Review of Delta Conveyance Project Benefit-Cost Analysis: Implications for Decision-Makers and Financing

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Table of Contents

Executive Summary 3
1. Background and Context for the Delta Conveyance Project Benefit-Cost Analysis 6
1.1. Benefit Cost Analysis, Financial Planning and Decision-Making 6
1.2. Key Differences Between the DCP and WaterFix 9
1.3. Comparison to Previous Analysis of Single-Tunnel Staged WaterFix Proposal 10
2. Extreme Assumptions Regarding Project Lifespan and Discount Rates 11
2.A. Unusually Long Project Lifespan Assumption 12
2.B. Unusually Low Discount Rate 12
3. Overvaluation of Benefits 14
3.1 Overvaluation of Urban Water Supply Benefits 14
3.1.1 Market-based Water Valuations Are Much Lower 15
3.1.3 Increases Water Supply Value By Over 40% ($750/AF, 2023$) from WaterFix Reports Despite Declining Demand 18
3.1.4 Cost of Alternative Water Supplies Also Yield Lower Values 19
3.2 Overvaluation of Agricultural Water Supply Benefits 20
3.3 Seismic Risk Reduction Benefits Are Low, But Still Grossly Overestimated Due To A Calculation Error 21
4. Omitted Environmental Costs 23
5. Major Project Risks Not Considered in Sensitivity Analysis 24
6. Other Considerations: Financial Plans and Comparative Costs 25
6.1 Incorrect Cost Comparisons in DWR Promotional Materials 25
6.2 Implications for Financial Plans 25
6.2.1 Responsibility for Risks, such as Construction Cost Escalation, is not Assigned or Analyzed 26
6.2.2 Remaining Agricultural Users Are Likely To Opt-Out Or Default 26
6.2.3 Timing and Scale is Mismatched with MWD'S Long-run Financial Plan 27
Appendix: Comparison to Previous WaterFix Analyses 29

Executive Summary

At its recent estimated cost of $20.1 billion (2023$),[1] the Delta Conveyance Project (DCP) is an enormous financial commitment for water agencies facing increasing constraints on their customers' ability to pay. The Department of Water Resources (DWR) claims its latest benefit-cost analysis of the DCP (2024 BCA or benefit-cost analysis) [2] supports a decision to build the DCP, because the analysis has a benefit-cost ratio of 2.2. This review finds the benefit-cost ratio is inflated and unreliable. However, before reviewing the numbers and assumptions, it is important to understand how to interpret a benefit-cost analysis and the insights these analyses provide to finance, planning, and decision-making.

A benefit-cost ratio is a tool that ranks alternatives. A benefit-cost ratio below one indicates a bad investment regardless of how alternatives perform, but a benefit-cost ratio above one is only meaningful in comparison to alternatives. The 2024 BCA analysis does not consider any other alternatives, and thus the summative benefit-cost ratio of 2.2 does not indicate it is a good investment. Any water supply alternative would have a high benefit-cost ratio if evaluated under the generous valuations and assumptions of DWR's 2024 BCA. Nevertheless, the report does provide useful information on the comparative scale of benefit categories that has implications for project finance and long-range planning. Accepting the inflated benefit estimates, there are still three important conclusions that can be drawn from examining the materials provided in the 2024 BCA.

1. For agriculture, the benefit-cost ratio is only 0.39, an estimated 39 cents in benefits for farmers for each $1 in cost.
    - Implication: Farmers will likely opt-out or default. Thus, the DCP should be viewed as an urban only project, and the Metropolitan Water District (MWD) would likely pay 75% of its costs -not 47% as currently planned. Other urban State Water Project water agencies will also likely see their cost shares rise by about 60%.
2. The Seismic reliability benefits are relatively small.
    - Implication: Seismic risk reduction is a poor justification for the DCP, and there are less costly and controversial ways to address the risk.
3. Water supply accounts for almost all of the DCP's benefits.
    - Implication: MWD (and other State Water Project agencies) should evaluate the DCP like any other water supply project in the context of their long term water planning.

[1] https://www.dcdca.org/wp-content/uploads/2024/05/2023-Bethany-Total-Project-Cost-Estimate.pdf

[2] Sunding, D., Browne, O. (2024) *Benefit-Cost Analysis of the Delta Conveyance Project*. Department of Water Resources. https://water.ca.gov/-/media/DWR%20Website/Web%20Pages/Programs/Delta%20Conveyance/Public%20Information/DCP%20Benefit-Cost%20Analysis%202024-05-13__ADA.pdf

In the critical case of MWD, it should evaluate the DCP as part of its Climate Action Master Plan for Water[3] (CAMP4W) process. CAMP4W is structured around adaptive management with incremental investment decisions made at 5-year intervals. This incremental approach is sensible, because only one of the four future scenarios requires any major development of new water supplies at all, including conservation programs. To address the unlikely event that CAMP4W's high-demand "Scenario D" turns out to be the future, the plan identifies potential investments, but does not move ahead unless or until specified "signposts" reflecting current conditions warrant such investments.

MWD's Long-Range Finance Plan – Needs Assessment projects that meeting the water supply needs of the high-demand Scenario D would require $15 billion in capital investment over 20 years that would add 500,000 acre-feet (AF) of new water supply and 250,000 AF of new storage. In comparison, a 75% share in the DCP would supply only 60% of the required water supply and 0% of the required storage for the full Scenario D capital investment. In essence, if MWD chooses to commit financing now to the DCP, it is essentially abandoning its own CAMP4W framework in favor of a premature bet on the unlikely "Scenario D" growth projection, putting the entire projected $15 billion capital investment into a single risky and potentially unnecessary project.

So how does DWR's benefit-cost analysis for the DCP arrive at a surprising 2.2 benefit-cost ratio for such a questionable investment? This report reviews the details and finds the conclusion is based on a series of unjustified, optimistic assumptions that compound into a grossly inflated valuation of benefits. Specifically, the BCA:

- Inflates urban water supply values by assuming extreme demand growth, including a stunning 2.8 million new households on single-family lots by 2045 in MWD service area. The result is a projection of extreme future water shortages that drives excessive water supply values in their methodology.
- Includes an optimistic (100 year) assessment of project lifespan, resulting in an extended benefit evaluation to year 2144 while applying low capital replacement costs and extremely low (sub-2%) discount rates.
- Ignores largest sources of project risk in its sensitivity analysis: cost escalation, lower water demand, endangered species regulation, lifespan and interest rates.
- Ignores impacts on salmon and other threatened and endangered fish species.

DWR and the Delta conveyance Design and Construction authority (DCA) have compounded the flaws in the BCA with misleading public relations materials.[4] For example, in some of its online materials DWR features an erroneous cost comparison that uses a levelized cost per acre foot cost

[3] Metropolitan Water District of Southern California. *Climate Adaptation Master Plan for Water – Draft Year One Progress Report and Next Steps*. https://mwdh2o.legistar.com/View.ashx?M=F&ID=12917603&GUID=B5ECAF7D-1B1B-4FA9-8995-6A4253F07E7D

[4] Dept. of Water Resources. (2024) *Understanding Costs, Benefits, Funding, and Financing for the Delta Conveyance Project*. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Delta-Conveyance/Public-Information/DCP_CostFunding_FAQ_2024.pdf; Dept. of Water Resources (2024). *Analysis: Benefits of the Delta Conveyance Project Far Exceeds Costs*. May 2024. https://water.ca.gov/News/News-Releases/2024/May-24/Benefits-of-the-Delta-Conveyance-Project-Far-Exceed-Costs

for the DCP based on a 100-year operating period and sub 2% interest rates and compares it to alternative water supply costs from other studies that used 25-50 year life spans, and interest rates 2-3 times higher. If a levelized cost of DCP water supplies is calculated with comparable time horizons and interest rates that were used for calculating other water supply sources, the DCP water supply costs are $3,000 to $5,000 per acre foot plus conveyance costs from the Delta, higher than other water supply alternatives.

1. Background and Context for the Delta Conveyance Project Benefit-Cost Analysis

Background and context are critical in assessing the ultimate decision as to whether to build the DCP, and in evaluating the accuracy and usefulness of the May, 16 2024 "Benefit-Cost Analysis of the Delta Conveyance Project" prepared by the Berkeley Research Group (2024 BCA). This section provides general background on benefit-cost analysis and current planning processes, highlights important differences between the earlier (2013-2019) Twin-Tunnel WaterFix proposal and the current single-tunnel DCP proposal (2020-present), and compares a 2018 BCA of a single-tunnel WaterFix option by the same consultants to the 2024 BCA of the DCP. The Appendix reviews four previous analyses of Delta tunnel proposals by the same consultants to show how their analyses and valuations have changed over time.

1.1. Benefit Cost Analysis, Financial Planning and Decision-Making

A benefit-cost ratio is a tool used to rank alternatives. While a benefit-cost ratio below one generally shows a project is not worth the costs regardless of alternatives, a benefit-cost ratio above one does not mean a project is the best option, it only shows the project exceeded a minimal threshold. The 2024 DCP BCA does not consider any alternatives, and thus the summative benefit-cost ratio of 2.2 is not very meaningful. As explained in later sections of this review, every water supply alternative would have an extremely high benefit-cost ratio if evaluated under the generous valuations and assumptions of DWR's 2024 BCA.

Benefit-cost analyses also provides important insights that go beyond supporting a yes or no decision or alternative rankings. Even if there are concerns that benefits are exaggerated (as in the case of the 2024 BCA), it can still provide useful information on the comparative scale of benefit categories which inform key financial planning issues such as cost-sharing and risk assessment. For example, do benefits exceed costs for all project participants? For the DCP, a key question is does it make sense for agricultural users (such as the Kern County Water Agency), and can they pay their cost share?

