scenario. While this demonstrates that building the tunnels is not in their ratepayers' best interest, some export water agency executives and political leaders will still want to finance and build the WaterFix. A benefit-cost ratio below one reflects a poor return on investment, but does not mean that water agencies do not have the financial capacity to make the investment.

Despite a decade of planning for the tunnels, a financial assessment or detailed financial plan has never been released for either the BDCP or the WaterFix. The most detailed analysis of financial issues was conducted by Blue Sky Consulting in 2014 for the California State Treasurer's Office.[29] The report analyzed the tunnels as described in the 2013 BDCP, and in its base scenario estimated over $20 billion in bonds would be needed to finance the project, resulting in over $1.5 billion in annual debt service payments. The report did not analyze the WaterFix proposal, and thus did not consider the increase in costs and construction time from 10 years to nearly 15 years, reduced water yields and loss of regulatory assurance from the transition from BDCP to WaterFix. Despite using an analysis that overestimated farmers' capacity to pay,[30] the Blue Sky Consulting found substantial challenges and financial changes that would be needed for agricultural CVP contractors.

> "Even if the CVP contractors develop a new credit with a take-or-pay obligation and similar credit features of DWR bonds, it is not clear at this point whether $10.25 billion of bonds (assuming a 50/50 split) in the Base Case could reasonably be issued without a large rate stabilization fund or other credit enhancement or subsidy from the federal government, state government, or SWP contractors." (page 8)

The financial challenges for the WaterFix go beyond the poor return on investment described in the benefit-cost analysis, and the potential need for new contract provisions and subsidies as found in the Blue Sky Consulting report. Below is a brief list of additional financial challenges that will have to be addressed before bonds can be issued to finance construction of the tunnels.

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[29] Blue Sky Consulting. 2014. "The Bay Delta Conveyance Facility: Affordability and Financing Considerations" http://baydeltaconservationplan.com/Libraries/Dynamic_Document_Library/Bay_Delta_Conveyance_Facility-Affordability_and_Financing_Considerations_Report_11-14-14.sflb.ashx

[30] For more detailed reviews of the Blue Sky Consulting Analysis, see http://valleyecon.blogspot.com/2015/02/treasurers-report-on-delta-tunnels.html, and http://hydrowonk.com/blog/2014/12/10/is-bdcp-a-doable-deal-redux-part-2/

- **Cost allocation**: Proponents say that "costs will follow water", and this is consistent with California Proposition 218. However, most of the water from the tunnels and thus most of the cost under this scenario goes to agricultural users who receive lower benefits from the tunnels and have the least capacity to pay.

- **Making debt payments during droughts:** As demonstrated in recent years, the revenue of water agencies decline substantially during droughts, but fixed costs such as debt service must be paid. The WaterFix will not significantly enhance water supplies during droughts, but will greatly increase agencies' costs during drought years. Bond investors will require some protections to ensure they are paid during a drought. For example, they could require a significant drought contingency reserve to be funded up front or a general taxpayer guarantee.

- **Step-up provisions for cost overruns or default:** The $16 billion cost estimate represents only 10% design. It is not unusual for costs of tunneling projects to escalate significantly once underway. A financial plan will have to identify which agencies or entities will be responsible for cost-overruns and step-up to pay more in the case that other agencies do not meet their financial obligations.

- **Credit Quality of Agricultural Agencies:** Many of the agricultural agencies involved in the project do not have significant experience with large revenue bond issues and may not have a credit rating. Recently, the largest agricultural water agency, Westlands Water District, was found by the Securities and Exchange Commission to be misleading investors, becoming only the 2nd municipal bond issuer to be finded by the SEC.[31]

- **Legal Challenge to Using Property Taxes Without a Public Vote:** Many water agencies expect to pay part of their share of the WaterFix costs with property taxes, and argue that they can levy these taxes without a new vote because the WaterFix is part of the State Water Project already authorized by California voters in 1960. The Howard Jarvis Taxpayers Association and others have challenged this interpretation, and the ability of water agencies to use property taxes to pay for the WaterFix is almost certainly headed to court.

- **Proposition 53 on the Fall 2016 ballot:** Proposition 53 would require voter approval before the state could be involved in issues certain revenue bonds over $2 billion. If Proposition 53 passes, the WaterFix bonds would have to be approved in a statewide vote. Currently, there is no such requirement.

- **Impact of Tunnels Debt on Other Projects:** Many water agencies are planning extensive capital investments in the near future, and have environmental obligations that are not yet funded. Issuing $20 billion in bonds for Delta tunnels could impact the cost and capacity of water agencies to fund these other initiatives.

[31] https://www.sec.gov/news/pressrelease/2016-43.html