THE UNAFFORDABLE AND UNSUSTAINABLE TWIN TUNNELS:

WHY THE SANTA BARBARA EXPERIENCE MATTERS

Photo credit: Kenji Photography

Report by:

California Water Impact Network (C-WIN)
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california water impact network

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The California Water Impact Network is a non-profit, tax exempt California Corporation that advocates for the just and environmentally sustainable use of California's water, including in-stream flows and groundwater reserves, through research, planning, public education, media outreach, and litigation.

PURPOSE OF THIS REPORT

1. Examine the deficiencies and cost impacts of Governor Brown's Twin Tunnels/CA WaterFix, illustrating the untenable financial burden these proposals place on local water agencies and ratepayers;

2. Highlight that the Tunnels/CA WaterFix will not provide more water when needed, i.e., during drought;

3. Explain the unintended consequences of participation in the State Water Project (SWP) utilizing the experience of Santa Barbara County as an example of the statewide problem;

4. Highlight the exorbitant cost and unreliability of importing water from the State Water Project (SWP) to the communities of Santa Barbara's South Coast.

This report was prepared by Carolee Krieger and Arve Sjovold with the assistance of Joan Wells, Beno Budgor and Georgia Strickland. The California Water Impact Network (C-WIN) obtained data on cost, usage, and fiscal indicators to evaluate the performance of the SWP. C-WIN has used public information obtained from the Central Coast Water Authority (the county's manager of SWP water) and its constituent water agencies for its information. Some data was obtained through requests under the California Public Records Act. Much of the data is available through CCWA and its member agency websites.

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I. WHAT IS THE TWIN TUNNELS/CAWATERFIX PROJECT?

Twin Tunnels/CA WaterFix Proposal: Governor Brown has proposed twin trans-Delta tunnels, each 40 feet in diameter, 35 miles long and buried 150 feet deep, running from the lower Sacramento River to Modesto. Bypassing the San Francisco Bay/Delta, they are intended to move water south "more efficiently" to corporate agricultural water districts in the western San Joaquin Valley and urban southern California water agencies who are beneficiaries of and contractors to the State Water Project (SWP) and the Central Valley Project (CVP). This includes the largest SWP contractor, the Metropolitan Water District of Southern California. There is no clear plan for financing the Tunnels. The administration and its supporters intend to build them without a vote of the people who must pay for them, the ratepayers of the State Water Project (SWP) and the Central Valley Project (CVP).

As of the date of this report, DWR has acknowledged that engineering for the project is only 10% complete and that an additional 3 years and $1.2 billion is needed just to complete the planning. On top of what is needed to complete the planning, construction costs are estimated at $20 billion to $38 billion, according to analysis by ECONorthwest (see Appendix A). The annual cost burden to the contractors will reflect the amortization of the construction costs plus annual operations and maintenance, presumably under the terms of the SWP contracts. The project has not defined quantitatively any of the purported benefits in terms of expected additional water deliveries. In fact, if there is to be additional water from the project it is not certain where it is to be delivered.

The water purveyors in Santa Barbara County are concerned about these two aspects of the proposed project: additional costs to SWP contractors and no clear statement as to how they are to be benefited. The microcosm of the Santa Barbara experience serves as a red flag warning for all Southern California SWP contractors and their customers.

Concerning the affordability of the project, the introduction to the section of the Bay Delta Conservation Plan/ CA WaterFix, *Economic Benefits and Financing Strategies, (March 2012)* [for the CA WaterFix Tunnels], it states:

"California's investment need is relatively modest compared to the size of the economy. California is the 8th largest economy in the world with an annual Gross Domestic Product of $1.9 trillion. Investments for Ecosystem Restoration and Water Supply Reliability are also relatively small compared to current annual expenditures. Approximately $20 to $30 billion is spent annually for water services and water related programs. Water rates are lower than other household utility costs. Average monthly household water and wastewater rates are less than average costs for other utilities such as electricity, cable/satellite, cell phone... California's investment need is substantial, but well within the capacity of California."

The situation in Santa Barbara County in general, and the South Coast of Santa Barbara County in particular, do not fit this rosy picture of affordability. In this report we analyze the current problems with affordability of SWP and what the difficulties would be with the addition of the Twin Tunnels project. We have also analyzed the Sacramento River hydrology to assess the likelihood of more

reliable deliveries from the SWP due to this project. These are our conclusions.

- **The Twin Tunnels project promises more debt and no additional water to the South Coast districts.**
- **The South Coast districts are already at their limits for absorbing new debt and cannot afford more.**
- **Current South Coast debt burdens are now crowding out budget expenditures for needed infrastructure and maintenance.**
- **SWP water deliveries have never been reliable for the South Coast, especially in droughts and the Twin Tunnels project promises no relief from that circumstance.**

Each of these conclusions follows from the detailed, quantitative analyses in the body of the report. We start with the economic challenges that the water districts presently face with the current SWP debt burdens. We have examined each of the South Coast districts budget details and how they are meeting their financial obligations. We also examined the difficulties of providing water deliveries to their customers with a strong focus on the current drought and the failure of the SWP. The difficulties of the SWP in providing reliable deliveries is revealed in a thorough examination of the Sacramento River hydrology (Appendix B) where it is shown that the droughts are the determining factor in why the SWP demonstrates such poor reliability, while the Bay Delta Conservation Plan/CA WaterFix deals almost entirely with the capability of the Twin Tunnels to capture more water during wet periods. Then we examine the likely cost impacts of the proposed Twin Tunnels project, based on the meager information available on its estimated construction costs, and how those costs when allocated to SWP contractors will affect water district budgets.

We conclude by finding that for Santa Barbara's South Coast purveyors the cost/benefit analysis cannot justify the Tunnels construction. By analysis, the construction of the Tunnels could result in vast economic hardship and financial turmoil for agencies and ratepayers, financial resources that can be applied to construction and delivery of more reliable sources of water such as treated wastewater and desalination.

Map 1: Proposed Twin Tunnels route

THE SANTA BARBARA EXPERIENCE

I. OVERVIEW

History of SWP and South Coast Santa Barbara County

The costs of bringing SWP water to Santa Barbara County were not accurately disclosed in 1991 when voters approved the project. The reliability and delivered amounts of SWP water have been much less than originally promised in 1991. Prior to that election, the state's estimate of the total cost to ratepayers for construction of the Coastal Aqueduct was **$270 million.** SWP contractors located south of the terminus of the Coastal Aqueduct in Santa Maria additionally, must pay for a local aqueduct connection. Based on information provided by the Central Coast Water Authority (CCWA), the total costs of construction for the coastal branch and the local branch was **$670 million**, which is to be contrasted with the $270 million as the estimate given to the voters. Santa Barbara ratepayers will have paid **$1.76 billion** including amortization with interest and operations and maintenance (O & M) for bringing state water to Santa Barbara. The large cost is best illustrated by Montecito, which has only 4,200 meters, but must pay over $5 million a year for SWP related debt whether any water is delivered or not. As will be shown, the much higher than expected construction costs has materially affected the affordability of the SWP for the South Coast districts.

Santa Barbara County has paid and will continue to pay extremely high costs for minimal amounts of the SWP water, largely due to the low reliability of the SWP. **Actual delivery of SWP water between 1998 and 2015 for the four South Coast water agencies (Montecito, the City of Santa Barbara, Goleta and Carpinteria) was only 28% of full contract amounts,** despite the fact that Santa Barbara County voters were told in 1991 ballot information that intimated the State Water Project would deliver 97% of contract amounts to urban water users.

Current Cost/Benefit Analysis

The SWP has failed in delivering water to Santa Barbara's South Coast water districts and cities in a cost-effective and reliable manner. But to fully understand these impacts, they must be viewed from an historical perspective.

Prior to the 1987-1992 drought South Coast water purveyors had relatively small budgets. Water supply costs represented less than 10% of the budgets and local sources provided all the water. The drought changed everything. At the peak of the drought, all South Coast water purveyors, convinced of the reliability of state water delivery system, voted to import state water at enormous construction costs. The South Coast is now living with the consequences of that decision; some very important lessons have been learned.

A. Costs:

Due primarily to the region's connection to the SWP, South Coast water district budgets have increased substantially. By way of example, the budget for the Montecito Water District went from $1 million in the early 90's before deliveries of state water to $14 million today. For the upcoming year, the budget is $21 million, an extraordinary increase of $7 million, as Montecito tries to catch up on needed repairs to old infrastructure. As the 1987-1992 drought unfolded, mandatory conservation and severe use restrictions decreased water demands dramatically. These measures also had the adverse effect of decreasing water sales to the point that water rates had to be raised substantially in

order to balance budgets. Upon emerging from the 1987-92 drought, the water districts were immediately faced with increasing cost burdens from the construction of the Coastal Aqueduct and the local aqueduct necessary for the importation of state water. Rates had to be maintained at high levels, and raised in many cases. When the drought ended and mandatory conservation and restrictions were lifted, demand remained depressed due to the high water rates that were still in effect. Before the drought, water use was not necessarily sensitive to water costs, but the higher costs have caused demand to decrease. Increased rates are met with commensurate decreases in demand such that the districts have resorted to large increases in the fixed charges for water service.

B. Benefits:

Because of its inherent unreliability, there have been few benefits redounding from the importation of state water, especially during droughts. Because severe droughts are often statewide phenomena, state water deliveries typically are curtailed at the very time they are needed most on the South Coast. The current drought demonstrates this exceedingly well.

There has been one benefit of the Coastal Branch, the South Coast's tie-in to the SWP: water demand has decreased due to the cost impacts of the project on water agencies and ratepayers. Before the 1987-1992 drought, normal water demand in the City of Santa Barbara was about 16,500 acre-feet per year. The post-drought, new normal, is now 13,500 acre-feet, which is 3,000 acre-feet less than the pre-drought level. This drop in demand can be attributed directly to higher water prices.

The additional cost to agencies and ratepayers from the construction of the Twin Tunnels will have a negative effect on water supply and demand given the unreliability of delivery, lack of new water sources, and higher rates required to cover costs plus more stringent conservation measures.

Twin Tunnels and Additional Debt from the State Water Project

The CCWA's local contractors are paying large amounts of money for the planning and engineering of the tunnels. The State Water Project (SWP) and the Central Valley Project (CVP) contractors have spent **$250 million** on planning to date and estimate it will cost an additional **$1.2 billion** to get the project "shovel ready". These costs are paid proportionately by South Coast Contractors.

C-WIN has documented the estimated cost of construction of the Twin Tunnels. The annual payment with interest and principle on these construction costs, which will be allocated to Santa Barbara County under its contract with the SWP, will range from **$7.7 million/yr.** to **$46.4 million/yr.** The South Coast districts' share will range from **$2 million/yr.** to almost **$15 million/yr.** These estimates are based on a 55/45 division in costs between the State Water Project (SWP) and the Central Valley Project (CVP); **if the CVP doesn't participate, these estimates will roughly double.**

If Santa Barbara County is forced to participate in the construction of the Twin Tunnels, its SWP expenditures will increase significantly at a minimum. The resultant increases in retail water costs will burden Santa Barbara County customers without any assurance that additional water supplies will be forthcoming. This increased cost burden will depress demand even further.

Why would Santa Barbara County want to pay more money for unreliable water it may not need or use?

2) TERMINOLOGY

Water issue terminology may be unfamiliar to some readers. The following are some key terms that will be used throughout the report:

Acre-foot: One acre-foot is equal to an acre of land (or 43,560 square feet) covered to a depth of one foot. An acre-foot is thus 43,560 cubic feet of water or about 325,829 gallons. It is equivalent to the annual consumption of water by two average California families.

Table A Allocations: "Table A Allocations" are the total contractual amount of water that may be delivered under the terms of a State Water Project water service contract. The actual amount of water delivered, depends on how much water is available from nature; this varies widely from year to year. The cost of Table A Allocations is based on the SWP contractors' percentage share of the total Table A Allocations. This cost reflects the percentage of both the original SWP contract and Santa Barbara's share of the Coastal Branch aqueduct constructed after the 1991 SWP election. All costs incurred by each SWP contractor must be paid every year regardless of whether any water is delivered at all.

Table A Deliveries: This amount represents what a water contractor actually receives in deliveries from the State Water Project under the contract in a given year. For Santa Barbara County water districts, Table A deliveries have always been less than the full amounts for a given year because the water is either not available from the State, or is not needed, and is therefore not requested.