For a $20 billion mega-project paid for by a large group of water agencies like the DCP, the cost-share of a participating agency can rise substantially if other participants decide to opt-out or are unable to pay their full share. As described later in this review, agricultural users currently represent about 3/8 of the estimated users of the DCP and their estimated benefits fall far short of their estimated cost share. It is highly likely that most of the agricultural share of the DCP will shift to the urban users that currently represent the remaining 5/8 of the project. While those urban users have more ability and willingness-to-pay for water, they also have more water supply alternatives and are experiencing declining water demand as efficiency increases and the California population is no longer growing. When a benefit-cost analysis only looks at one alternative, as in the case for the 2024 DCP BCA, and there is a strong likelihood that urban agencies' shares will rise, it is critical for decision-makers at urban water agencies to adjust the analysis to fit the framework they are using for long-range decision-making about alternative water supply investments.

The Metropolitan Water District (MWD) is paying 47.4% of DCP planning costs, proportional to its overall share of SWP water supply, but it makes up 75-80% of the total urban water supply share of the State Water Project. Given most agricultural agencies are likely to opt-out of the DCP, its ratepayers are likely to ultimately pay for the majority of the DCP. MWD is evaluating future investments through its Climate Adaptation Master Plan for Water (CAMP4W). Water supply investment decisions in CAMP4W, ranging broadly from conservation programs to desalination, are to be adjusted at 5-year intervals in an adaptive management process based on real-world conditions, including climate, financial capacity, and updated projections of need. The framework identifies potential investments before each 5-year decision point, and then makes Go/No-go decisions on projects with 5 to10 year implementation periods. Figure 1 below illustrates CAMP4W's incremental Adaptive Management Process for investment decisions.

Figure 1. MWD's CAMP4W Adaptive Management Process Visualization. (Source: Figure 2-2 in CAMP4W Year One Progress Report, May 14, 2024.)[5]

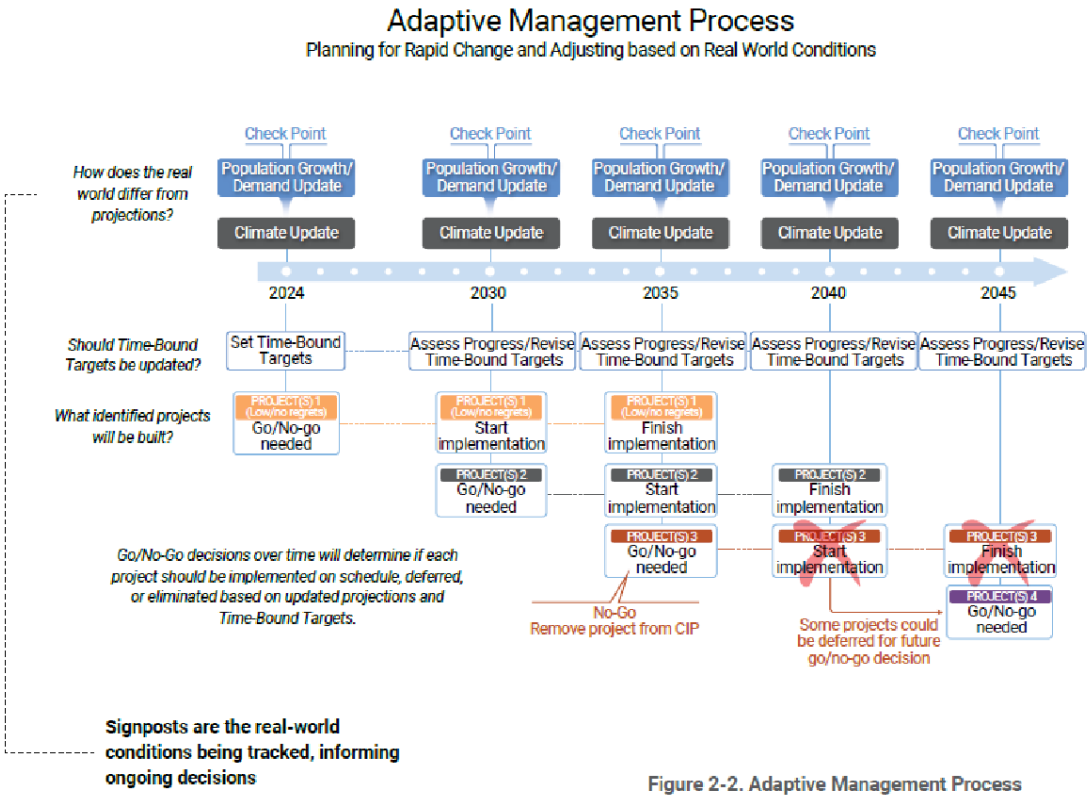


Figure 2-2. Adaptive Management Process

The CAMP4W process is informed by four scenarios of future conditions developed under its 2020 Integrated Resource Plan Needs Assessment (IRP-NA). As shown in Figure 2 below, three of the four scenarios require little to no investment in new water supply or storage, with a maximum of 100,000 AF of new supply, even without new storage. Only Scenario D, reflecting a shift to high-demand growth and significant reduction in imported supply, requires new supply investment estimated at 500,000 AF of new core supply and 250,000 AF of new storage by 2045. If future conditions were to move to the Scenario D path and stay there for each five-year interval, MWD's

[5] Pg. 24 of 47 https://www.mwdh2o.com/media/pf1dwsbs/05142024-fam-8-3-b-l.pdf?keywords=Year%20One%20Progress%20Report

Long-Range Finance Plan – Needs Assesment (LRFP-NA) estimates up to $15 billion in new capital will be required over the next twenty years.

Figure 2: CAMP4W IRP Scenarios Visualization. (Source: Table 1 in CAMP4W Year One Progress Report, May 14, 2024)[6]

Table 1: How Much Core Supply Do We Need Based on How Much Storage We Develop?

If we build this much storage...	We will need this much additional core supply... (conservation reduces demands and "counts" toward core supply needs)			
	IRP Scenario A	IRP Scenario B	IRP Scenario C	IRP Scenario D
0 TAF	No supply or storage requirements	100 TAF	50 TAF	650 TAF
100 TAF		70 TAF	15 TAF	600 TAF
250 TAF		30 TAF	15 TAF	550 TAF
500 TAF		30 TAF	15 TAF	500 TAF

** TAF=thousand acre-feet; 1 acre-foot is the amount of water that would cover an acre of land at 1-foot depth*

It is very challenging, if not impossible, to integrate the DCP into this framework because of its long timeline, and immense cost and scale. The DCP is a 20-year implementation project, and investment decisions would need to be made very soon for it to be operational by 2045. And for this reason, it does not fit the timelines and flexible approach of the CAMP4W adaptive management plan.

More importantly, the DCP has an immense cost and scale: a $20 billion price tag that is estimated to generate about 400,000 af of additional water supply annually.[7] If agricultural users drop out, MWD's share would likely increase to at least 75% of the DCP, approximately $15 billion. A $15 billion investment in DCP would absorb all of MWD's maximum projected capital spending in the LRRP-NA. So in return for a 75%/$15 billion investment, the DCP is projected to result in 300,000 AF of water, 60% of the core water supply and 0% of the storage that MWD's LRFP-NA projects are needed for Scenario D and which MWD estimates could be obtained for $15 billion investment in incremental supply and storage projects. Of course, if the future matches the lower-growth Scenarios A, B, or C in the LRFP-NA (scenarios that are more consistent with current demographic and water demand trends) the DCP would represent a massive overinvestment with severe ratepayer impacts. Rather than investing in incremental projects to protect against overspending, the DCP costs would come in one massive chunk with a long implementation time. In essence, an MWD choice to commit financing to the DCP would essentially mean abandoning the CAMP4W

[6] Draft Climate Adaptation Master Plan for Water Year One Progress Report, Pg. 20 of 47, https://www.mwdh2o.com/media/pf1dwsbs/05142024-fam-8-3-b-l.pdf?keywords=Year%20One%20Progress%20Report

[7] DWR BCA pg. 9, https://water.ca.gov/-/media/DWR%20Website/Web%20Pages/Programs/Delta%20Conveyance/Public%20Information/DCP%20Benefit-Cost%20Analysis%202024-05-13__ADA.pdf

framework in favor of an early 20-year bet on "Scenario D" with all of its projected $15 billion capital investment directed into a single risky project.

Other conservation and water supply and storage projects under consideration by MWD have scale and timelines that fit within the CAMP4W planning process. By far, the largest alternative project is Pure Water, and while its scale is very large (over 100,000 AF water, and $6+ billion), it can be phased-in, unlike the DCP and the choice to invest in later phases would be under MWD's control. While Pure Water's scale does not easily fit into the CAMP4W adaptive management plan, its scale and timelines are one-half to one-third the DCP.

1.2. Key Differences Between the DCP and WaterFix

The obvious physical changes between the WaterFix and the DCP (one tunnel/two tunnels, tunnel route) are less important to the economic analysis than the operational changes in the projects as described in their respective Environmental Impact Reports (EIR).[8] The DCP operations analyzed in the EIR and used in the 2024 BCA make no changes to the use of the existing south Delta intakes, simply adding new north Delta intakes to divert additional water from the Sacramento River.

In contrast to the DCP's business-as-usual approach to the existing south Delta intakes, the prior WaterFix proposal reduced use of the south Delta pumps, shifting water diversions from the south to the proposed new intakes in the north. WaterFix operations included an environmentally beneficial commitment to reduce reverse flows in the Delta by curtailing use of the south Delta pumps, but this additional environmental protection came at the expense of water supplies. In WaterFix, most north Delta diversions were replacing reduced south Delta diversions, whereas with DCP, north Delta diversions are in addition to existing diversions in the south Delta. Thus, the DCP proposal increases water supply by more than the WaterFix even though the physical infrastructure is reduced and is used less frequently.

Physically, DCP downsizes the WaterFix from twin-tunnels 40 miles in length to a single-tunnel 45 miles in length. Other physical changes include: (a) the reduction in water intakes on the Sacramento River from three to two, (b) reduction in total conveyance capacity from 9,000 cfs to 6,000 cfs, (c) an adjustment in tunnel alignment to the east with a terminus at Bethany reservoir instead of Clifton Court forebay, (d) and a larger pumping plant because the twin-tunnels were partially reliant on gravity-conveyance. The change in physical design results in a slight reduction in environmental impacts in the Delta from construction, but does not result in a substantial change of the construction cost estimate.