Article 21, and other "surplus water": The SWP contracts deal with three types of non-scheduled water deliveries. They are Article 21 or "Surplus Water"; "Turn-back Pool"; and "Carryover Water".

Article 21 or surplus water is non-Table A water that may be declared available in the first three months of the contract year after all current Table A demands are met, reservoir refill requirements are satisfied, and there is fresh water in the Delta.

Turn-back Pool water is Table A water that was requested but not fully delivered in the previous contract year. The contractor who has unused Table A water receives a specified rebate for relinquishing his unused amount; any other contractor may offer to buy water from Turn-back Pool sources at a specified price.

Carryover Water is Table A water for a specific contractor that was available but not fully delivered in the previous contract year and can be claimed during the first three months of a new contract year if there is a demand for it or a place to store it.

The determining factors for exploiting these accounts are adequate capacity in the aqueduct facilities that deliver the water, satisfaction of all demands by the SWP contractors for Table A water, and water availability. The test of water availability is not necessarily constrained by Delta health considerations. Availability can be met simply by certifying that there is fresh water in the Delta as if it were a lake. This has not been healthy for the Delta.

Cachuma Project: The Cachuma Project consists of the Bradbury Dam and Lake Cachuma reservoir. The project stores floodwater runoff from the Santa Ynez River in Santa Barbara County. Completed in 1958, it is managed by the Bureau of Reclamation and provides water for South Coast urban and agricultural use by a series of tunnels that traverse the Santa Ynez mountain range.

Central Coast Water Authority (CCWA): Is a Joint Powers Authority (JPA) that manages Santa Barbara County's water from the SWP. It was created in 1991 when the County Board of Supervisors ceded management of the State Water Project. CCWA's voting membership is comprised of representatives of the eight county water agencies that contract for state water: the City of Santa Barbara, Montecito, Carpinteria, Goleta, Santa Ynez WCID #1, Santa Maria, Buellton, and Guadalupe. However, the legal responsibility for state water obligation payments is with the County of Santa Barbara Board of Supervisors, sitting as the Santa Barbara County Flood Control and Water Conservation District (SBCFCWCD). Thus, Santa Barbara County taxpayers ultimately have the fiscal responsibility for SWP payments. CCWA is acting as the agent for SBCFCWCD, which is the technical entity that holds the contract with the SWP.

Hundred Cubic Feet (HCF): A common measure of water consumption used by retail water agencies to describe how much water their local customers consume in a billing period. 1 HCF equals 748 gallons; 1 acre-foot equals 435.6 HCF.

Safe Yield: The level of water a project can deliver every year, given some small probability of short fall. "Safe Yield" is an operational concept whereby a reservoir is operated on the basis of a steady, firm annual yield calculated at a high probability to extend through the worst drought of record; the droughts extension is determined as the interval between spills or fills.

Twin Tunnels: The Twin Tunnels are a Gov. Brown administration plan to divert water from the Sacramento River under the San Joaquin-Sacramento River Delta to the federal and state pumps in the South Delta. The two proposed tunnels would each be 40 feet in diameter, buried more than 150 feet below the Delta and run for about 35 miles. The project would include three new intakes, each with a flow capacity of 3,000 cubic feet per second. The "Bay-Delta Conservation Plan" (BDCP) is a plan initiated by the State Dept. of Water Resources (DWR) to facilitate approval and construction of the Twin Tunnels. The BDCP has since been subsumed by the CA WaterFix.

Unit Cost: The cost of a given measurement for water. For example, units of measuring water may include cubic feet, gallons, or acre-feet. The *unit cost* of water is the cost per increment of each such designation (i.e., the "cost per acre-foot" or "cost per hundred cubic feet", etc.) consumed or supplied.

Effective Unit Cost: This is the cost of supply divided by the actual water delivered over a given time period, usually a year. It is a measure of the cost-effectiveness of a given source of supply.

Urban Preference: In state water law, urban preference means giving domestic and industrial water rights holders priority in receiving water during droughts, prior to the claims of agricultural water users. The theory in state law is that water for people is a higher social priority than water for farming.

Water Supply Reliability is the likelihood that the requested demand for delivery in a given year by a contractor can be met. It is usually stated as a probability. The prudent level of probability for each contractor depends on the availability to that contractor of other sources of water. For example, a contractor that is totally dependent on SWP water requires a very high level for SWP deliveries because shortfalls for that contractor are not easily tolerated. On the other hand, a contractor that has a year-to-year or longer term storage carryover capability can tolerate lower levels of probability of delivery. The reliability of delivery is also limited by the availability of water to the project and the ability of the project to carry over water year-to-year in storage reservoirs. The probability of

availability can be calculated by investigating the probability distributions of runoff from the hydrologic record convolved with the prescribed operations. This differs from CALSIM II modeling done by the State, which utilizes "frequency of return" calculated by CALSIM II as a measure of reliability.

Water Year: October 1 - September 31 of a given year, as opposed to **Calendar Year** which runs from January 1 - December 31 or **fiscal year** which typically runs from July 1- June 30.

Lake Cachuma during current drought

3) GEOGRAPHIC AREA COVERED BY THE REPORT

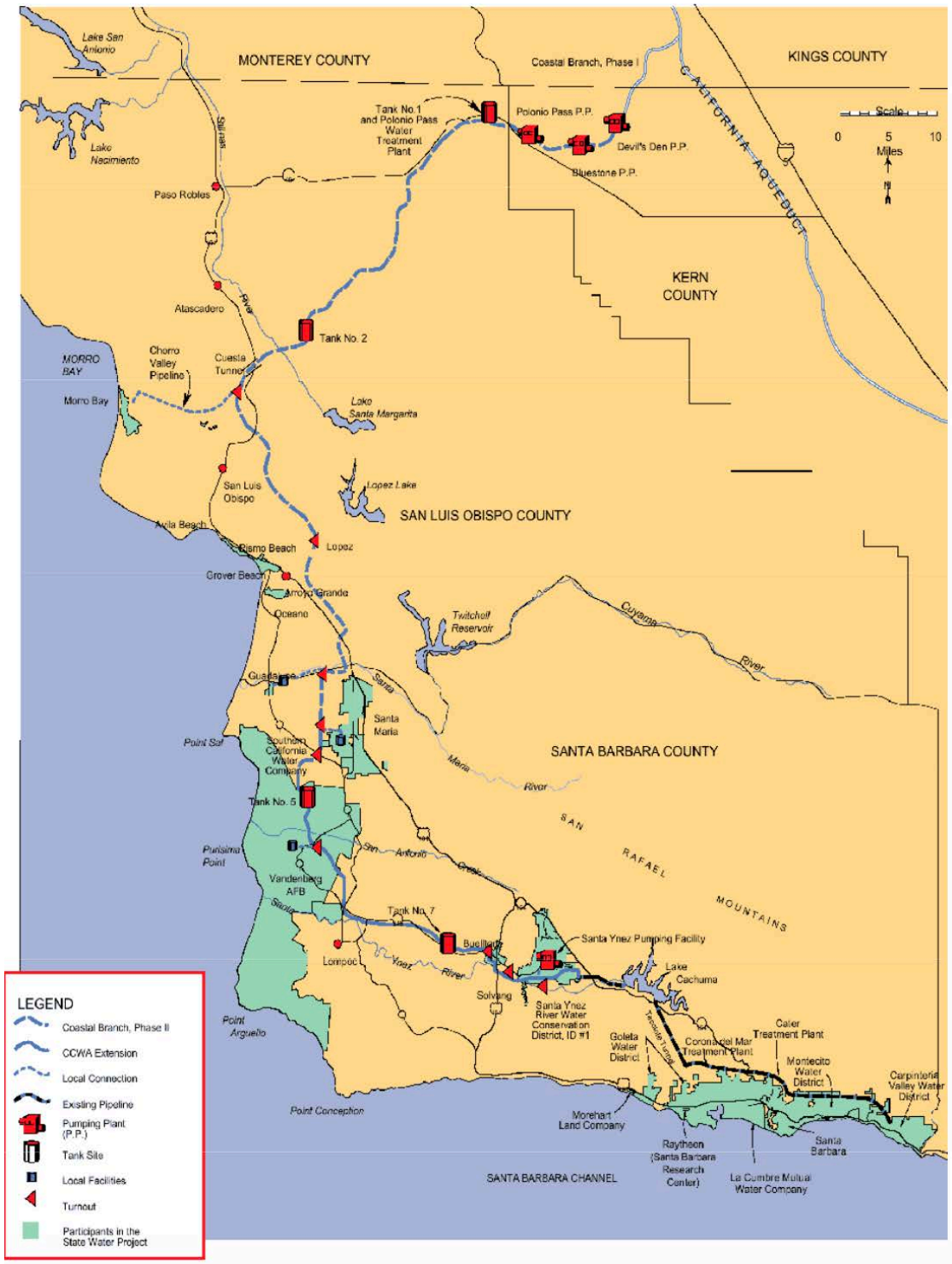
This report clarifies the cost of State Water Project water to four urban and suburban water districts and their customer service areas along the foothills and coastal plain of Santa Barbara County. These water districts include:

- City of Santa Barbara
- Montecito Water District
- Carpinteria Valley Water District
- Goleta Water District

They are located on the littoral plain of the south coast of Santa Barbara County along Highway 101. They are about 330 miles south of Tracy, where State Water Project water is pumped from the Bay-Delta Estuary.

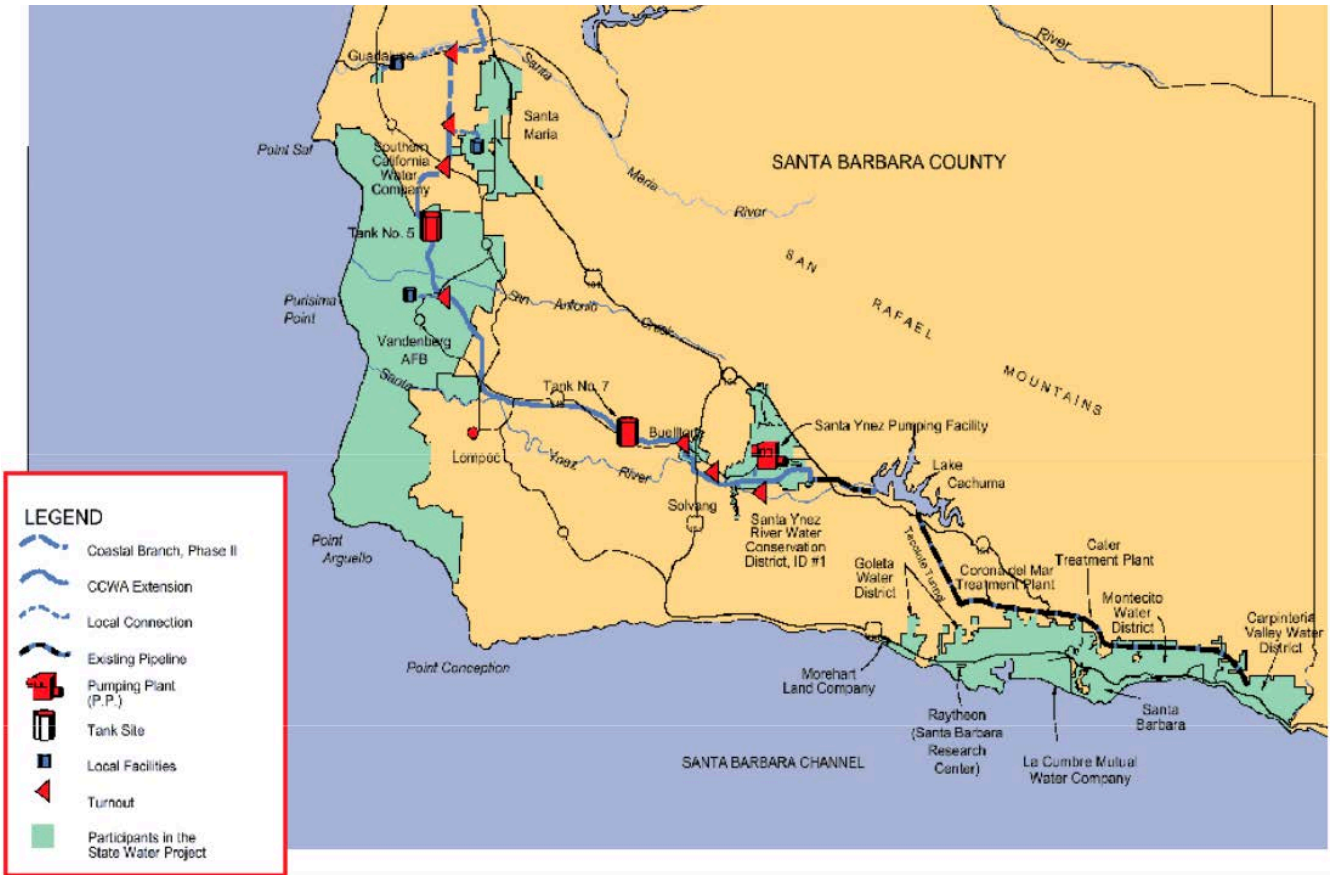
After studying the impacts to date of the SWP, C-WIN then analyzed the costs of the Twin Tunnels project and its likely impacts.