The final important difference is the participating water agencies which is related to the operational differences. The WaterFix proposal included both the State Water Project (SWP) and the federal Central Valley Project (CVP), whereas the single-tunnel DCP is an SWP-only project. The CVP primarily serves agricultural users, and the largest agricultural CVP agency voted against paying for the WaterFix in 2017. The CVP agencies declined to participate in the DCP plan due to costs in

[8] Final EIR for the WaterFix (https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/exhibit102/docs/vol1/Introduction_to_Final_EIR-EIS.pdf)
Final EIR for the DCP (https://www.deltaconveyanceproject.com/planning-processes/california-environmental-quality-act/final-eir)

comparison to relatively small and uncertain water supply benefits. Table 1 illustrates key differences between the DCP and WaterFix according to the final EIRs for each project.

Table 1. Differences between DCP and WaterFix

	WaterFix (SWP + CVP)	DCP (SWP only)
Construction Cost	$16.73 bil (2017$) $20.8 bil (2023$)	$20.12 bil (2023$)
# of tunnels	2	1
# of new north Delta intakes	3	2
Conveyance Capacity (cubic feet per second, cfs)	9,000	6,000
Project adds new environmental restrictions on south Delta pumping to reduce reverse flows	Yes (EIR) No (Econ BCA)	No
Yield, Increase in Water Supply (taf)	172 (EIR) 1,002 (Econ BCA)	403

Note: The WaterFix EIR and economic analysis had different assumptions about Delta pumping regulations with and without the project which resulted in substantial differences in water yields between the two analyses. For the DCP, the EIR and the BCA have consistent operations.

1.3. Comparison to Previous Analysis of Single-Tunnel Staged WaterFix Proposal

The same consultants have led multiple economic assessments of Delta tunnel(s) proposals, including the Twin-Tunnels proposed as part of the Bay Delta Conservation Plan (BDCP), and multiple iterations of the so-called WaterFix. The Appendix to this report reviews the structure of their analyses over time and shows that the consultants added favorable assumptions to increase the project's estimated benefits as the real-world economics of the project have become more unfavorable.

While WaterFix was primarily a two-tunnel proposal, a single-tunnel phased approach was considered for several months after the Westlands Water District, the CVP's largest agricultural water agency, voted against investing in its share of the WaterFix and the participation of the CVP seemed unlikely. In February 2018, the consultants did a benefit-cost analysis of the single-tunnel option that had the same 6,000 cfs conveyance capacity as the current DCP proposal. The single-tunnel WaterFix analysis removed the south Delta reverse flow restrictions from the project description (referenced above in Table 1) to increase the water yield.

Table 2 compares the 2018 single-tunnel WaterFix analysis to the current 2024 DCP BCA. It shows the costs of the current DCP was estimated to be $6.3 billion more in 2023$ than the Stage 1 WaterFix, an increase of 46%. In addition, the water yield of the DCP is less than half of what was estimated for WaterFix Stage 1 in the February 2018 analysis.

With costs 46% higher, and water supply over 50% lower, it seems clear that DCP would have a substantially lower benefit-cost ratio than the single-tunnel WaterFix. Instead, the consultants

found a much higher overall benefit-cost ratio for the DCP. The benefit-cost ratio for agriculture dropped as expected, the large increase in cost and decrease in water supply offset the boost from a lower-discount rate. The agricultural benefit-cost ratio dropped from 1.03 to 0.39 or 39 cents of return for each $1 invested. In contrast, the urban benefit-cost ratio soared from 1.29 to 3.28 despite the DCP's higher costs and lower water supply.

Contrasting these two reports makes clear that the consultants change their analysis to increase benefits. The next sections of the report explain in detail how the 2024 BCA overestimates the benefits of a delta tunnel.

Table 2. Comparing DWR Consultants' Analyses of Single-Tunnel, 6,000cfs, Delta Conveyance Proposals.

	Feb 2018 WaterFix, Stage 1 (SWP only scenario)	**May 2024 DCP**
Estimated Annual Water Yield (AF)	864,000 Total 574,000 Urban 290,000 Agriculture	403,000 Total 254,500 Urban 148,500 Agriculture
Construction Costs	$11.09 bil (2017$) $13.79 bil (2023$)	$20.12 bil (2023$)
Benefit-cost ratio	1.2 Total 1.29 Urban 1.03 Agriculture	2.2 Total 3.28 Urban 0.39 Agriculture
Discount Rate (both reports assume 100-years of operations)	3% (all years)	2% (2023-2079) declining over time to 1.4% in 2135
Metropolitan Water District Region Total Demand Forecast (actual was 3.4 MAF in 2015)	3.7 MAF in 2050 Source: Metropolitan Water District Econometric Demand Model (MWD–EDM)	4.4 MAF in 2045 Source: MWD IRP-Needs Analysis Scenario D (High Demand, Reduced Imports)

2. Extreme Assumptions Regarding Project Lifespan and Discount Rates

Project lifespan and discounting assumptions are critical to the evaluation of projects like the DCP that have lengthy construction periods and lifespans. The 2024 BCA makes an unusually optimistic 100-year lifespan assumption on project benefits that is amplified by an unusually low discount rate, especially for a project with a high-risk profile.

2.A. Unusually Long Project Lifespan Assumption

Economic analysis of infrastructure projects is based on the project's expected usable life. Given the uncertainty of usable life and importance of financial planning, assessments are sometimes based on expected repayment period of project financing. Recent analysis of the cost of various water supply investment options by the Pacific Institute and PPIC utilized lifespans between 25 and 50 years for projects such as water recycling and desalination plants.[9]

As shown in the Appendix to this report, the consultants initially used a conventional 50-year project lifespan for benefit-cost analysis for delta tunnels in the BDCP and WaterFix. The consultants first introduced a 100-year project lifespan for the February 2018 analysis of the single-tunnel Phase 1 WaterFix when it was clear that benefits would not exceed costs in a 50-year analysis, as the ratio barely exceeded one when assuming 100 years of benefits. DWR's economic analyses of delta tunnel proposals have maintained the 100-year lifespan ever since.

With the SWP itself now in service for 50 years, it can be argued that longer lifespans should be considered for a project like the DCP. However, when combined with extremely low discount rates as discussed below, project lifespan is a critical assumption that should be included in the sensitivity analysis. In addition, it is important that maintenance and capital replacement costs included in operating and maintenance costs are sufficient to support the extended period. Costs for Capital Replacement for the DCP appear low for a 100-year lifespan, as its 100-year cumulative capital replacement cost budget would be insufficient to replace the pumping plant alone.[10] Finally, it is important that calculations from this report with a 100-year lifespan are not directly compared to calculations from reports prepared regarding the costs of alternative water supplies that assume much longer lifespans; DWR has already made this error in its 2024 BCA summary and PR materials.

2.B. Unusually Low Discount Rate

Discount rates are utilized in benefit-cost analyses to account for costs and benefits that occur at different points in time and reflect the time value of money and social rate of time preference. Since benefit and costs estimates already account for inflation and are calculated in constant dollars (2023 dollars in this case), discount rates are often based on real (inflation-adjusted) interest rates for government borrowing. Real interest rates have declined over time, and it is now common for benefit-cost analysis to incorporate much lower discount rates than the 6% to 7% rates that were common twenty to thirty years ago. During the past decade, the California Water Commission (CWC) recommended a 3.5% discount rate in valuing public benefits of water storage projects it was evaluating,[11] and the Public Policy Institute of California (PPIC) has also used a 3.5%

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[9] PPIC Report *Water Partnerships between Cities and Farms in Southern California and the San Joaquin Valley*. pg.8, https://www.ppic.org/wp-content/uploads/1020aer-appendix-b.pdfpg.

[10] BCA, Pg. 47, https://water.ca.gov/-/media/DWR%20Website/Web%20Pages/Programs/Delta%20Conveyance/Public%20Information/DCP%20Benefit-Cost%20Analysis%202024-05-13__ADA.pdf

[11] Water Storage Investment Program Technical Reference. California Water Commission. November 2016. page 5-5

discount rate in recent analysis of water infrastructure projects.[12] In previous benefit-cost analysis of the WaterFix, the consultants used a 3% discount rate.

In the 2024 BCA, the consultants use a much lower discount rate that begins at 2% and gradually declines to 1.4% in future decades.[13] Specifically, the 2024 BCA uses a 2% discount rate from 2023-2079, 1.9% from 2080-2094, 1.8% from 2095-2105, 1.7% from 2106-2115, 1.6% from 2116-2125, 1.5% from 2126-2134, and 1.4% from 2135-2140. These rates are specified in the 2023 revision of OMB Circular A-94 that provides federal guidance on benefit-cost analysis of regulatory programs.[14] However, a closer look at Circular A-94 casts doubt on the use of this low rate for the DCP.

First, the document specifies that the guidance does not apply to water resource projects like the DCP. In contrast, the Department of Interior specifies the discount rate to be used in Water Resources Planning; the most recent guidance for Fiscal Year 2024 is a discount rate of 2.75% and will increase to 3.0% in FY2025 according to its methodology.[15]

In addition, circular A-94 states

> "Discounted benefits or costs should be determined using a real discount rate of 2.0 percent if the benefits or costs reflect certainty-equivalent valuations and 3.1 percent if they do not (unless a project-specific risk premium is calculated)."[16]

Certainty-equivalence refers to a certain value that is lower than the expected value of an uncertain benefit that a risk-averse investor would accept. The BCA's benefit estimates, as described below, are extremely high and are likely well-above the expected value of these benefits. They definitely do not reflect conservative "certainty-equivalent" benefit levels that account for risk. Likewise, a certainty-equivalent cost is an amount higher than expected costs that an investor would be willing to pay today if it eliminated the risk and uncertainty around future costs. At this stage, DCP cost estimates are subject to significant uncertainty.

Thus, according to Circular A-94, it is not appropriate to use a risk-free 2% or lower discount rate in considering the water-supply benefits of investing in the Delta tunnel, and the current guidance from the federal government suggests 2.75% to 3.1%, a level consistent with the 3% discount rate used in previous WaterFix reports. At minimum, the BCA should include higher discount rates in its sensitivity analysis.

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[12] PPIC report. https://www.ppic.org/wp-content/uploads/1020aer-appendix-b.pdf

[13] BCA pg. 18 https://water.ca.gov/-/media/DWR%20Website/Web%20Pages/Programs/Delta%20Conveyance/Public%20Information/DCP%20Benefit-Cost%20Analysis%202024-05-13__ADA.pdf

[14] https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-4.pdf

[15] (https://www.federalregister.gov/documents/2023/11/16/2023-25310/change-in-discount-rate-for-water-resources-planning)

[16] https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-94AppendixD.pdf

The following example shows the difference between a 2% and 3% discount rate when considering a project like the DCP where benefits begin occurring twenty years in the future and extend for 100 years (2045-2144). What is the present discounted value of a $1 annual benefit that begins in 2045 and continues at $1 until 2144? With a 2% discount rate, the present value of the benefit is $27.88, whereas with a 3% discount rate the present value of the benefit is $16.49. Using a 2% rate generated a 69% higher present value than a 3% rate in this scenario. Because the DCP analysis uses rates below 2% at more distant year, this discount rate assumption boosts benefits by even more than 69%. As costs are incurred much earlier, a lower discount rate boosts the present value of costs by a much lower amount than the present value of benefits.

3. Overvaluation of Benefits

The BCA estimates that water supply benefits make up most of the value of the DCP, thus it is critical to examine the values used for water supply benefits. The 2024 BCA uses much higher values for water supply benefits than DWR's consultants used in previous WaterFix reports, which were already high. Economically, it would make sense for inflation-adjusted future water supply benefits to be valued lower today than five to ten years ago when WaterFix assessments were completed, as population dependent water demand forecasts have declined substantially, and profit margins of farming per unit of water have also declined. Yet, the consultants come to the opposite conclusion in the 2024 BCA, and this section explains how the inflated values are derived.

3.1 Overvaluation of Urban Water Supply Benefits

Before valuing the water supply benefits of the DCP, it is important to recognize the characteristics of this water supply. First, the incremental water supply provided by the DCP is untreated water at the Delta that still must be conveyed to recipient SWP water agencies. Conveying and treating the water consumes enormous quantities of electricity. WaterFix reports by the consultants estimated this cost at around $600 per acre foot. Second, the DCP water supply is unreliable. According to the DCP EIR, it will produce no additional water supply in approximately one out of every six years, and the operation of the north Delta intakes is subject to significant environmental risk due to Endangered Species Act restrictions from the seven listed fish species that will be impacted by the DCP intakes, similar to the existing diversions in the south Delta The 2024 BCA states that the DCP increases overall water supply reliability, which is true of any water supply project, but the DCP's highly variable supply across years and high-level of regulatory risk means it is less reliable than many water supply alternatives.

According to Table 1 in the DCP BCA, urban water supply represents 94.4% of water supply benefits and 89% of the total benefits of the DCP. Thus, it is critical to consider the accuracy of these urban water supply values, examine the assumptions underlying the valuation, and include sensitivity analysis to account for uncertainty in future values. The 2024 BCA values DCP urban water supplies at the Delta at an average of $2,560/AF. A more reasonable range for DCP water at the source in the Delta is $500-$1800/AF, as described below.

3.1.1 Market-based Water Valuations Are Much Lower

Water transfers are a direct approach for agencies to augment their supplies and are comparable to DCP water supplies at the source. Westwater Research publishes the California Water Market Report and reports the average price of sales between SWP contractors over time. SWP transfers are a mix of agricultural and urban water buyers and sellers. While the majority of SWP water is supplied to urban water agencies, the California Water Market Report states that the majority of water transfers in the south-of-Delta region involve agricultural buyers and sellers. Data in the California Water Market Report for June 12, 2024 shows average south-of-Delta water transfer prices from the first week of June from 2018 to 2024, and states that early June prices are a good predictor of annual average prices. Prices ranged from $36/AF in the wet year of 2023 to $1,534/AF in 2022, which was a critical dry year at the end of a 3-year drought. The seven-year period was slightly skewed towards dry years (3 dry/critical dry years, 2 wet years, and 2 normal years) and south-of-delta transfer prices averaged $657/AF in 2023$.

Figure 2 in the 2024 DCP BCA shows the incremental annual water supplied by implementing the DCP across years with a variety of water availability. It shows that the largest water supply benefit from the DCP would come in average to above-average years like 2024 which corresponds to current messaging from DWR that an additional 909,000 AF of water would have been captured and moved in 2024 when conditions were ideal for the DCP.[17] In other recent years when market water transfer prices were higher, the DCP water yield would have been far below the estimated annual average of 403,000 AF. During the two normal years (2018, 2024) when the DCP would deliver the most water, the average SOD transfer price in June was $408/AF (2023$). It seems the appropriate transfer price for DCP deliveries would be somewhere between transfer prices in average water years and the average across all years. This range is between $408/AF and $657/AF according to the California Water Market Report data. This range is approximately one-sixth to one-fourth the average value of urban water supplies used in the 2024 BCA.

Another source for market values of water supply is the Veles Index. This NASDAQ based index reflects water transfers in the southern California market with 80% municipal and industrial buyers. This is another reasonable source of market values for urban water supplies from the DCP. Currently, the Veles Index indicates a water value of $288/AF during a relatively average water year, and a higher value during drought conditions when water supplies are scarce. The 2024 BCA uses this index as a source of agricultural water values in the Central Valley, but it is clear from the description that the Index represents southern California water transfers to primarily urban users. The report cites the average value of the Veles Index over the past 5 years at $642/af, which is comparable to the SWP south-of-Delta transfer values cited above.[18] For most SWP water users, the Veles Index value would be higher than the value of DCP water, because Veles is based on

[17] https://water.ca.gov/News/News-Releases/2024/May-24/Benefits-of-the-Delta-Conveyance-Project-Far-Exceed-Costs#:~:text=If%20the%20Delta%20Conveyance%20Project,conflicts%20in%20the%20south%20Delta. It is not clear if all of the 909,000 AF would have been able to be received and stored by water agencies this year as reservoir levels are high.

[18] https://www.nasdaq.com/solutions/nasdaq-veles-water-index

sources in the southern California market which would have lower conveyance costs than DCP water at the Delta.

The water transfers valued in these indices would be a conventional approach to dealing with normal variability in water supplies and the strategy employed for most expected water shortages. From this market data, it can be argued that $400-650/AF is the best value range to use for average urban water valuation for DCP water supplied at the Delta. Some analysts would view it as the low-end of the value range for future DCP water supplies as other approaches yield higher values, and farmers may be less willing to sell water to urban users in the future due to more constrained water supplies or higher agricultural profits. However, according to Scenarios A, B, and C from the MWD IRP-Needs Assessment, the DCP water supply would be surplus to their projected need. That means the future use of the DCP water could be a supply that is sold in these water markets, potentially to agricultural users, not alleviating future urban water shortages as projected in the 2024 BCA. In this case, farm profits per AF of water would limit how high the value could go even if agricultural water supplies are very scarce in the future as expected. Thus, under water demand projected in Scenarios A, B, and C, these current water transfer values could be the best basis for valuing urban water supplies from the DCP.

3.1.2 BCA Only Uses MWD IRP Worst-case "Scenario D" to Estimate Future Water Demand, and Combines it with Little to No Conservation or Investment in Alternative Supplies

If the DCP is built, MWD would likely pay the majority of the costs and receive the majority of the water supplied. Thus, valuing the benefits of additional water supply to MWD when the DCP would begin operating in 2045 critically depends on an estimate of future water demand and needs for MWD. This question also lies at the heart of MWD's CAMP4W effort referenced above. The IRP-Needs Assessment is based on four scenarios from Scenario A, the lowest demand, to Scenario D, the highest demand combined with reduced imports. The figure below, taken from the IRP Needs Assessment, illustrates the difference between the scenarios in light of a 15-year trend of decreasing net demand for MWD water.[19]

Scenario C, the second lowest demand projection, closely matches the 2020 Urban Water Management Plan[20] and would have been the forecast if the consultants followed their past methodology. By using the unlikely, high-growth Scenario D, DWR's consultants are projecting over 600,000 AF of additional demand and a nearly 50% increase in MWD water sales by 2045. Scenario D estimates 2.8 million additional households in MWD's service area between 2020 and 2045,[21] an average of over 112,000 new households per year, which is more than double the rate of 54,000

[19] Source: Figure 3-4, Metropolitan Water District Integrated Regional Needs Assessment. Adopted April 12, 2022
https://www.mwdh2o.com/media/sgvlkith/2020_irp_needs_assessment.pdf