The four water districts and cities are among the major customers in Santa Barbara County for water delivered by the State Water Project's California Aqueduct. SWP water originates at Lake Oroville and travels down the Feather River to the Delta. When water is pumped from the Bay-Delta estuary, it must travel 330 miles south through the California Aqueduct traversing the western San Joaquin Valley to the state-owned Coastal Branch Aqueduct. The Coastal Branch aqueduct terminates at the Santa Maria River. (See Map 2 on following page.)



Map 2: Water Agencies of the Central Coast Water Authority; Coastal Branch Aqueduct, and the Local Aqueduct in Santa Barbara County. Map courtesy of CCWA

From the Santa Maria River, the water enters the Central Coast Water Authority's local pipeline to Lake Cachuma in Santa Barbara County. (Map 3 portrays the route of the local aqueduct, and the location of the districts that receive SWP water.)



Map 3 Central Coast Water Authority pipeline. Map courtesy of CCWA

The transport of state water in Santa Barbara County occurs under the jurisdiction of the Central Coast Water Authority (CCWA).

This report excludes some Santa Barbara County contractors from detailed analysis for several reasons:

- The City of Santa Maria is located close to the terminus of the Coastal Branch Aqueduct and faces none of the costs of financing, construction, operation, and maintenance for delivery of water to Lake Cachuma. Consequently, Santa Maria's water importation burdens are not equivalent to those borne by the South Coast districts. The difference is due to the significant costs of the local aqueduct, which is intended to serve districts downstream from Santa Maria. *However, due to Santa Maria's large allocation of Table A water, it represents a special case when it comes to the assessment of impacts due to the Twin Tunnels. These impacts will be addressed later in this report.*

- Vandenberg Air Force Base is excluded from this analysis because it is a **federal military** installation and is not a voting CCWA member. It will be able to pay the costs of any water supply that is provided in Santa Barbara County.

- Other voting members of the Central Coast Water Authority were excluded from the analysis in this report because they had small Table A Allocations. C-WIN chose a threshold of 1,000 acre-feet of Table A Allocation for determining a voting member exclusion from this report. Voting members excluded under this criterion included the City of Buellton, the City of Guadalupe, Solvang, and the Santa Ynez Water Conservation Improvement District #1.

- Because information from private corporations is not available under the Public Records Act, non-voting members such as Raytheon, Morehart Land Company, Southern California Water Company, and La Cumbre Mutual Water Company are not included here.

The primary reason for focusing on the water agencies analyzed in this report is their location at the terminus of the Coastal Aqueduct and the CCWA local pipeline. The cost burdens faced by the South Coast water districts for their shares of the local aqueduct are nearly equal to the cost of their shares in the SWP Coastal Aqueduct.

Table 1 presents a summary profile of the cities and water agencies that are included in the scope of this report. Readers may wish to refer back to this table from time to time.

Table 1
Summary Profile of Four Santa Barbara County Water Districts

	Goleta Water District	City of Santa Barbara	Montecito Water District	Carpinteria Valley Water District
Population(2010 census)	86,946	91,416	14,000	15,141
Single Family Accounts	13,342	16,920	4,204	3,078
MF Res Accounts	1,578	6,126	74	314
Total Water Budget Fiscal Year 2011	$24,646,996	$34,600,000	$13,545,136	$11,147,539
Residential Deliveries 2010 (AF)	6,115	8,755	3,794	1,354
Table A Allocations (AF)	4,500	3,000	3,000	2,000
2010 SWP Deliveries (AF)	813	541	541	363

As can be seen in Table 1, SWP deliveries are small fractions of Table A Allocations and small fractions of deliveries.

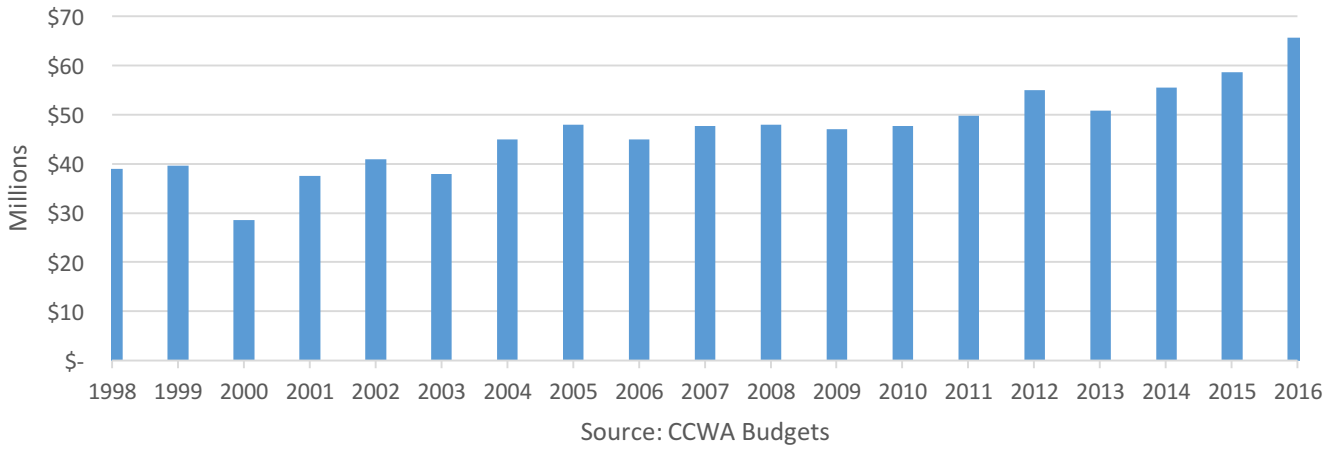
4) COSTS TO SANTA BARBARA COUNTY OF SWP WATER

In 1991, the voters of Santa Barbara County approved a ballot measure to construct 144 miles of the Coastal Branch Aqueduct in order to connect Santa Barbara County water districts to the State Water Project. The vote was 66% for and 34% against. Earlier, in 1979, when voters were told the truth about high cost and low reliability in droughts, county voters defeated a similar measure by a vote of 72% to 28%. Before the 1991 election, Santa Barbara County voters were told that the costs for a Santa Barbara hook-up to the SWP would be **$270 million**; the construction costs alone for the Coastal Branch Aqueduct were just under **$500 million**. The addition of the local aqueduct construction costs brought the **total to $670 million.** The local aqueduct construction had to be financed at a much higher interest rate than the Coastal Branch construction. Because the South Coast Districts are at the end of the local pipeline they have much higher shares of the proportionate costs. The consequences of this higher cost, together with the higher interest rate, causes the South Coast water districts payments for the local aqueduct to be nearly equal to that of their Coastal aqueduct costs.

Water agencies face two key challenges as they continue providing SWP water to the suburban and urban communities along the Santa Barbara Coastal Plain: 1) rising State Water Project water costs, and 2) poor reliability for what they pay.

Santa Barbara County water districts cumulatively paid more than $893 million for all project costs (capital, financing, power, operations and maintenance) between July 1, 1997 and June 30, 2016; further, costs continue to escalate annually. Figure 1 shows the trend of total annual costs to all the CCWA water districts receiving state water, (including local aqueduct charges), from completion of construction to the present. This figure shows increasing costs, even though Santa Barbara County water districts have not added any new projects. These recent increases most likely reflect the resources that DWR has dedicated to the ongoing planning for the BDCP/CA WaterFix and the Twin Tunnels. These costs are buried in the invoices for the SWP that are sent to the SWP contractors.

Figure 1
Annual SWP Payment by Santa Barbara County Water Agencies



Based on district budgets and financial information supplied by CCWA, C-WIN has calculated the proportion of CCWA's annual budget for repayment of SWP capital and operating charges, as well as operations and maintenance charges for delivery of SWP water. Figures 2 through 5 present these costs in pie charts showing the percentage of SWP costs of water district budgets for each of the four South Coast districts (City of Santa Barbara, Carpinteria Valley Water District, Montecito Water District and Goleta Water District). These figures represent the averages from 2012 to 2015.

Figure 2
City of Santa Barbara Water Budget

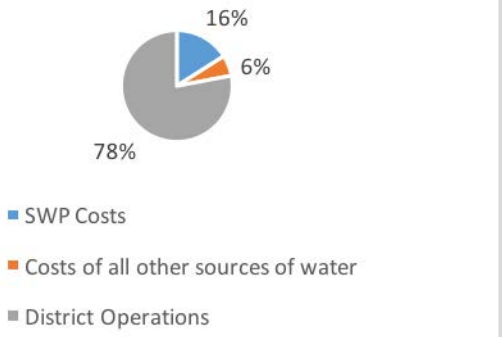


Figure 3
Carpinteria Valley Water District Budget

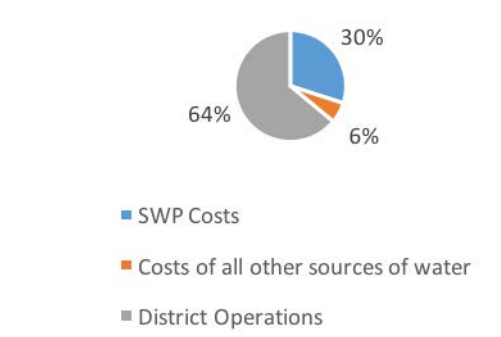


Figure 4
Montecito Water District Water Budget

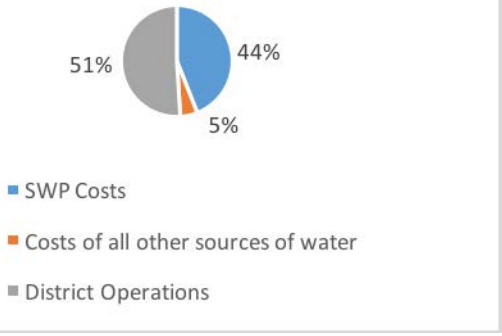
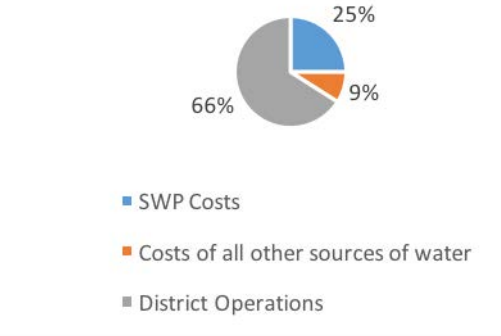


Figure 5
Goleta Water District Water Budget



Impact on Local Water Districts: The high costs imposed by the SWP on the South Coast districts may also cause distortions in district priorities. For example, a report by the Santa Barbara County 2006-07 Grand Jury noted that the Carpinteria Valley Water District is paying half of its $10 million/year budget for non-operational expenses, i.e., those primarily related to purchase and delivery of SWP water (this includes some other non-SWP costs as well).

The opening paragraph of this Grand Jury Report states as follows:

> *"The Carpinteria Valley Water District (CVWD) has delivered an essential product but has experienced the need for an exceptional amount of facility maintenance and upgrades. This*

has resulted in outstanding loans of $33.8 million against a total operating budget of less than $5 million per year. Coupled with the expense of a State Water option, ***which it does not need and uses little,*** *the district is strapped with nonoperational yearly expenses, which exceed $5 million. Total annual expenses therefore exceed $10 million, giving rise to high water rates."*

Montecito's 2012-13 Adopted Budget states that 45% ($4,995,100) of its operating budget and 39% of its total budget is required to pay for its SWP costs. **In 2014 all SWP contractors received only 5% of their Table A allocations of State Water**, but had to pay the full costs of the construction debt**.**

Many other Santa Barbara County water districts are also suffering from the high cost of SWP water. Repayment of SWP debt, along with SWP ongoing operation and maintenance costs, comprise the dominant costs for each water agency. Yet the volume of water these districts draw from the SWP in normal and wetter years is minimal compared to other available local sources such as the Cachuma Project. The high cost for the SWP debt, combined with reduced water sales strains district budgets, compromises district ability to maintain adequate reserves, perform system upgrades, and needed repairs. As a result, maintenance and upgrades are backlogged or must be paid out of dwindling reserve funds. C-WIN believes districts defaults on SWP payments are a real threat for many of these districts.