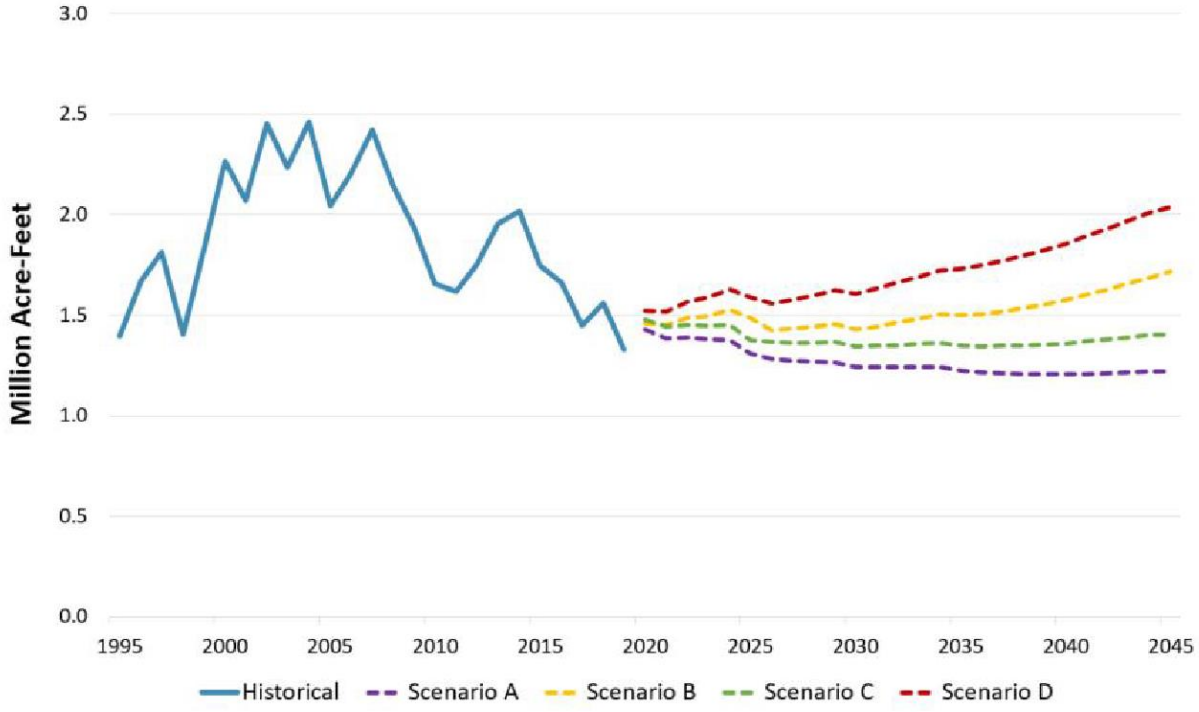
[20] https://www.mwdh2o.com/media/21641/2020-urban-water-management-plan-june-2021.pdf

[21] refined-gap-analysis-assumptions_posting-_rev1.pdf (mwdh2o.com)

new households per year that the California Department of Finance projects in the six counties MWD serves.[22] DWR's consultants describe their use of Scenario D as follows,[23]

> "In this analysis, we consider the IRP's Scenario D, which is characterized by growing demand and reduced imports. This scenario most closely comports with our other assumptions pertaining to climate change and population growth. It is described in the IRP as follows: "This scenario is driven by severe climate change impacts to both imported and local supplies during a period of population and economic growth. Demands on Metropolitan are increasing due to rapidly increasing demands and diminishing yield from local supplies. Efforts to develop new local supplies to mitigate losses underperform. Losses of regional imported supplies are equally dramatic."

Figure 3. Illustration of Future Water Demand Scenarios A, B, C, D (Source: Figure 3-4 from MWD Integrated Regional Needs Assessment



The use of this stunningly inflated demand forecast is a major error in the BCA, which is actually compounded with additional assumptions. The BCA not only assumes Scenario D demand, but it assumes that none of the other investments contemplated in CAMP4W to satisfy this demand are made, even though the DCP water yield is insufficient to resolve the projected shortage. This is shown by the fact that the 9% average shortage in the IRP Scenario D with no-action matches the

[22] https://dof.ca.gov/wp-content/uploads/sites/352/Forecasting/Demographics/Documents/P4_HHProjections_B2019.xlsx

[23] 2024 BCA, p. __, fn. 25.

no-action scenario in the benefit-cost analysis which states, "In the no-project scenario there is an average shortage of 9% of total demand. Construction of the DCP reduces the size of the shortage to only 5% of total demand." This is important because the willingness-to-pay demand estimates that are the basis of the 2024 BCA valuation approach have higher values at higher levels of shortage. Assuming no other actions to eliminate shortage drives up willingness-to-pay values. Instead, the DCP analysis should assume that MWD invests in additional storage and supplies to eliminate the remaining 5% shortage, which would be following their adopted plan. Under this reasonable assumption, the DCP would be eliminating an average 4% shortage, not 9%, and its water valuation would be lower.

In addition to the aggressive assumption of Scenario D growth to 2045, the consultants compound the error in a second way by assuming flat demand after 2045 even though there is strong consensus of population decline after 2045. For example, the State of California's Department of Finance Demographic Forecasting Unit projects the state's population will peak in 2044 at just one million more people than present, and then decline steadily thereafter.[24]

In summary, the BCA's urban water valuation relies on the following extreme growth assumptions:

- Household growth through 2045 is more than double the State's official planning projections.
- Water agencies will not invest in other new supplies or storage to alleviate the shortages that result from this projected growth such that the DCP is valued more because it is alleviating more severe shortages. Many of these projects, such as Pure Water, have received support from the public and significant grants.
- Water demand maintains this high-level after 2045 despite the state's projections of population decline, and water agencies continue to ignore investment in new storage and supplies to resolve the remaining shortage.

These assumptions drive the inflated urban water supply value in the BCA. The next section demonstrates that their valuation would have been at least $750AF lower if they would have used the demand forecasts from the previous WaterFix reports.

3.1.3 Increases Water Supply Value By Over 40% ($750/AF, 2023$) from WaterFix Reports Despite Declining Demand

The 2024 BCA uses the same methodology to value urban water supply benefits in the DCP report as the consultants employed in the earlier WaterFix reports. It is a technically sophisticated model that values households' willingness-to-pay to avoid projected future water shortages based on forecasts of future water demand. For the WaterFix analysis, future demand was projected based on growth forecasts from various regional planning agencies or an econometric model of water demand in the MWD region developed by the consultants. In the decade since these growth forecasts were created, population growth has been much slower than expected and urban water use has also trended well below forecast. Current forecasts for population growth are much lower

[24] https://dof.ca.gov/wp-content/uploads/sites/352/2023/07/P2A_County_Total.xlsx

than in the past, generally projecting little to no growth with declining population in places such as Los Angeles. Thus, it is reasonable to expect that urban water supply values updated for the DCP analysis would be lower to reflect decreased demand.

Instead, the 2024 BCA's estimate of the value of water supplies has increased by 41%, from $1818/AF in 2023$ (originally valued at $1414/AF in 2015$) to an average of $2,560/AF in 2023$. The result of the urban valuation increasing between reports when it should have been decreasing is likely driven by adoption of more aggressive and unrealistic demand growth and future shortages as described in section 3.1.2 above. In short, an approach consistent with prior WaterFix analysis would result in urban water supply values from the DCP to be below $1,818/AF.

3.1.4 Cost of Alternative Water Supplies Also Yield Lower Values

Valuing the DCP using the cost of alternative water supplies is the most intuitive approach, but it is tricky in practice because alternatives vary in reliability and location, and cost estimates can vary widely due to local circumstances and assumptions made regarding lifespan and financing. The 2015 WaterFix benefit-cost report explains that it is appropriate to use values at the low-end of the range of alternative water supplies because "these values are at the low end of the range of water supply alternative costs, which is understandable since the water supplies preserved by WaterFix vary considerably between wet and dry years whereas alternatives such as recycling and desalination are more reliable."[25]

MWD's long-range financial plan needs assessment (LRFP-NA) can be used to provide estimates of alternative water supplies ranging from low-cost options like conservation to the highest-cost options like desalination.[26] MWD estimates the cost of water supply through its various current conservation programs at $403/AF. However, it also speculates that higher incentives may be necessary to spur further conservation actions and the cost of conservation could rise as high as $1,000/AF if conservation targets were increased substantially. This $400-$1,000/AF cost range is similar to the current cost of purchasing water transfers on the spot market, which the LRFP-NA calls "flex supply." The most expensive, but highly reliable options for new supply are expanded water recycling and desalination, which the LRFP estimates cost approximately $3,000/AF of new supply.

However, it is important to remember that DCP water is not comparable to desalination and this cost requires adjustment to be appropriately used for the purposes of DCP benefit-cost analysis. Most importantly, about 1/3 of the cost of desalination is electricity, but pumping water from the DCP tunnel in the Delta to southern California uses a comparable amount of electricity per acre foot.[27] In addition, these estimates of desalination costs also use a much shorter project lifespan assumption than the DCP analysis, even though it is not clear that project components like water intakes and pumping plants would have 2-3 times longer lifespan for the DCP than a desalination plant. Adjusting desalination costs by removing the energy cost component and equalizing

[25] Page 13, https://www.restorethedelta.org/wp-content/uploads/2016/09/CA-WaterFix-Economic-Analysis-Sunding.pdf

[26] concurrence-with-the-long-range-finance-plan-for-camp4w-planning-purposes-nov-14-2023.pdf (mwdh2o.com). See Figure 19, page 40.

[27] https://www.ppic.org/wp-content/uploads/1020aer-appendix-c.pdf

lifespan and finance assumptions so that it was more comparable to DCP water in this study would substantially reduce the cost of the highest alternatives to below $2,000 per acre foot. In addition, not all DCP water would be replaced by the highest cost sources, as DCP water could be surplus under MWD future scenarios A, B, and C. Thus, the analysis of alternative water supplies supports a valuation range of DCP urban water supplies at the Delta ranging from $400-$2,000/AF.

Because of the difficulty in converting alternative water supplies into a form that is comparable to DCP water supplies, this may not be the best approach despite its intuitive appeal. However, it does provide a useful reasonableness check on the value ranges in the earlier discussion of market transfer values and previous studies by the consultants of WaterFIx descried in earlier sections. This reasonable range is far below the $2,560/AF average value used in the 2024 BCA.

3.2 Overvaluation of Agricultural Water Supply Benefits

One approach to estimating the average value of farm irrigation water in California is to derive the value from cropland rental values. In 2023, USDA NASS reported average cropland rents of $486/acre for irrigated land and $38/acre for non-irrigated land.[28] Thus, the average value of irrigation to California farmland was $448 per acre which equates to $154/AF given average applied irrigation water of 2.9 feet per acre.[29] Over the past 15 years, the value of irrigation water derived from land rents has averaged $166/AF (2023$) over the past 15 years with a peak of $209/AF (2023$) in 2019. This simple approach provides a reasonable estimate of the current value of irrigation water, but it should probably be considered a lower bound for this application, as it does not capture the increasing acreage in permanent crops, and the effects of more constrained future water supplies from implementation of the Sustainable Groundwater Management Act (SGMA) combined with a warming climate.