Debt Requirements Looming: In some cases, water districts are struggling to maintain the lenders' required bond coverage covenant of 125%. For instance, for fiscal year 2012-2013, Montecito had a bond coverage ratio of only 115%. During fiscal year 2009-2010, Goleta had a bond coverage ratio of only 120%.

Santa Barbara County during current drought

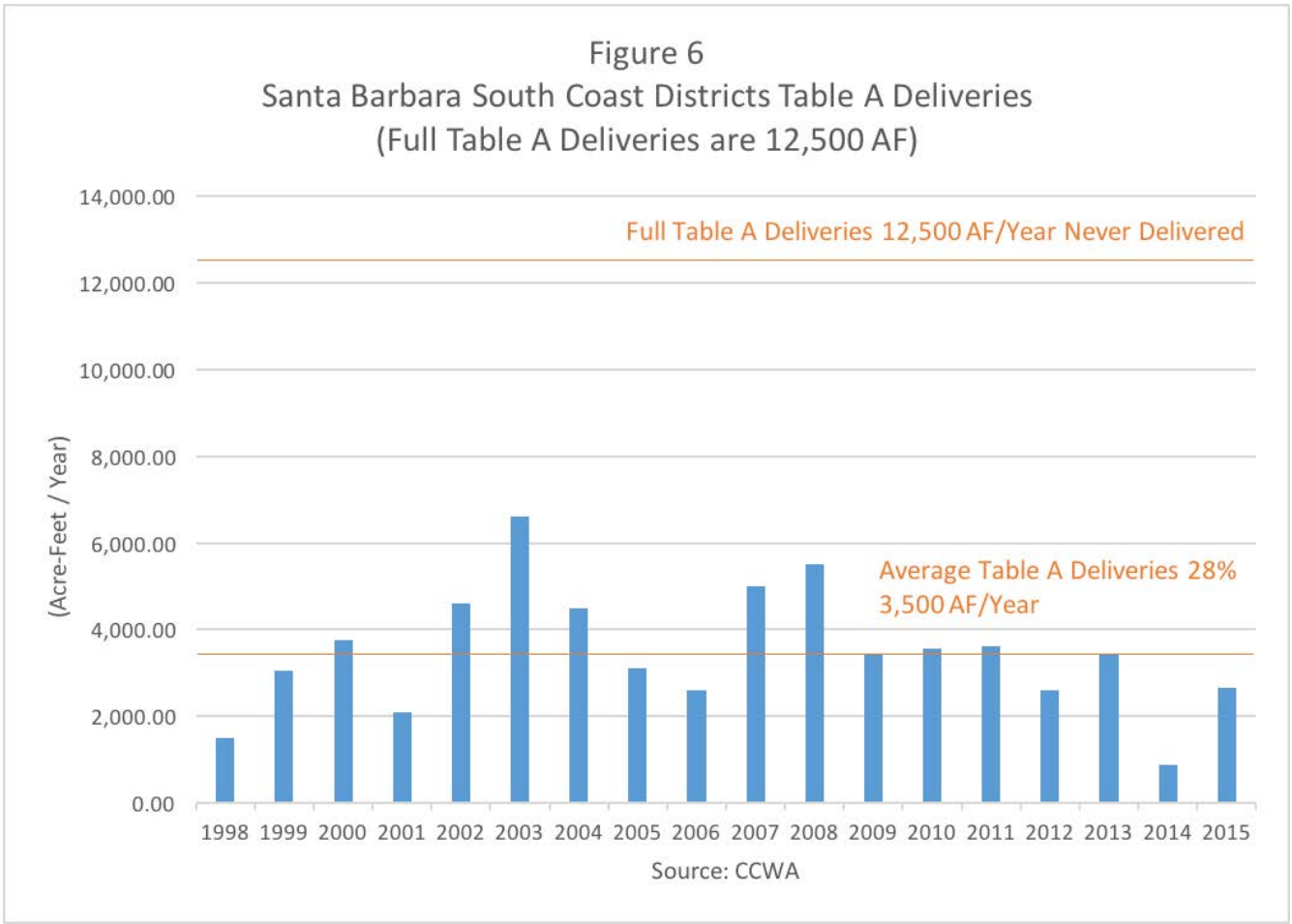
5) SWP RELIABILITY AND EFFECTIVE UNIT COSTS

Reliability

Before the 1991 election, voters were promised that the SWP contracts would be "97% reliable", meaning 97% of Table A water could be delivered. This promise has never been fulfilled.

However, it was made clear by all the supporting districts that SWP water was sought as a supplemental source to existing local sources, a supply that would be utilized during extreme droughts when local sources proved to be insufficient. This established a requirement for reliability quite different than that characterized as average delivery capability over a long period of time. The assurance of state water in time of need constitutes the best measure of reliability. This assurance is probably best met by operating the SWP on the basis of **safe yield**, which is that level the project can deliver every year given some small probability of shortfall. The SWP is not operated on this basis, and can therefore never meet the requirements for a reliable supplemental water source as intended by Santa Barbara County's water districts.

Figure 6 shows that over the past 18 years, the four South Coast districts received approximately 28% of their Table A allocation. **2014 was a very dry year for the entire state. The official SWP allocation of 5% is a clear demonstration the SWP coming up very short in the years it is needed most.**



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The availability of state water under present operational rules is limited year-to-year by the amount of runoff experienced in each year. C-WIN has examined the 98-year hydrologic record of the Sacramento River and found that **it is very likely that present operations can only provide a small fraction of Table A amounts during droughts**. DWR has never performed a proper analysis to determine a truly reliable level of delivery. Without such analysis, it is fruitless to propose structural solutions to the Delta's problems, given that *precipitation is the main limiting factor*. (See Appendix B for details on mischaracterizations of Sacramento River hydrology by DWR.)

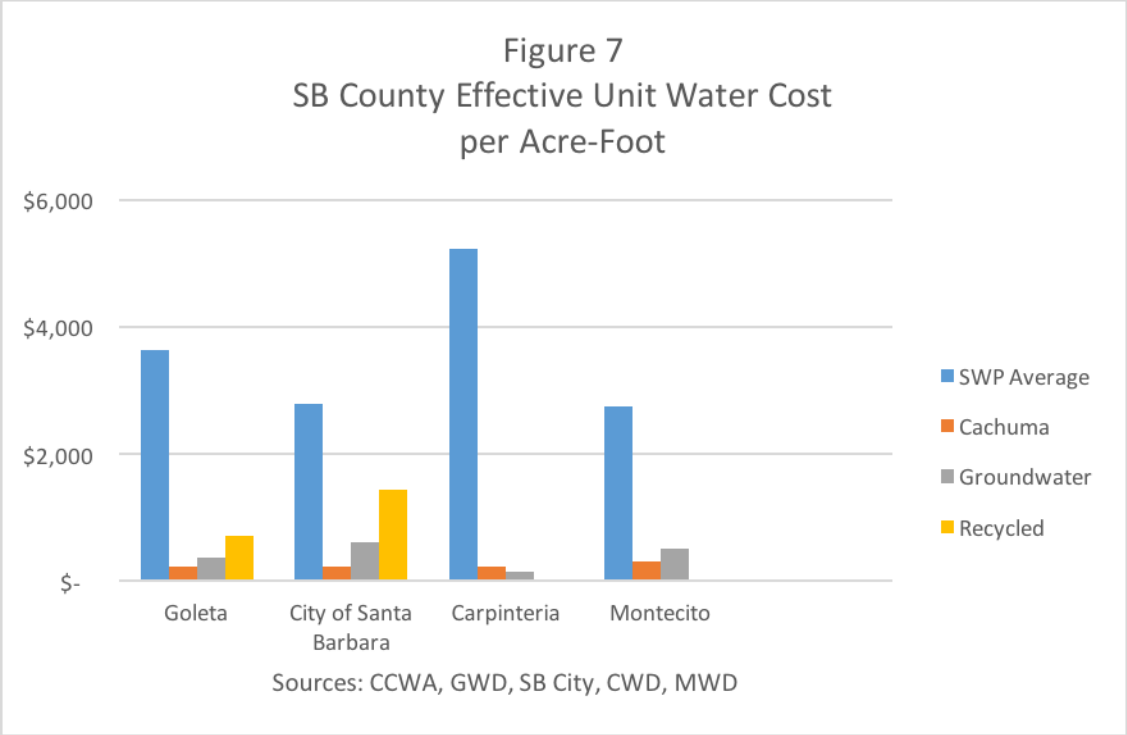
The SWP's difficulties in delivering full Table A allocations can be traced to the origin of the project, which dates to the late 1950's. The full statewide Table A amounts were developed in the 1950's and 1960's, and were based on potential new sources anticipated from further damming of California's North Coast rivers. Federal and State Wild and Scenic River designations for most North Coast rivers closed the door on these projections. The State Water Project also planned to build a Peripheral Canal to move water through the Delta. The bond measure to fund the Peripheral Canal was voted down by California voters in 1982, in large part due to the potential environmental devastation to the Bay/Delta. Without the availability of these sources, there is no likelihood of meeting Table A amounts.

Effective Unit Costs

The effective unit (acre-foot) costs of SWP water are highly variable and have led to costs considerably higher than those estimated for the 1991 ballot measure. This is because the water agencies must pay the fixed costs for the amount of water contracted, regardless of the amount delivered annually. Even if no SWP water is delivered these fixed costs must be paid.

C-WIN has determined that CCWA's estimated unit costs for SWP water on a per acre-foot basis are often greatly understated because CCWA bases cost estimates on full delivery of Table A Allocation amounts what has been shown to be a fictitious delivery amount. As shown in Figure 6 on the previous page, full Table A Allocations have **never** been delivered by the SWP and are unlikely to ever be delivered because of limited availability in times of drought and lack of need during wet years when the water is available.

Figure 7, on the following page, shows the **effective unit water cost** per acre foot for SWP water; *the cost of supply divided by the actual water delivered.* This is based on information from the four water agencies. Figure 7 compares the effective unit costs of state water against the effective unit cost of local sources for each of the four South Coast districts. In this figure, average costs over the last 5 years for SWP and local sources are presented. This is another way of showing the impact of a costly and unreliable project. Figure 7 shows that SWP costs significantly outweigh the costs of local water sources.



	SWP Average	Worst year, 2014 SWP Drought	Avg. Cachuma	Avg. Groundwater	Avg. Recycled
Goleta	$8,150AF	$21,500AF	$240AF	$376AF	$707AF
City of Santa Barbara	$12,299AF	$28,200AF	$240AF	$610AF	$1,450AF
Carpinteria	$8,800AF	$19,800AF	$240AF	$144AF	
Montecito	$15,132AF	$30,600AF	$310AF	$516AF	

Table 2 demonstrates the singular effects of SWP costs and deliveries by calculating the *effective unit costs of SWP deliveries* focusing only on those costs that are the fundamental allocations of Table A made by DWR at the beginning of each new contract year. Accordingly, no deliveries associated with the Article 21 surplus water, Turn-back Pool water, or Carryover water are included in delivered Table A allocations. Similarly, all the costs that are included in the CCWA invoices for such deliveries have been deducted from the invoiced costs. Also excluded are deliveries of and costs for supplemental purchased water.

On this basis Table 2 confirms the very high effective unit costs and exposes the extraordinary high costs during droughts when deliveries are curtailed. It is important to note that the costs and deliveries shown in Table 2 are more representative of SWP contract scenarios as they stood in 1991, when votes were taken. Since 1991, the SWP contract has been significantly amended to provide a far more liberal interpretation of non-Table A types of water and the established requirements for buying and selling water among SWP and non-SWP contractors. Further the amended SWP contract eliminated the **urban preference** for Table A deliveries, a primary factor causing lower deliveries during drought years and consequent high unit costs. The urban preference required

water for people before agriculture in times of drought. This safe guard was eliminated by the Monterey Amendments to the SWP contracts in 1995. C-WIN is currently contesting these Amendments in court.

Table 2
SWP Effective Unit Cost

City of SB			
	Delivery	Total Cost	Eff Unit Cost
	(Acre-ft/yr)	$M	$/AF
2010	541	4.31	$7,970
2011	773	4.71	$6,090
2012	703	4.77	$6,735
2013	339	4.24	$12,500
2014	165	4.81	$28,200
2015	0	4.66	(NWD)

Montecito			
	Delivery	Total Cost	Eff Unit Cost
	(Acre-ft/yr)	$M	$/AF
2010	500	4.91	$9,800
2011	218	4.86	$22,300
2012	0	4.45	(NWD)
2013	1155	5.27	$4,560
2014	165	5.06	$30,600
2015	660	5.56	$8,400

		Goleta	
	Delivery	Total Cost	Eff Unit Cost
	(Acre-ft/yr)	$M	$/AF
2010	1103	3.75	$3,400
2011	1126	6.63	$5,900
2012	972	7.24	$7,400
2013	1433	6.5	$4,500
2014	373	8.03	$21,500
2015	1592	9.83	$6,200

		Carpinteria	
	Delivery	Total Cost	Eff Unit Cost
	(Acre-ft/yr)	$M	$/AF
2010	492	3.22	$6,500
2011	501	3.23	$6,400
2012	433	3.03	$7,000
2013	500	3.66	$6,600
2014	110	3.08	$19,800
2015	450	3.01	$6,500

In the years of no SWP water deliveries, each district is still required to pay millions of dollars for their share of the revenue bonds.

Impact on Ratepayers

Retail water agencies are responsible for delivering water directly to homes and business customers. As nonprofit governmental institutions, they must by law recover their costs through their revenue-generating operations. They typically have two means of doing this: charging customers for the water they directly consume ("water rates") and charging customers for the meters that provide access to water and measures their consumption at the street. The latter is commonly referred to as the "fixed service charge."

Montecito is an example of the severity of the budget shortfalls experienced when water sales drastically decrease. Montecito has not been able to generate enough revenue from water sales or fixed service charges, and in 2014 instituted rationing. Severe penalties were imposed for going over allocation. When even this measure was not enough, Montecito levied an additional drought surcharge. Montecito's revenue from fines, levies and fixed charges is greater than revenue from water sales. This is not a sustainable way to run a water district.

Single Family Residential Rate Structures

C-WIN investigated retail water costs for an average single-family residential customer by obtaining data from updated Urban Water Management Plans (UWMP) and current district fee schedules for the four water agencies of the Santa Barbara coastal plain.

All four water districts have responded similarly in their efforts to increase revenues following high SWP costs. Prior to the 1987-1992 drought, unit rates and service charges were substantially lower as were the consequent water bills of the customers. These rates, however, are not as high as would be indicated by the effective unit costs of SWP deliveries. That is due to the fact that the bulk of delivered retail water is supplied by much lower- cost sources such as Lake Cachuma. Nonetheless, customer bills are several times higher than before the drought. For example, in 1991 (before South Coast districts incurred state water debt), Montecito's Water District's annual budget was $1 million. Today, with SWP debt, it is $14 million. The current drought promises further rate increases due to the need to procure supplemental purchased water because SWP water isn't there. These additional sources must be purchased on the spot market at prevailing prices, which are much higher than the variable costs of SWP water.

Balancing of Water Rates for Large and Small Users

The Santa Barbara County Grand Jury Report on the Carpinteria Valley Water District noted "…a serious imbalance in the monthly service charges between small and large meters … resulting in small water user costs that … are 2 ½ times the going rate in the general area." The subtext here: it is particularly difficult for Carpinteria to increase rates to provide sufficient revenues. Carpinteria has a substantial agricultural sector that constitutes a significant fraction of its retail water deliveries. If rates for agriculture are raised too high many of the farmers will activate private wells that can be operated at lesser cost. This results in lost revenue to the district leaving the residential sector to bear a disproportionately higher load.

In Montecito the district has instituted a parcel fee that is applied to developed and undeveloped parcels alike. This has helped raise needed revenues. Santa Maria has folded its waste water operation into the water department to constitute a single enterprise fund to help meet its obligations. *The need for increased revenues has brought about many creative cost management solutions to balance revenues with obligations, of which the single most important factor is SWP charges.*

6) IMPACTS OF THE PROPOSED TWIN TUNNELS

- Construction of the Twin Tunnels will place a significant burden on ratepayers, especially urban ratepayers, without delivery of any additional water when needed most in drought.
- Public water agencies may find it difficult to maintain fiscal solvency with this added burden.
- Planning costs of the Twin Tunnels already have increased the financial burden for ratepayers. The State already has spent $250 million, and is moving forward in the permitting process with only 10% of the proposed project engineered. The State has announced its need for an additional $1.2 billion to finalize the plans and complete the engineering for the Twin Tunnels.

Estimated Costs and Allocations to SB County Water Districts

In 2012, BDCP/CA WaterFix cost estimates for the Tunnels were $17.2 billion for construction. This is a gross underestimate because cost estimates have not been updated to reflect the construction timeline and do not include the potential for cost overruns. Such overruns are all too common for large construction projects, and can occur for a variety of reasons. The Coastal Branch Phase II Aqueduct, the most recent project built by DWR, which serves Santa Barbara and San Luis Obispo counties, is a classic example of an engineering project with significant cost overruns.

The construction costs for the tunnels range from an estimate of **$20.6 billion** (DWR) to **$38 billion** (ECONorthwest). The $20.6 billion number represents DWR's $17.2 billion estimate escalated to the expected period of construction, while the $38 billion is based on an independent analysis obtained by the consulting firm ECONorthwest, also escalated to the expected period of construction. (See Appendix A).

In order to calculate the annual costs that would accrue from selling bonds to finance these construction costs, several assumptions have been made. First, an interest rate of 6.1% was used as the bond financing rate. How the annual bond financing costs would be paid is still uncertain.

The proposed project would be built under the authority of the SWP contracts. Under those contracts, the Twin Tunnels financing costs likely would be part of Delta water cost. On this basis, each contractor's proportionate share would be equivalent to its proportionate share of Table A allocations.

The tunnel project was conceived to provide for both CVP and SWP deliveries across the Delta, with the CVP responsible for half the costs. Almost all CVP deliveries south of the Delta are for agriculture and about one-fourth of SWP deliveries are for agriculture. Agribusiness contractors are unsure they can sustain such a financial burden. They would prefer that the urban contractors assume a larger share. There is no obvious objective basis within the SWP to make such a shift between agriculture and urban beneficiaries but we have assumed an allocation based on each contractor's proportionate share of SWP construction costs to date. Since urban SWP contractors typically lie at the ends of the various branches of the SWP, they assume proportionately larger shares of construction costs than proportions based on Table A allocations.

Santa Barbara County Water District contractual cost share of Table A Delta water is approximately 1.1 % of the financed total. If the allocation is based on proportionate shares of SWP construction costs, the Santa Barbara County share of financing costs is approximately 3.4 %. These two values were used in estimating the impacts on Santa Barbara County SWP contractors. The costs are

further allocated within Santa Barbara to CCWA members (the water districts) on the basis of their proportionate shares of Table A water.

The impact analysis also addresses the possibility that the CVP would decline to participate in the tunnels project which provides a high value limit. In Tables 4 and 5, the designation "55/45" represents shares of the total costs allocated to the SWP and CVP; "100/0" indicates the total burden allocated to the SWP.

Table 4 shows the estimated share that would be allocated to the Santa Barbara County Flood Control and Water Conservation District (SBCFCWCD), the entity that holds Santa Barbara's SWP contract. Table 5 shows the shares further allocated to CCWA participants. Invoices to the SBCFCWCD show only a single additional charge for each share of the Twin Tunnels financing costs. These will be passed on to the CCWA participants based on proportionate shares of Table A amounts.

Table 4
Annual Costs Allocated to SBCFCWCD (CCWA)
$Million/yr.

SB Co. %	SWP/CVP Share			
Allocation	Low (55/45)	Low (100/0)	High (55/45)	High (100/0)
1.1%	7.7	14	15	27.3
3.4%	23.4	43.3	46.4	84.3

In Table 5, "no participation" by the CVP, (100/0), was excluded because the costs are untenable for Santa Barbara County. (See Table 4).

Table 5
Annual Costs to CCWA Participants (Participant Budget Impacts)
$Million/yr.

	SWP/CVP Share			
SB Co. % Allocation	Low (55/45)	High (55/45)	Low (55/45)	High (55/45)
	at 3.4%	*at 3.4%*	*at 1.1%*	*at 1.1%*
Montecito	1.71	3.4	.56	1.1
SB City	1.71	3.4	.56	1.1
Carpinteria	1.14	2.27	.38	.74
Goleta	2.57	5.10	.84	1.65
Santa Maria	9.36	18.5	3.04	6.00

As a state water contractor, Santa Barbara County will be required to make all payments necessary to recover its portion of the state's bond costs for constructing and operating the Twin Tunnels project. Tables 4 and 5 demonstrate these impacts will significantly inpact Santa Barbara County and CCWA participants. Participation will likely result in even greater water rate increases to cover the costs of a project that will not provide additional water supplies.

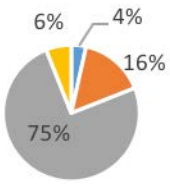
Steadily increasing water rates already have spurred fierce resistance from local ratepayers. The additional financial burden of the Twin Tunnels may result in ratepayer revolts through local elections or remedies provided by Proposition 218 to challenge fee increases. The statement from the 2006-07 Santa Barbara County Grand Jury Report on the Carpinteria Valley Water District is thus relevant to all County water agencies:

"Coupled with the expense of State Water option, which it does not need and uses little, the district is strapped with non-operational yearly expenses which exceed $5 million... giving rise to high water rates."

Budgetary Impacts

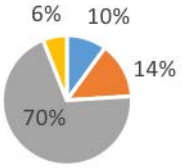
The cost allocations presented in Table 5 are examined from the perspective of water district budgets. This represents the impacts of the proposed Twin Tunnels. The following pie charts, one set for each district plus a set for Santa Maria, show the proportions of budgets that would be allocated to the SWP and the Twin Tunnels for each district under the assumptions of high and low construction costs. The pie charts in figures 8A-12B use the year 2014 as a baseline for all the costs not accounted by the SWP and the Twin Tunnels. These impacts reflect the degree of exposure for each district based on SWP Table A allocation relative to non-SWP sources of supply.