The SWAP model (Statewide Agricultural Production Model) developed at UC-Davis provides a more sophisticated approach that includes the ability to project crop production patterns, and the value of water under alternative scenarios for water supply, groundwater availability and regulations such as SGMA, and other inputs. SWAP has become the standard for evaluating the impact of water availability on California agriculture and has been widely employed in a variety of applications. The consultants used SWAP as the basis for valuing agricultural water supplies for the WaterFix BCA analyses. However, for the 2024 BCA, the current SWAP model projected value of $301/AF under SGMA was not used directly, as in the previous WaterFix analyses.

Instead of using the well-established approach of valuing agricultural water value with SWAP, the 2024 BCA made a bizarre choice to average the SWAP value with an unrelated non-agricultural water price index traded on the NASDAQ. As described in Section 3.1.1 above, the NASDAQ Veles index could be a reasonable basis for valuing overall SWP water supplies or a portion of the urban water supplies provided by the DCP, but it is a nonsensical basis for valuing Central Valley

[28] https://quickstats.nass.usda.gov/results/58B27A06-F574-315B-A854-9BF568F17652#7878272B-A9F3-3BC2-960D-5F03B7DF4826

[29] https://www.nass.usda.gov/Publications/Highlights/2019/2017Census_Irrigation_and_WaterManagement.pdf

agricultural water values as the Veles is based on water sales in southern California where only 10% of the buyers are agricultural and 80% of buyers are municipal and industrial users. The consultants use the average Veles value of $642/AF over the past 5 years, and average it with the $301/AF in the SWAP model to value agricultural water supplies at $474 per acre foot.[30] This unjustified assumption raises the agricultural water value by 58% over the previous, more conventional methodology used for the WaterFix analyses, and is more than double the value implied by current rents for irrigated cropland.

3.3 Seismic Risk Reduction Benefits Are Low, But Still Grossly Overestimated Due To A Calculation Error

The benefit valuation in the seismic risk reduction section doesn't make sense. For instance, the consultants state that their methodology for the DCP report is "significantly more conservative compared to an economic analysis this team previously produced for the WaterFix project." This would be the correct approach as more recent analyses of seismic risks shows shorter recovery times and less frequent mass levee breach events.[31] In addition, the DCP is smaller than the WaterFix and would have less conveyance capacity in the event of a seismic outage. For both of these reasons, it is obvious that the seismic risk reduction benefits estimated for DCP should be noticeably smaller than that estimated for WaterFix in the past. However, the seismic risk reduction benefits in the DCP analysis are substantially larger than what was reported in their previous WaterFix analyses. Clearly, something is wrong.

For example, the 2018 WaterFix analysis estimated that the economic loss from a 7.5 month earthquake outage was $419-$479 million ($508-$581 million, 2023$), but the 2024 BCA analysis says the water supply benefits from operating DCP at a minimal 500 cfs "health and safety" level during a 6.5 month inability to pump from the south Delta would total a whopping $2.14 billion. So the 2024 BCA claims that a tunnel with 2/3 the capacity of the WaterFix would produce four times the water supply benefit in one month less time while operating at minimal health and safety levels. The 2024 BCA further states, "Assuming the DCP is operating at capacity during an earthquake event, the average avoided water supply disruption benefits amount to $28.4 billion." This is an astoundingly high number considering that the worst-case scenario 30 month/2.5 year disruption in the 2018 WaterFix analysis only generated $4.4 billion to $8.1 billion in losses in 2018$.

A closer look at Table 4 in the 2024 BCA reveals a calculation error. For example, consider the 500 cfs health and safety level. That amounts to 991 AF per day, or a total water supply savings of

[30] The average of $642 and $301 is $471.50, indicating there is likely a minor typo in the BCA report, which states the average at $474.

[31] See the discussion of Risk Management Actions in the Delta Islands Risk Management Report (https://mwdh2o.legistar.com/gateway.aspx?M=F&ID=c2d02b71-d9da-4485-b19f-63c53ccb6a11.pdf) for a good discussion of risk-reduction and levee investment strategies that are far more sensible than managing this risk with a Delta tunnel. Levee improvements protect water exports from risk, are supported by Delta communities, and provide a much broader range of public safety, infrastructure, and property damage benefits. This results in more cooperation and potential cost sharing. In addition, these materials explain the progress already made by MWD and others to minimize risk, and indicate that expected outage periods, should the ability to divert from the south Delta be interrupted, are likely to be shorter than assumed in the BCA. .

204,146 AF if the DCP was operated at this level for what is described as an average 203 day disruption. The report values this 204,146 AF of water supply at $2.141 billion or $10,489/AF. Repeating this calculation for other lines in the table consistently reveals a water supply benefit of around $10,500/AF. That is nearly four times the inflated urban water supply value used elsewhere in the report and nearly 25 times higher than the value of agricultural water supplies. Overall, it appears the water supply benefits are overestimated by a factor of approximately ten due to what appears to be a calculation error.

Finally, it is incorrect to even consider the possibility that the tunnel would pump water at full capacity in a seismic event. First, environmental restrictions on the north Delta intakes would still exist, endangered fish would still be migrating past these pumps and freshwater bypass flows would be even more environmentally valuable when downstream water quality has been harmed by the seismic event. Second, the quantities of water that would be moved if operated at capacity are absurdly high. Tunnel capacity of 6,000 cfs is equivalent to 11,893 AF per day. Pumping at this level for a 203 day disruption would 2,414,279 AF which is more than the 2,393,000 AF that the BCA report states would be delivered in an average 365 day year with the DCP (see Table 2 of the BCA report).

It makes no sense that the SWP would deliver substantially more water after a seismic event with only the north intakes than it would during normal times when both intakes are operational. Instead, a full restoration of normal deliveries would be the maximum plausible level, and this would be unlikely due to environmental constraints. To value the full restoration scenario, the correct water supply to use would be the no-project value in Table 2 of the BCA report because the DCP water yield has already been considered and valued in the analysis. Thus, assuming the full restoration of expected SWP deliveries during a seismic event is equivalent to valuing an additional water supply benefit of 5,452 AF per day. Using the 203 day disruptions scenario, the total water supply protected by the DCP in a full restoration scenario is 1,106,767 AF. Using the inflated values of water supply benefits from the 2024 BCA report, which is a weighted average of $1,778AF across urban and agricultural users, results in a $1.968 billion water supply benefit under full restoration assumption for the catastrophic Delta flood scenario. The net present value over a 500-year return period is $127 million under the consultants' assumptions. Looking at the consultants' summary Table 1 shows they estimate $969 million in seismic reliability benefits, but the maximum plausible value is $127 million.

In summary, it is clear that the seismic risk reduction benefit of the DCP is substantially lower than the WaterFix, which was estimated to have present value of about $500 million in previous analyses. However, the 2024 BCA estimated $969 million in benefits even after they stated that the DCP seismic benefits should be lower than they calculated in the past. Calculation errors are apparent in Table 4 of the BCA analysis. I estimate the maximum possible value that should have resulted from the 2024 BCA methodology is $127 million in benefits, a number which would be consistent with their previous WaterFix analyses and the fact that DCP seismic risk reduction benefits would be lower. Whether corrected to about $100 million or using the incorrect figure near $1 billion, the benefit-cost analysis finds the seismic reliability benefit is very small relative to the DCP's cost and is a very small fraction of the estimated benefits. The bottom line is that seismic risk reduction is not an economically compelling reason to build the DCP even when using

overestimated values.[32] Unfortunately, this alleged benefit of the DCP continues to feature prominently in DWR's public relations materials.

4. Omitted Environmental Costs

The 2024 BCA makes monetary estimates of a few of the DCP's environmental impacts directly in the construction zone and thus claims to be a comprehensive benefit-cost analysis. The impacts that were valued include lost agricultural land in the Delta, construction-related air quality impacts, construction-related noise impacts, construction-related transportation impacts, and water salinity impacts on Delta agricultural production. As of this time, I have not reviewed the details of the analysis for those specific impacts, which were valued as having a present-discounted value environmental cost of $167 million, a relatively inconsequential sum in comparison to the price tag of building the DCP. This section focuses on what the consultants did not value as environmental costs, especially those that are likely to generate the largest environmental costs.

The environmental review documents for the DCP disclose scores of important environmental impacts during both construction and operation, but the 2024 BCA ignores most of these impacts. In most cases, the reasoning is that if the EIR finds an impact is less-than-significant after mitigation, it can be ignored. While this may be acceptable for some impacts as it is infeasible to monetize every impact identified in an EIR, the most important environmental impacts with high public values should not be ignored. In the case of the DCP, some of the most highly valued and controversial impacts are on threatened and endangered fish species, including salmon, steelhead, and Delta smelt.

This report is not a scientific critique of the EIR, but it is sufficient to say many reputable scientists and government regulatory agencies are deeply concerned about the project's impacts on endangered and threatened salmon, as well as non-endangered commercially important salmon species whose numbers have declined so much that commercial and sport fishing has been suspended for the past two years. As one example, in its March 2023 review of the DCP Draft Environmental Impact Statement, the U.S. Environmental Protection Agency concluded,

> "given that the status of many Delta fish species is threatened, endangered, or other description of impairment, further diversion of Sacramento River water under the Project could very well lead to greater impairment or extinction."[33]

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[32] In other reports and presentations, I have argued that the seismic risk reduction benefits should be disregarded for both moral and economic reasons as the disaster scenario here would have enormous loss of life, property and infrastructure that exceeds the cost of an interruption to water exports. Assessing any seismic benefit assumes the State does nothing to address this catastrophic risk in the no-tunnel scenario. I will not repeat those arguments at length in this report, as the consultants' calculations themselves show the benefits are relatively small, and nearly inconsequential to the benefit-cost results.