Figure 8A
City of Santa Barbara Estimated Budget Impacts of Proposed Twin Tunnels
(Assumes 2014 as baseline. Considering low costs to build)



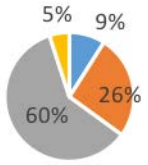
Twin Tunnels SWP
District Operations Local Water Sources

Figure 8B
City of Santa Barbara Estimated Budget Impacts of Proposed Twin Tunnels
(Assumes 2014 as baseline. Considering high costs to build)



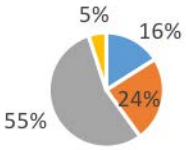
Twin Tunnels SWP
District Operations Local Water Sources

Figure 9A
Carpinteria Estimated Budget Impacts of Proposed Twin Tunnels
(Assumes 2014 as baseline. Considering low costs to build)



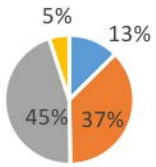
Twin Tunnels SWP
District Operations Local Sources

Figure 9B
Carpinteria Estimated Budget Impacts of Proposed Twin Tunnels
(Assumes 2014 as baseline. Considering high costs to build)



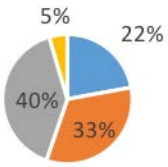
Twin Tunnels SWP
District Operations Local Sources

Figure 10A
Montecito Estimated Budget Impacts of Proposed Twin Tunnels
(Assumes 2014 as baseline. Considering low costs to build)



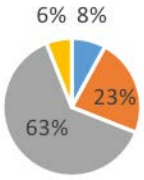
Twin Tunnels SWP
District Operations Local Sources

Figure 10B
Montecito Estimated Budget Impacts of Proposed Twin Tunnels
(Assumes 2014 as baseline. Considering high costs to build)



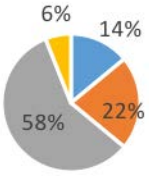
Twin Tunnels SWP
District Operations Local Sources

Figure 11A
Goleta Estimated Budget Impacts of Proposed Twin Tunnels
(Assumes 2014 as baseline. Considering low costs to build)



Twin Tunnels SWP
District Operations Local Sources

Figure 11B
Goleta Estimated Budget Impacts of Proposed Twin Tunnels
(Assumes 2014 as baseline. Considering high costs to build)



Twin Tunnels SWP
District Operations Local Sources

Santa Maria has a large Table A allocation and is thus likely to have a very large allocation of and more significant exposure to Twin Tunnels costs:

Figure 12A
Santa Maria Estimated Budget Impacts of Proposed Twin Tunnels
(Assumes 2014 as baseline. Considering low costs to build)

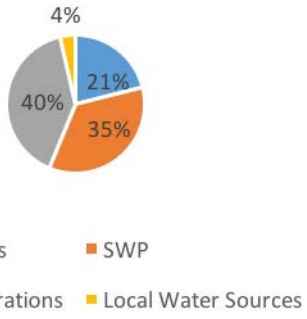
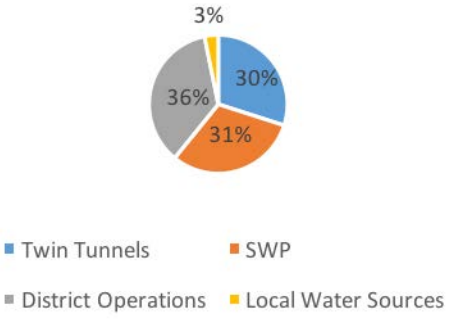


Figure 12B
Santa Maria Estimated Budget Impacts of Proposed Twin Tunnels
(Assumes 2014 as baseline. Considering high costs to build)



Cost Estimating Risk

The estimates provided above are based on the analyses of ECONorthwest as presented in Appendix A. Those analyses in turn are based on the best available information from project proponents: Bay Delta Conservation Plan (BDCP), DWR studies, and input from SWP contractors. That information is meager at best. Detailed investigations of tunneling to support competent engineering designs, which is a first order cost driver for the project, have not yet been completed. Without such designs it in unlikely that initial cost estimates are very accurate. The financing plan originally articulated in the March 12, 2012, BDCP, "Economic Benefits and Financing Strategies" has been used by ECONorthwest to develop the cost impacts of the project (Appendix A).

The BDCP estimated a 10 to 12 year construction period; that means 10 to 12 years of construction costs are accumulated before any tangible water delivery benefits are produced. The financing strategy proposes to capitalize only two years of the bond interest accumulated over the construction period; project participants are expected to cover the major fraction of the bond financing during the construction period. These costs are considerable. According to the spreadsheets prepared by ECONorthwest, these uncapitalized interest costs, when allocated to the SBCFCWCD accumulate to $45 M and $135 M for the low case at 1.1% and 3.4% respectively. Correspondingly, the amounts for the high case are $99 M and $308 M. These amounts equate to 20% to 24% of the estimated project costs without capitalized interest. Accordingly, all the values presented in Tables 4 and 5 would be increased by these percentages if it is determined that construction interest should be fully capitalized. This determination should be made by the project participants, the SWP contractors. It should also be a concern for the bond issuers and the bond buyers.

Twin Tunnels Benefits

The benefits of the Twin Tunnels project must be measured by its likelihood of improving the delivery of SWP and CVP water.

According to the analysis in Appendix B, at least half of the years in the 100-year record of the Sacramento River watershed will be dry. Of those years, half are too dry to confidently allow much, if any, export. In the other half of the dry years, if we account for senior water rights in the Delta and Sacramento Valley and provide for sufficient outflow to maintain Delta health, it is very unlikely that the dry group exports can exceed 2 million acre-feet. During droughts, 4-5 dry years can occur in sequences; therefore the project must be operated to provide a reliable yield under these circumstances; in effect a **safe yield** operation**. Because the Twin Tunnels proposes only to capture excess flows during wet years, it can make no claim to improve reliability.**

Project proponents claim the Twin Tunnels will improve the State's ability to capture and store the excess run-off that occurs in wet years. Wet years comprise 44% of the 100-year run-off record as shown in Appendix B; however, **the Twin Tunnels project involves no new storage.** Project supporters claim ground water basins in the San Joaquin Valley can be used to store significant amounts of water. But these basins are neither SWP nor CVP facilities. **Storing water there would amount to a privatization of project waters. Santa Barbara water districts have just witnessed the monopolistic windfall profits water privateers reap by selling to distressed water districts during drought periods.** These circumstances are at a complete variance with what voters were told in 1991.

The SWP did acquire a large ground water basin in Kern County for the specific purpose of improving SWP deliveries as part of their contractual obligations. But this basin ultimately was transferred to the Kern Water Bank Authority, a quasi-public district controlled by a non-SWP party. Water from this basin has been sold to water districts at monopoly prices though the current drought. If the SWP had continued to own and operate the basin, the costs of the water through the drought would be governed by SWP contractual pricing. It is this aspect of the Twin Tunnels project that is most disquieting**. It potentially allows the privatization of large amounts of project water with no guarantee of price limitations of any sort. Without a complementary SWP storage element south of the Delta, the Twin Tunnels provide no benefit to SWP contractors.**

Potential Benefits

Since there is **no public storage component south of the Delta** as part of the project, it is inconceivable that the Tunnels will deliver any new water. It could provide the capability to continue deliveries of SWP and CVP water south in the event of possible levee failures due to earthquakes, although the integrity of the delivery system itself may be jeopardized by such an event. Its merits as a hedge against climate change and consequent sea level rise are even less certain. **C-WIN sees no benefits for Santa Barbara County water users from the Twin Tunnels.**

7) CONCLUSIONS

C-WIN has documented the fundamental problems associated with the importation and distribution of SWP water. These findings have shown the ominous fiscal consequences for Santa Barbara County generally and for the South Coast water districts specifically: The City of Santa Barbara, Goleta, Carpinteria and Montecito. Costs estimated for construction of Governor Brown's Twin Tunnel/ CA WaterFix would add to the burden, forcing these agencies even closer to insolvency. Meanwhile ratepayers are responding to the price elasticity of supply and demand by using less water, resulting in declining district revenue.

Costs

For Water Districts:

- Presently, significant portions of water district budgets must be dedicated to the fixed costs of State Water Project delivery infrastructure and expenses.
- The four South Coast water districts addressed in this report presently have great difficulty with cost recovery, and the consequent drawdown of cash reserves signals that they are operating at a continuing deficit.
- All the districts in this study experience high effective unit costs for SWP water; this applies to normal years, but spikes during drought years when water supplies decrease.
- The Twin Tunnels will add significantly to these present burdens with no prospect of commensurate benefits.

For Both Ratepayers and Water Districts:

- Agencies have increased water rates substantially and local customers and ratepayers will see continued appreciation in water rates to cover ongoing State Water Project costs especially with Twin Tunnels' burdens added in. To recover all costs and rebuild reserves without going into additional debt, the water agencies would need to continue increasing monthly water service (i.e., fixed access) charges.
- Increased water rates and drought awareness have increased water conservation; this reduces revenue, incentivizing larger water users to turn to private sources, e.g. wells.
- Water districts are paying high fixed and operational costs for state water they either don't take, or take in small amounts. In times of need such as our current drought, state water is either unavailable or available only in deeply reduced allocations. The Twin Tunnels will only make this circumstance worse.

Approval and construction of the Twin Tunnels is not inevitable. This report finds that the extra costs of the project will produce significant budgetary impacts and no benefit.

We fear that it is too late for Santa Barbara County and its water agencies to withdraw from the burdensome financial obligations that they have incurred by connecting to the State Water Project. However, it is not too late to withdraw from the Bay-Delta Conservation Plan/CA WaterFix and any subsequent plan to construct tunnels under or around the Sacramento-San Joaquin Bay Delta. Santa Barbara County needs its financial resources to explore and create alternative water conservation projects and new local water resources such as desalination.

APPENDIX A

California WaterFix:

Potential Costs to Santa Barbara County

July 2016

Prepared for:

California Water Impact Network

FINAL REPORT

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Acknowledgments

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Kristin Lee and Ralph Mastromonaco prepared this report to California Water Impact Network with additional assistance from ECONorthwest staff and others. That assistance notwithstanding, ECONorthwest is responsible for the content of this report.

The staff at ECONorthwest prepared this report based on their general knowledge of water resource economics, and on information derived from government agencies, private statistical services, the reports of others, interviews of individuals, or other sources believed to be reliable. ECONorthwest has not independently verified the accuracy of all such information, and makes no representation regarding its accuracy or completeness. Any statements nonfactual in nature constitute the authors' current opinions, which may change as more information becomes available.

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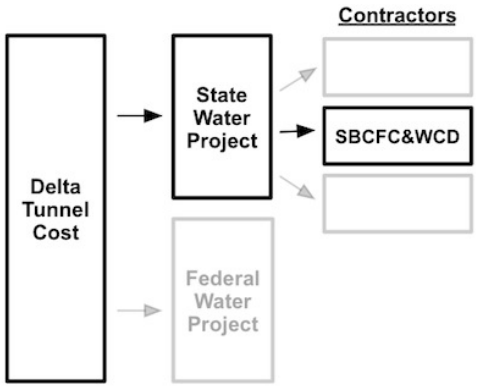
Introduction

In this report we summarize our analysis of the potential costs of the California WaterFix project to Santa Barbara County Flood Control and Water Conservation District (SBCFC&WCD). Our study has two primary scenarios: a low-cost scenario and a high-cost scenario. For each of these scenarios, we conduct several analyses using alternative assumptions about (1) how the costs of the WaterFix project would be allocated between the State and Federal Water Projects and (2) how the costs allocated to the State Water Project would be distributed among the 29 contractors (including SBCFC&WCD) participating in the State Water Project. (See Figure 1 below).

Figure 1. Flow of Costs of the Bay-Delta Conveyance Structure to Santa Barbara County Flood Control and Water Conservation District



Source: ECONorthwest

I. Cost of California WaterFix Project

In this section we describe our calculations of the cost of building and operating the California WaterFix project. We base our calculations on publicly available information about the project's costs.

The costs of the project would be paid, at least in part, by the State Water Project (SWP). The SWP would, in turn, pass the costs along to the 29 contractors that participate in the SWP. Ultimately, ratepayers, including those in Santa Barbara County, would bear the burden of paying for the project.

Given the preliminary nature of the available cost information, we conducted our analysis using two primary scenarios: a low-cost scenario and a high-cost scenario, as we describe below and in Table 1.

A. Low-Cost Scenario (Excluding Finance Charges)

Information from the California Natural Resources Agency (CNR) released in June 2016 identifies the estimated cost of the California WaterFix project. According to CNR, the project's design, construction, O&M, and related mitigation cost is an estimated $17.1 billion (in 2014 dollars).[1] We use this estimated cost in the low-cost scenario. Additional detail about the construction and mitigation costs (but not the O&M costs) is included in a January 2016 agreement between the Department of Water Resources and the Conveyance Project Coordination Agency.[2] We gleaned additional information about the costs by reviewing the cost data, and underlying documentation, for the previous proposals.[3]

We adjusted the costs to account for likely inflation of costs between the time of the cost estimate, 2014, and the estimated year construction would begin. For the design and construction costs, we also account for inflation during the 10-year construction period. For purposes of our analysis, we inflate the $17.1 billion in costs (in 2014 dollars) by applying an annual inflation rate of 2 percent, which is the same inflation rate used in previous analyses of the BDCP.[4] As Table 1 shows, the result is $20.3 billion (in 2017 dollars).

B. High-Cost Scenario (Excluding Finance Charges)

To address the uncertainty associated with the cost estimates, we use a high-cost estimate with double the design and construction costs of the low-cost estimate. As Table 1 shows, we use the same mitigation and O&M costs as in the low-cost estimate. Cost overruns on large construction projects are not uncommon. In its analysis of the costs of the WaterFix project, the San Diego Water Authority also used a high-cost estimate that was twice the size of the low-cost estimate to help capture the uncertainty associated with the cost estimates.[5] For purposes of this analysis, we use a high-cost estimate of $38.2 billion (in 2017 dollars).

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[1] California Natural Resources Agency. 2016. "Fast Facts." June. Accessed at http://www.californiawaterfix.com/.