[33] March 16, 2023 EPA Comment Letter on the Army Corps Draft EIS on Delta Conveyance Project, p. 5 (Detailed Comments), https://www.dropbox.com/scl/fi/l8tjeck3e3kzo1vc62jpd/2023.03.16-EPA-201900899_Redacted.pdf?rlkey=h5llfo2q9ip42163wa31pe0sd&st=65i7fsdz&dl=0.

In contrast, the 2024 DCP takes the view that impacts on endangered salmon, steelhead, smelt and other fish species can be considered zero because habitat improvement projects included as mitigation are claimed to reduce impacts to "less than significant" levels according to the authors of the EIR. However, the concept that large-scale habitat restoration can fully offset the negative impacts of a delta tunnel(s) was already rejected by the scientific review of the Bay Delta Conservation Plan (BDCP) proposal, a fact well-known to the 2024 BCA consultants. If the consultants' hypothesis that habitat fully offsets tunnel impacts on endangered fish was true, this would be an analysis of the BDCP not the DCP. Furthermore, the habitat restoration proposed as mitigation in the DCP is miniscule in scale to the BDCP proposal. The EIR's finding that mitigation makes the impact on endangered salmon and steelhead "less than significant" is an area of substantial scientific dispute, and even if true, the environmental costs could still be substantial because a "less than significant after mitigation" EIR finding is not equal to zero impact.[34]

Endangered and threatened salmon are iconic species that are highly valued by the public. Any project that harms them has enormous social and environmental costs. The State and Federal governments have already demonstrated a willingness to invest billions of dollars in projects that may make incremental improvements in these species populations, and thus even if the DCP negative impacts are incremental or "less than significant" in the words of the EIR, the costs could still amount to billions of dollars. It is beyond the scope of this review to assess and monetize the environmental costs of the DCP on threatened and endangered fish. However, it is very much in the scope of a benefit-cost report and the consultants' failure to include it is a major omission.

The impact on endangered and threatened fish species is not only an omitted cost, but it is also a major operational risk to the DCP if constructed. If the DCP intakes, including the experimental cylindrical fish screens, are more deadly to salmon than predicted in the EIR, the Endangered Species Act (ESA) is likely to significantly restrict their operation just as is the case with the existing south Delta diversions. The DCP does not have 50-year Safe Harbor protections under the ESA as was proposed in the BDCP, and the 2024 BCA fails to account for the risk of increased regulation under the ESA.

5. Major Project Risks Not Considered in Sensitivity Analysis

The 2024 BCA only focuses climate-change forecasts as a source of uncertainty. It shows that incremental water supplies from the DCP are not substantially changed across climate change scenarios. However, the performance of the DCP in differing climate scenarios is not the primary project risk. As discussed in the previous sections, the 2024 BCA uses extreme values in multiple

[34] In comments on the DCP EIR, for instance, fisheries experts noted that the new DCP diversions would be on the path of outmigrating Sacramento salmon, and that the diversions are likely to yield high levels of predation on a large fraction of each of the depleted populations of Sacramento Salmon and Steelhead. https://www.dropbox.com/scl/fi/4wrx7z9wmskhk3z64y0s6/2022-Herbold-Comments-DCP-DEIR.pdf?rlkey=ezrkxudcytvhsgtyckox2337q&st=6v2x9zpf&dl=0

areas and includes no sensitivity analysis of how dependent the results are on assumptions such as:

- Construction Cost Uncertainty
- Endangered Species Act Risk
- Water Demand and Value
- Analytical Assumptions (e.g. Lifespan and Discount Rate)

All of these factors have substantial risks for the DCP benefit-cost analysis that very likely exceed climate risk. Because of the optimistic assumptions used in the report, almost all of these risks are heavily skewed in a negative direction for the DCP benefit-cost ratio.

6. Other Considerations: Financial Plans and Comparative Costs

6.1 Incorrect Cost Comparisons in DWR Promotional Materials

When DWR released its updated construction cost estimate and benefit-cost analysis, the featured graphic states that DCP water supplies have costs comparable to conservation programs and less than half the cost of desalination.[35] Specifically, DWR takes a $1325/AF 100-year levelized cost from the 2024 BCA out of context, and displays it next to estimates from other studies that make very different assumptions about interest rates, project life and other key inputs. The cost comparisons come from comparative cost studies by the Public Utilities Commission (PUC), Pacific Institute, and Public Policy Institute of California (PPIC). I do not have the PUC study, but a review of the Pacific Institute and PPIC reports shows that they used project lifespans of 25-50 years and interest rates of 6% and 3.5% respectively.

For a more realistic comparison, I recalculated the levelized costs of the DCP water supply using a more conventional 50-year lifespan and discount rates of 2%, 3.5%, and 6%. Using these inputs, the levelized costs become $1,971/AF at 2%, $2,889 at 3.5%, and $5,089 at 6%. Thus, the appropriate figure to use for comparing to these other studies would be $2,880 to $5,089, but even this would be too low because that is only the cost of untreated water at the Delta, so additional costs for conveyance energy and treatment would have to be added before comparison. With these simple adjustments, it is clear that the cost of DCP water supplies are actually above most alternative supplies, not below as portrayed by DWR.

6.2 Implications for Financial Plans

A benefit-cost is a critical input into a financial plan. A positive benefit-cost ratio does not mean a project is financially feasible. While this review shows that the positive benefit-cost ratio is highly doubtful under an alternative and more realistic framework for valuing benefits, decision-makers

[35] https://water.ca.gov/News/News-Releases/2024/May-24/Benefits-of-the-Delta-Conveyance-Project-Far-Exceed-Costs

can still derive important implications for DCP finance from the report. These include assigning responsibility for project risks and assessing the financial capacity of project partners.

6.2.1 Responsibility for Risks, such as Construction Cost Escalation, is not Assigned or Analyzed

The 2024 BCA only conducts sensitivity analysis for climate change risk, and completely ignores risk and sensitivity analysis regarding the DCPs cost. Cost uncertainty is clearly expressed in the cost estimate used in the analysis, as it says costs could increase by up to 80% at this level of analysis. Mega-projects like the DCP are notorious for cost overruns. According to mega-project scholar Bent Flygberg, about 90% of mega-projects exceed their budget with an average cost overrun of 60%, a figure that would amount to $12 billion in the case of the DCP.[36]

A complete financial plan must state clearly who or what entity is responsible for covering cost overruns. If there is no identified source of funding, the project could be left incomplete. In the case of the DCP, one could envision a half-built project where by 2035 or 2040 it is becoming apparent that the expected water demand is not materializing while the construction costs escalate by billions. What would be the plan in that case? Would the project be left incomplete, an outcome possibility that is becoming a more visible for California's best known megaproject, high-speed rail. Lawmakers have made it clear that state and federal taxpayers will have no role in financing the DCP, and thus the SWP would have to recover these costs from its ratepayers. As explained in the next section, its agricultural users lack the financial capacity, and the risks will fall on urban users, which is mostly MWD. Covering a typical megaproject cost overrun of 60% for the DCP would amount to about $2,000 per household in the MWD service area, a figure that does not include the rate increases projected to come even if the project comes in on-time and on-budget. While this is certainly a crude estimate, the point is that these financial risks and the plans for dealing with them should be made clear to decision-makers before committing to a project like the DCP.

6.2.2 Remaining Agricultural Users Are Likely To Opt-Out Or Default

While the DCP benefit-cost analysis does not break down the comparative benefit-cost ratios for urban and agricultural users, a benefit-cost relationship for the agricultural users is easy to calculate. According to Table 1 in the 2024 BCA, the water supply and water quality benefits to agricultural users has a present value of $2.36 billion. Assuming, agricultural users receive a share of seismic benefits that is proportional to their share of total water supply and quality benefits (6.4%), they also receive an additional $60 million in seismic reliability benefits for a total of $2.42 billion in benefits.

The 2024 BCA also estimates that agricultural users will receive an average water yield of 148,500 AF, which is 36.35% of the total projected water yield of 403,000 AF. That means that agricultural users would be responsible for 36.35% of the DCPs costs. Excluding the environmental impact cost which would not be paid by water users, agricultural users share of project costs would have a present value of $6.213 billion. The benefit-cost ratio for agricultural users is 0.39, which is clearly a terrible investment for agricultural users even when analyzed using the exaggerated values and

[36] The Iron Law of Megaprojects. Over budget, over time, under benefits... | by Bent Flyvbjerg | Towards Data Science

generous assumptions of the 2024 BCA. In reality, agricultural users would be likely to receive far less than 39 cents of benefits for each $1 invested in the DCP.

Many of the SWP's agricultural agencies have already come to this conclusion and are not participating in the project. Some of them already have active litigation to stop the DCP; opposition is not limited to Delta counties and water agencies, tribes and environmental interests.[37] The agricultural analysis of the 2024 BCA is clear. The DCP is a bad investment for agriculture; more of these users can be expected to drop out of financing the plan, and those who remain are at high risk of default.

This has important implications for the financial plan of the DCP. The costs and water supply are unlikely to follow current SWP allocations after agricultural users drop out. All urban users should expect their shares to rise. MWD should be planning on an increased 75% share which has significant implications for its long-term financial plan, especially as MWD reconsiders its business model.

6.2.3 Timing and Scale is Mismatched with MWD'S Long-run Financial Plan

The DCP is a megaproject, and considerations of timing and scale are of particular importance in its financial planning. When the SWP was conceived and constructed during the 1950s and 1960s, it was relatively clear that there would be demand for the water due to California's rapid growth that was projected indefinitely into the future. Circumstances are much, much different now. California has experienced population loss due to the combined effects of changing demographics and its extreme cost of living, a factor that squeezes the ability to finance megaprojects in multiple dimensions, from ratepayer affordability to declining water demand.