[2] State of California, Department of Water Resources and Conveyance Project Coordination Agency. 2016. "Agreement Regarding Construction of Conveyance Project Between the Department of Water Resources and the Conveyance Project Coordination Agency." January. Accessed at http://www.californiawaterfix.com/resources/design-and-construction-enterprise/.

[3] *See,* for example, California Department of Water Resources. 2013. *Bay Delta Conservation Plan. Public Draft. November.* Sacramento, CA. Prepared by ICF International (ICF 00343.12). Sacramento, CA; and California Department of Water Resources. 2012. *Bay Delta Conservation Plan. Administrative Draft. November.* Sacramento, CA. Prepared by ICF International. Sacramento, CA.

[4] Ibid.

[5] San Diego County Water Authority. 2015. "Bay Delta Conservation Plan/California WaterFix: Potential Cost Impact to the Water Authority." December.

Table 1. California WaterFix: Low-Cost and High-Cost Scenarios without Financing Costs

		Design & Construction	Mitigation	O&M	Finance Costs	Total
Low-Cost Scenario	2014 $	$14.9 billion	$796 million	$1.4 billion	Not included	$17.1 billion
	2017 $	$17.9 billion	$845 million	$1.49 billion	Not included	$20.3 billion
High-Cost Scenario	2017 $	$35.8 billion	$845 million	$1.49 billion	Not included	$38.2 billion

Source: "Low Cost Scenario" data are from CNR "Fast Facts"
"High Cost Scenario" data are based on calculations by ECONorthwest.
Note: all dollar values are undiscounted.

II. Financing California WaterFix

The most recent publicly available information about the WaterFix project does not include details on how the project would be financed. For purposes of this analysis, we assume the project would be financed similar to the financing plan outlined for the project in the Bay Delta Conservation Plan (BDCP).[6] According to this plan, four revenue bonds would be used to finance the design and construction elements of the project.[7] Each bond would fund a portion of these costs over time. All of the bonds would have a period of capitalized interest and a 40-year pay-back period, with interest rates ranging from 6.132 to 6.135 percent.[8]

[6] *See,* for example, California Department of Water Resources. 2013. *Bay Delta Conservation Plan. Public Draft. November.* Sacramento, CA. Prepared by ICF International (ICF 00343.12). Sacramento, CA; California Department of Water Resources. 2012. *Bay Delta Conservation Plan. Administrative Draft. November.* Sacramento, CA. Prepared by ICF International. Sacramento, CA; and Southern California Water Committee and The PFM Group. 2012. *Bay Delta Conservation Plan: Economic Benefits and Financing Strategies*. March.

[7] As we understand, these bonds would be issued by DWR. Financing costs would be different if the contractors had to issue separate bonds for their shares.

[8] These interest rates represent the "all in true interest cost." *See,* for example, California Department of Water Resources. 2013. *Bay Delta Conservation Plan. Public Draft. November.* Sacramento, CA. Prepared by ICF International (ICF 00343.12). Sacramento, CA; and California Department of Water Resources. 2012. *Bay Delta Conservation Plan. Administrative Draft. November.* Sacramento, CA. Prepared by ICF International. Sacramento, CA.

Table 2. Overall Costs of California WaterFix, with Finance Costs Included

	Design & Construction	Mitigation	O&M	Finance Costs	Total	Annual Cost
Low-Cost Scenario	$17.9 billion	$845 million	$1.49 billion	$30.5 billion	**$50.8 billion**	**$1.27 billion**
High-Cost Scenario	$35.8 billion	$845 million	$1.49 billion	$61.1 billion	**$99.2 billion**	**$2.48 billion**

Source: ECONorthwest.

Table 2 shows the financing costs associated with the two cost scenarios. Adding the costs of financing brings the overall cost of the low-cost scenario to $50.8 billion and the high-cost scenario to $99.2 billion. It also shows, for budgeting purposes, the peak annual costs associated with payments on the bonds and the mitigation and O&M costs. See the Appendix for more detailed tables of results.

III. Allocation of Costs Between State and Federal Water Projects

In this section we calculate the share of the overall WaterFix costs that would be allocated to the State Water Project (SWP). This is the first step in identifying the potential costs that the SBCFC&WCD would bear.

Based on the information we have reviewed, we assume that the State and Federal Water Projects would share the costs of California WaterFix.[9] Although the split between the state and federal projects has not been determined, there is precedent for a 55/45 cost share ratio (the SWP would pay 55 percent of the cost, and the federal project would pay 45 percent of the cost).[10] Therefore, for one set of calculations, we assume the SWP would be allocated 55 percent of the overall cost. We also run a second set of calculations using an assumption that the SWP would pay 100 percent of the cost.

[9] According to the California Natural Resources Agency, "state/federal funding" may also cover an unidentified portion of the $1.4 billion O&M. *See* California Natural Resources Agency. 2016. "Fast Facts." June. Accessed at http://www.californiawaterfix.com/.

[10] California Department of Water Resources. 2013. *Bay Delta Conservation Plan. Public Draft. November.* Sacramento, CA. Prepared by ICF International (ICF 00343.12). Sacramento, CA. *See also,* San Diego County Water Authority. 2015. "Bay Delta Conservation Plan/California WaterFix: Potential Cost Impact to the Water Authority." December.

Table 3. State Water Project Share of California WaterFix Costs

	SWP Share	Total
Low-Cost Scenario	55	$27.9 billion
	100	$50.8 billion
High-Cost Scenario	55	$54.6 billion
	100	$99.2 billion

Source: ECONorthwest.

Table 3 shows that the SWP would bear $27.9 billion to $99.2 billion of costs for the project, depending on how the cost estimates would be allocated between the State and Federal Water Projects.

IV. Allocation of Costs to State Water Contractors

In this section we calculate the potential costs that the Santa Barbara County Flood Control and Water Conservation District (SBCFC&WCD) would bear. We assume that the State Water Project would pass the WaterFix costs onto its 29 contractors, including SBCFC&WCD.

For this part of the analysis, we allocated the costs in two different ways. First, we allocated the costs based on SBCFC&WCD's share of the water allotment from the State Water Project. We used the "Table A" maximum amount. SBCFC&WCD has a maximum volume of 45,486 acre-feet, which is 1.1 percent of the total maximum volume of the State Water Project.[11] Therefore, one set of our calculations is based on allocating 1.1 percent of the SWP's WaterFix costs to SBCFC&WCD.

Second, we used a different allocation of costs, based on SBCFC&WCD's share of total payments to the SWP. According to the latest data available, SBCFC&WCD payments account for 3.4 percent of the total payments to the SWP through 2013.[12] Therefore, a second set of our calculations is based on allocating 3.4 percent of the SWP's WaterFix costs to SBCFC&WCD.

[11] California Department of Water Resources. 2016. "California State Water Project Contractors: Maximum Table A Amounts." January. Accessed at www.water.ca.gov/swpao.

[12] California Department of Water Resources. 2015. *Management of the California State Water Project.* Bulletin 132-14. November.

Table 4. Allocation of Costs to SBCFC&WCD

		SWP 55/45		SWP 100	
	SBCFC&WCD Share:	1.1%	3.4%	1.1%	3.4%
Low-Cost Scenario		$304 million	$554 million	$944 million	$1.7 billion
High-Cost Scenario		$595 million	$1.08 billion	$1.84 billion	$3.35 billion

Source: ECONorthwest.

Table 4 shows SBCFC&WCD's shares of the California WaterFix costs. The results range from $304 million to $3.35 billion using the different allocation assumptions for the SWP allocations and, in turn, for the SBCFC&WCD allocations.

Summary

This analysis provides a range of results identifying SBCFC&WCD's potential share of the costs of the California WaterFix project over a 10-year construction period and 40 years of operations.

Based on the low-cost scenario of $50.8 billion in overall costs, SBCFC&WCD would bear costs ranging from $304 million to $1.7 billion depending on how the costs are allocated to the SWP and to SBCFC&WCD.

Based on the high-cost scenario of $99.2 billion in overall costs, SBCFC&WCD would bear costs ranging from $595 million to $3.35 billion depending on how the costs are allocated to the SWP and to SBCFC&WCD.[13]

[13] See the Appendix for more detailed tables of results.