As discussed in sections 1.1 and 3.1.2 of this report, MWD's LRFP-NA recognizes this new reality and that very little to no new water supply development is required in three out of the four future scenarios envisioned. To ensure that MWD can respond to a scenario where rapid growth returns, the CAMP4W process uses an adaptive framework with incremental capital investments considered at five-year intervals. This is a sensible approach that safeguards against unaffordable and unneeded overinvestment with being ready to respond should the forecast change. The financial scale and timing of the DCP is completely incompatible with the LRFP-NA and CAMP4W frameworks, as it would basically absorb the full capital investment that would be required to adapt to Scenario D with a series of smaller, more flexible, incremental investments.

In summary, the DCP would be a financial disaster in the likely case that the future resembles Scenarios A, B or C instead of Scenario D in MWD's LRFP-NA. If the DCP looked like a good investment under those future demand scenarios that more closely match current growth projections, DWR's consultants certainly would have considered them, as that would have fit with standard analytical practices, including their own past reports. Instead, the 2024 DCP BCA

[37]For example, the Tulare Lake Basin Water Shortage District, is a litigant suing on the legal adequacies of DWR's December 2023 DCP approval documents . According to Courthhouse News Service, "The Tulare district in its suit wrote that the delta tunnel project would add costly new infrastructure to state water facilities and potentially affect the cost and amount of water it can buy from the state." https://mavensnotebook.com/2024/05/31/courthouse-news-california-judge-weighs-injunction-for-planned-water-conveyance-project/

assumes that future demand is Scenario D with 100% certainty, and even in that case, additional questionable assumptions and choices were required to produce benefits that exceed costs.

Appendix: Comparison to Previous WaterFix Analyses

The same consultants have led multiple economic assessments of Delta tunnel(s) proposals, including the Twin-Tunnels proposed as part of the Bay Delta Conservation Plan (BDCP), and multiple iterations of the so-called WaterFix. A review of the structure of their analyses over time shows that the consultants added favorable assumptions to increase the project's estimated benefits as the real-world economics of the project have become increasingly unfavorable.

With each subsequent iteration, the consultants moved farther away from conventional analysis with more extreme assumptions. These adjustments have resulted in the analyses consistently finding positive benefit-cost, even as the project has consistently escalating costs and diminishing water supply benefits with each iteration.

Previously, the consultants made repeated statements in presentations and writing that single-tunnel proposals were uneconomical and not cost-effective when DWR was pushing for the Twin-Tunnels iteration of the project:

> "This report also examines different possible configurations of the tunnels. For example, would it be preferable to build a smaller set of tunnels, say 6,000 cfs or even 3,000 cfs as suggested by the NRDC? This scaled-down project would have lower construction costs, but would also result in reduced water supply benefits. The conclusion on this issue is clear: reducing tunnel size is an engineering solution to a governance problem, and makes little economic sense."[38]

Now that DWR has changed its preferred project to a single-tunnel, the same consultants come to the opposite conclusion.

As discussed in a previous section and displayed in Table 1, the low water yield of the WaterFix created by its environmental commitment to reduce south Delta pumping was a problem for that proposal's economics. So that WaterFix could pass a benefit-cost test, the consultants' adjusted the project from the EIR proposal and increased the estimated water yield by eliminating the environmental restrictions on reverse flows from the project and putting these restrictions in the no-project baseline. Because the DCP proposal does not include changes to south Delta operations, the consultants were unable to boost benefits of the tunnel in this way for the DCP, and thus the estimated annual water yield of the DCP is lower and matches the EIR.

Table A1 illustrates the changes in how the consultants have approached benefit-cost analysis of Delta tunnels over time. The BDCP tunnel analysis was able to generate a positive benefit-cost ratio considering a standard 50-year lifespan, because it used an enormous projection of water yield. As water yield projections declined in subsequent versions, a benefit-cost ratio greater than one required more changes.

A November 2015 report that was not released as promised by DWR, but was obtained with a public-records request shows consultants assumed a $4 billion public subsidy, but were still

[38] Page 3 of CalWater Fix Economic Analysis: Draft. November 15, 2015. The Brattle Group. CA-WaterFix-Economic-Analysis-Sunding.pdf (restorethedelta.org)

unable to get a positive benefit-cost ratio for agriculture. Both the subsidy and the negative result for agriculture are probably the reason it was not released.

Table A1. Attributes of Consultants' Previous Delta Tunnel Assessments for DWR.

	2013 BDCP	Nov 2015 WaterFix	Feb 2018 WaterFix, Stage 1	Fall 2018 WaterFix	May 2024 DCP
# of tunnels	2	2	1	2	1
Estimated Annual Water Yield (AF)	1,300,000 to 1,700,000	1,000,000	864,477	1,001,182	403,000
Construction Costs	$14.34 bil (2012$) $19.03 bil (2023$)	$14.94 bil (2015$) $19.51 bil (2023$)	$11.09 bil (2017$) $13.79 bil (2023$)	$16.73 bil (2017$) $20.8 bil (2023$)	$20.12 bil (2023$)
Special Financial Assumptions		$3.9 billion taxpayers subsidy reduces water agency cost to $11 bil	Single-tunnel considered to reduce costs after CVP agencies decline to pay their share	MWD finances CVP cost share, and leases tunnel capacity back to CVP	SWP project only.
Additional water supply if Delta WQ standards abandoned after tunnels	None	Discussed, not monetized	Discussed, not monetized	Included, $5.7 billion in added benefits	None
Tunnel Lifespan	50 years (2025-2075)	50 years (2031-2080)	100 years (2032-2131)	100 years (2034-2133)	100 years (2045-2144)
Discount Rate	3%	3%	3%	3%	2% - 1.4%, declining over time
Benefit-cost ratio	1.4	2.43 SWP Urb 0.71 SWP Ag 0.62 CVP Ag	1.35 SWP Urb 1.04 SWP Ag 1.08 CVP Ag	1.31 SWP Urb 1.20 SWP Ag 1.29 CVP Ag	2.2 total

DWR did release benefit-cost analysis of a single-tunnel, Stage 1 option and the twin-tunnel WaterFix in 2018. For these later analyses, the consultants increased the assumed lifespan from 50 years to 100 years to increase the project benefits. A hastily created single-tunnel cost estimate reduced the costs of the single-tunnel by an unrealistic amount, over 30% cheaper than the DCP, which allowed the benefit-cost ratio to increase over 1. For the final Fall 2018 WaterFix BCA, they still needed more to get the benefit-cost ratio over 1, so they created a new "sea-level rise" benefit that assumed that currently required salinity protection for the Delta could be abandoned if the twin-tunnels were in place, allowing for additional water exports that were valued at $5.7 billion – enough of a boost to get the benefit-cost ratio over 1. This so-called "sea-level rise" benefit was

based on assuming Delta environmental and water quality standards could be continuously violated in the future, or that the standards would be abolished. It made no attempt to estimate the cost on downstream water users of abandoning these standards. In the 2024 BCA analysis, this category of benefit was excluded without explanation, perhaps because it is unlawful or also perhaps because the single-tunnel DCP plan still relies heavily on the south Delta diversions, which require salinity control in the Delta.

As explained earlier in this review, the 2024 BCA includes two new wrinkles to inflate the benefits in addition to retaining the new 100-year lifespan assumption introduced in 2018: 1) a sub 2% discount rate, and 2) the extremely high future urban demand forecast that results in an inflated value for urban water supplies.

Links to Previous Studies with Comments:

2013 BDCP Study
https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/exhibit5/docs/Public_Draft_BDCP_Appendix_9A_-_Economic_Benefits_of_the_BDCP_and_Take_Alternatives.sflb.pdf

- The only report that compared alternatives. This report included a "through Delta" conveyance alternative had net benefits nearly three times higher than a 6,000 cfs tunnel like the DCP ($6.086 billion vs $2.098 bil, 2012$).

November 2015: https://www.restorethedelta.org/wp-content/uploads/2016/09/CA-WaterFix-Economic-Analysis-Sunding.pdf

- In July 2015, the Draft EIR for the WaterFix was released, and DWR promised a benefit-cost study would be released months later. No benefit-cost analysis was released, and this report was obtained in 2016 through a public records act request. While labeled draft, it is dated around the time the benefit-cost study was to be released. The report found a negative benefit-cost ratio for agricultural users despite assuming water supplies higher than the EIR, and found a $3.9 billion taxpayer subsidy would be required to cover certain costs allocated to the Central Valley Project. Both the large subsidy and the negative results for agriculture contradicted public statements about the project at the time which may be why it was not released as promised.

February 2018: Economic Analysis of Stage I of the California WaterFix

https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/CDWA%20et%20al/part2rebuttal/sdwa_317.pdf

- This report was issued when DWR was considering a switch to a single-tunnel phased approach after Westlands Water District voted against paying its cost share of the WaterFix, and a less expensive, SWP only plan was briefly considered. Section 1.3 of this review compares the 2018 single-tunnel WaterFix report to the current DCP, single-tunnel assessment.

September 2018. Economic Analysis of the California WaterFix: Benefits and Costs to Project Participants. Brattle Group. September 20, 2018.

https://www.dropbox.com/scl/fi/qbxgcqp7jq9q8r59ct0sy/2018-Economic_Analysis_CWF_Brattle_Group.pdf?rlkey=o7bm9ct1c6jpf2hvsz3tx680k&st=0c5zogdb&dl=0

By September 2018, DWR had rejected the phased, single-tunnel approach. Reasons given were that it was less cost-effective, and it would require revised environmental documents and review that would delay the project. Because the CVP was not committing to the WaterFix, this report of a 9,000 cfs dual conveyance assumed MWD financed the CVP cost share outside of the SWP, and optimistically assumed CVP participates by paying MWD wheeling costs to use tunnel capacity after the tunnel is built. This report would have shown a negative benefit-cost ratio if conducted like previous analysis, so it introduced a new "sea-level rise" benefit that assumed water that would be required to maintain Delta water quality through increased outflows under sea-level rise could instead by exported through the tunnels before passing through the Delta. This benefit assumes an abandonment of water quality standards and included no calculation of the harm on water users downstream of the tunnel intakes. This sea-level rise benefit was valued at $5.7 billion, more than the total net benefit found in the assessment, showing that the benefit-cost ratio would have been below one without creating this questionable new benefit.