Appendix: Detailed Tables

Total Payments, Low-Cost Scenario

								SWP Pays	*SWP Pays*	*SB % of SWP (vol)*	*SB % of SWP (vol)*	*SB % of SWP ($)*	*SB % of SWP ($)*
								55%	*100%*	*1.1%*	*1.1%*	*3.4%*	*3.4%*
Date	**1st Series Payment**	**2nd Series Payment**	**3rd Series Payment**	**4th Series Payment**	**O&M**	**Mitigation**	**Total**	**Cost Paid by SWP (55/45)**	**Cost Paid by SWP (SWP 100)**	**Cost Paid by SB (55/45)**	**Cost Paid by SB (SWP 100)**	**Cost Paid by SB (55/45)**	**Cost Paid by SB (SWP 100)**
6/1/17	-	-	-	-		$68,128,450	$68,128,450	$37,470,648	$68,128,450	$408,454	$742,643	$1,266,256	$2,302,284
6/1/18	$295,065,303	-	-	-		$70,839,023	$365,904,326	$201,247,379	$365,904,326	$2,193,723	$3,988,588	$6,800,811	$12,365,111
6/1/19	$295,065,303	-	-	-		$70,839,023	$365,904,326	$201,247,379	$365,904,326	$2,193,723	$3,988,588	$6,800,811	$12,365,111
6/1/20	$295,065,303	$285,192,400	-	-		$40,621,645	$620,879,348	$341,483,641	$620,879,348	$3,722,387	$6,767,977	$11,539,856	$20,981,556
6/1/21	$295,065,303	$285,192,400	$436,328,085	-		$40,621,645	$1,057,207,433	$581,464,088	$1,057,207,433	$6,338,325	$11,524,228	$19,649,585	$35,726,518
6/1/22	$295,065,303	$285,192,400	$436,328,085	-		$40,621,645	$1,057,207,433	$581,464,088	$1,057,207,433	$6,338,325	$11,524,228	$19,649,585	$35,726,518
6/1/23	$295,065,303	$285,192,400	$436,328,085	$194,767,054		$40,603,737	$1,251,956,580	$688,576,119	$1,251,956,580	$7,505,914	$13,647,117	$23,269,253	$42,307,732
6/1/24	$295,065,303	$285,192,400	$436,328,085	$194,767,054		$39,962,417	$1,251,315,260	$688,223,393	$1,251,315,260	$7,502,069	$13,640,126	$23,257,333	$42,286,060
6/1/25	$295,065,303	$285,192,400	$436,328,085	$194,767,054		$39,962,417	$1,251,315,260	$688,223,393	$1,251,315,260	$7,502,069	$13,640,126	$23,257,333	$42,286,060
6/1/26	$295,065,303	$285,192,400	$436,328,085	$194,767,054		$34,798,759	$1,246,151,602	$685,383,381	$1,246,151,602	$7,471,111	$13,583,839	$23,161,359	$42,111,563
6/1/27	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$25,620,645	$32,088,186	$1,269,061,674	$697,983,921	$1,269,061,674	$7,608,465	$13,833,573	$23,587,173	$42,885,769
6/1/28	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$25,620,645	$32,088,186	$1,269,061,674	$697,983,921	$1,269,061,674	$7,608,465	$13,833,573	$23,587,173	$42,885,769
6/1/29	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$25,620,645	$20,964,010	$1,257,937,498	$691,865,624	$1,257,937,498	$7,541,772	$13,712,312	$23,380,416	$42,509,847
6/1/30	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$25,620,645	$20,964,010	$1,257,937,498	$691,865,624	$1,257,937,498	$7,541,772	$13,712,312	$23,380,416	$42,509,847
6/1/31	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$25,620,645	$20,964,010	$1,257,937,498	$691,865,624	$1,257,937,498	$7,541,772	$13,712,312	$23,380,416	$42,509,847
6/1/32	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228	$20,964,010	$1,271,105,080	$699,107,794	$1,271,105,080	$7,620,716	$13,855,847	$23,625,153	$42,954,823
6/1/33	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228	$20,964,010	$1,271,105,080	$699,107,794	$1,271,105,080	$7,620,716	$13,855,847	$23,625,153	$42,954,823
6/1/34	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228	$20,964,010	$1,271,105,080	$699,107,794	$1,271,105,080	$7,620,716	$13,855,847	$23,625,153	$42,954,823
6/1/35	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228	$20,964,010	$1,271,105,080	$699,107,794	$1,271,105,080	$7,620,716	$13,855,847	$23,625,153	$42,954,823
6/1/36	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228	$20,964,010	$1,271,105,080	$699,107,794	$1,271,105,080	$7,620,716	$13,855,847	$23,625,153	$42,954,823
6/1/37	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228	$20,964,010	$1,271,105,080	$699,107,794	$1,271,105,080	$7,620,716	$13,855,847	$23,625,153	$42,954,823
6/1/38	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228	$20,964,010	$1,271,105,080	$699,107,794	$1,271,105,080	$7,620,716	$13,855,847	$23,625,153	$42,954,823
6/1/39	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228	$20,964,010	$1,271,105,080	$699,107,794	$1,271,105,080	$7,620,716	$13,855,847	$23,625,153	$42,954,823
6/1/40	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228	$20,964,010	$1,271,105,080	$699,107,794	$1,271,105,080	$7,620,716	$13,855,847	$23,625,153	$42,954,823
6/1/41	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228	$20,964,010	$1,271,105,080	$699,107,794	$1,271,105,080	$7,620,716	$13,855,847	$23,625,153	$42,954,823
6/1/42	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228	$20,964,010	$1,271,105,080	$699,107,794	$1,271,105,080	$7,620,716	$13,855,847	$23,625,153	$42,954,823
6/1/43	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228		$1,250,141,070	$687,577,589	$1,250,141,070	$7,495,030	$13,627,326	$23,235,509	$42,246,380
6/1/44	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228		$1,250,141,070	$687,577,589	$1,250,141,070	$7,495,030	$13,627,326	$23,235,509	$42,246,380
6/1/45	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228		$1,250,141,070	$687,577,589	$1,250,141,070	$7,495,030	$13,627,326	$23,235,509	$42,246,380
6/1/46	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228		$1,250,141,070	$687,577,589	$1,250,141,070	$7,495,030	$13,627,326	$23,235,509	$42,246,380
6/1/47	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228		$1,250,141,070	$687,577,589	$1,250,141,070	$7,495,030	$13,627,326	$23,235,509	$42,246,380
6/1/48	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228		$1,250,141,070	$687,577,589	$1,250,141,070	$7,495,030	$13,627,326	$23,235,509	$42,246,380
6/1/49	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228		$1,250,141,070	$687,577,589	$1,250,141,070	$7,495,030	$13,627,326	$23,235,509	$42,246,380
6/1/50	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228		$1,250,141,070	$687,577,589	$1,250,141,070	$7,495,030	$13,627,326	$23,235,509	$42,246,380
6/1/51	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228		$1,250,141,070	$687,577,589	$1,250,141,070	$7,495,030	$13,627,326	$23,235,509	$42,246,380
6/1/52	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228		$1,250,141,070	$687,577,589	$1,250,141,070	$7,495,030	$13,627,326	$23,235,509	$42,246,380
6/1/53	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228		$1,250,141,070	$687,577,589	$1,250,141,070	$7,495,030	$13,627,326	$23,235,509	$42,246,380
6/1/54	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228		$1,250,141,070	$687,577,589	$1,250,141,070	$7,495,030	$13,627,326	$23,235,509	$42,246,380
6/1/55	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228		$1,250,141,070	$687,577,589	$1,250,141,070	$7,495,030	$13,627,326	$23,235,509	$42,246,380
6/1/56	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228		$1,250,141,070	$687,577,589	$1,250,141,070	$7,495,030	$13,627,326	$23,235,509	$42,246,380
6/1/57	$295,065,303	$285,192,400	$436,328,085	$194,767,054	$38,788,228		$1,250,141,070	$687,577,589	$1,250,141,070	$7,495,030	$13,627,326	$23,235,509	$42,246,380
6/1/58	-	$285,192,400	$436,328,085	$194,767,054	$38,788,228		$955,075,767	$525,291,672	$955,075,767	$5,726,011	$10,410,928	$17,751,334	$32,275,152
6/1/59	-	$285,192,400	$436,328,085	$194,767,054	$38,788,228		$955,075,767	$525,291,672	$955,075,767	$5,726,011	$10,410,928	$17,751,334	$32,275,152
6/1/60	-	-	$436,328,085	$194,767,054	$38,788,228		$669,883,367	$368,435,852	$669,883,367	$4,016,183	$7,302,151	$12,450,660	$22,637,563
6/1/61	-	-	-	$194,767,054	$38,788,228		$233,555,282	$128,455,405	$233,555,282	$1,400,245	$2,545,900	$4,340,931	$7,892,601
6/1/62	-	-	-	$194,767,054	$38,788,228		$233,555,282	$128,455,405	$233,555,282	$1,400,245	$2,545,900	$4,340,931	$7,892,601
6/1/63	-	-	-	-	$38,788,228		$38,788,228	$21,333,525	$38,788,228	$232,549	$422,816	$720,930	$1,310,782
6/1/64	-	-	-	-	$38,788,228		$38,788,228	$21,333,525	$38,788,228	$232,549	$422,816	$720,930	$1,310,782
6/1/65	-	-	-	-	$38,788,228		$38,788,228	$21,333,525	$38,788,228	$232,549	$422,816	$720,930	$1,310,782
6/1/66	-	-	-	-	$38,788,228		$38,788,228	$21,333,525	$38,788,228	$232,549	$422,816	$720,930	$1,310,782
						TOTAL	**$50,784,476,175**	**$27,931,461,896**	**$50,784,476,175**	**$304,470,557**	**$553,582,830**	**$943,895,995**	**$1,716,174,537**

Total Payments, High-Cost Scenario

								SWP Pays	*SWP Pays*	*SB % of SWP (vol)*	*SB % of SWP (vol)*	*SB % of SWP ($)*	*SB % of SWP ($)*
								55%	*100%*	*1.1%*	*1.1%*	*3.4%*	*3.4%*
Date	**1st Series Payment**	**2nd Series Payment**	**3rd Series Payment**	**4th Series Payment**	**O&M**	**Mitigation**	**Total**	**Cost Paid by SWP (55/45)**	**Cost Paid by SWP (SWP 100)**	**Cost Paid by SB (55/45)**	**Cost Paid by SB (SWP 100)**	**Cost Paid by SB (55/45)**	**Cost Paid by SB (SWP 100)**
6/1/17	-	-	-	-		$68,128,450	$68,128,450	$37,470,648	$68,128,450	$408,454	$742,643	$1,266,256	$2,302,284
6/1/18	$590,130,606	-	-	-		$70,839,023	$660,969,629	$363,533,296	$660,969,629	$3,962,742	$7,204,986	$12,284,986	$22,336,338
6/1/19	$590,130,606	-	-	-		$70,839,023	$660,969,629	$363,533,296	$660,969,629	$3,962,742	$7,204,986	$12,284,986	$22,336,338
6/1/20	$590,130,606	$570,384,800	-	-		$40,621,645	$1,201,137,051	$660,625,378	$1,201,137,051	$7,201,233	$13,093,152	$22,324,705	$40,590,373
6/1/21	$590,130,606	$570,384,800	$872,656,171	-		$40,621,645	$2,073,793,221	$1,140,586,272	$2,073,793,221	$12,433,110	$22,605,654	$38,544,163	$70,080,296
6/1/22	$590,130,606	$570,384,800	$872,656,171	-		$40,621,645	$2,073,793,221	$1,140,586,272	$2,073,793,221	$12,433,110	$22,605,654	$38,544,163	$70,080,296
6/1/23	$590,130,606	$570,384,800	$872,656,171	$389,534,109		$40,603,737	$2,463,309,422	$1,354,820,182	$2,463,309,422	$14,768,395	$26,851,627	$45,783,831	$83,243,330
6/1/24	$590,130,606	$570,384,800	$872,656,171	$389,534,109		$39,962,417	$2,462,668,102	$1,354,467,456	$2,462,668,102	$14,764,550	$26,844,636	$45,771,912	$83,221,658
6/1/25	$590,130,606	$570,384,800	$872,656,171	$389,534,109		$39,962,417	$2,462,668,102	$1,354,467,456	$2,462,668,102	$14,764,550	$26,844,636	$45,771,912	$83,221,658
6/1/26	$590,130,606	$570,384,800	$872,656,171	$389,534,109		$34,798,759	$2,457,504,444	$1,351,627,444	$2,457,504,444	$14,733,592	$26,788,349	$45,675,938	$83,047,161
6/1/27	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$25,620,645	$32,088,186	$2,480,414,516	$1,364,227,984	$2,480,414,516	$14,870,946	$27,038,083	$46,101,752	$83,821,367
6/1/28	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$25,620,645	$32,088,186	$2,480,414,516	$1,364,227,984	$2,480,414,516	$14,870,946	$27,038,083	$46,101,752	$83,821,367
6/1/29	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$25,620,645	$20,964,010	$2,469,290,340	$1,358,109,687	$2,469,290,340	$14,804,252	$26,916,823	$45,894,995	$83,445,445
6/1/30	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$25,620,645	$20,964,010	$2,469,290,340	$1,358,109,687	$2,469,290,340	$14,804,252	$26,916,823	$45,894,995	$83,445,445
6/1/31	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$25,620,645	$20,964,010	$2,469,290,340	$1,358,109,687	$2,469,290,340	$14,804,252	$26,916,823	$45,894,995	$83,445,445
6/1/32	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228	$20,964,010	$2,482,457,923	$1,365,351,858	$2,482,457,923	$14,883,197	$27,060,358	$46,139,731	$83,890,421
6/1/33	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228	$20,964,010	$2,482,457,923	$1,365,351,858	$2,482,457,923	$14,883,197	$27,060,358	$46,139,731	$83,890,421
6/1/34	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228	$20,964,010	$2,482,457,923	$1,365,351,858	$2,482,457,923	$14,883,197	$27,060,358	$46,139,731	$83,890,421
6/1/35	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228	$20,964,010	$2,482,457,923	$1,365,351,858	$2,482,457,923	$14,883,197	$27,060,358	$46,139,731	$83,890,421
6/1/36	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228	$20,964,010	$2,482,457,923	$1,365,351,858	$2,482,457,923	$14,883,197	$27,060,358	$46,139,731	$83,890,421
6/1/37	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228	$20,964,010	$2,482,457,923	$1,365,351,858	$2,482,457,923	$14,883,197	$27,060,358	$46,139,731	$83,890,421
6/1/38	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228	$20,964,010	$2,482,457,923	$1,365,351,858	$2,482,457,923	$14,883,197	$27,060,358	$46,139,731	$83,890,421
6/1/39	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228	$20,964,010	$2,482,457,923	$1,365,351,858	$2,482,457,923	$14,883,197	$27,060,358	$46,139,731	$83,890,421
6/1/40	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228	$20,964,010	$2,482,457,923	$1,365,351,858	$2,482,457,923	$14,883,197	$27,060,358	$46,139,731	$83,890,421
6/1/41	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228	$20,964,010	$2,482,457,923	$1,365,351,858	$2,482,457,923	$14,883,197	$27,060,358	$46,139,731	$83,890,421
6/1/42	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228	$20,964,010	$2,482,457,923	$1,365,351,858	$2,482,457,923	$14,883,197	$27,060,358	$46,139,731	$83,890,421
6/1/43	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228		$2,461,493,913	$1,353,821,652	$2,461,493,913	$14,757,510	$26,831,837	$45,750,088	$83,181,978
6/1/44	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228		$2,461,493,913	$1,353,821,652	$2,461,493,913	$14,757,510	$26,831,837	$45,750,088	$83,181,978
6/1/45	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228		$2,461,493,913	$1,353,821,652	$2,461,493,913	$14,757,510	$26,831,837	$45,750,088	$83,181,978
6/1/46	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228		$2,461,493,913	$1,353,821,652	$2,461,493,913	$14,757,510	$26,831,837	$45,750,088	$83,181,978
6/1/47	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228		$2,461,493,913	$1,353,821,652	$2,461,493,913	$14,757,510	$26,831,837	$45,750,088	$83,181,978
6/1/48	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228		$2,461,493,913	$1,353,821,652	$2,461,493,913	$14,757,510	$26,831,837	$45,750,088	$83,181,978
6/1/49	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228		$2,461,493,913	$1,353,821,652	$2,461,493,913	$14,757,510	$26,831,837	$45,750,088	$83,181,978
6/1/50	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228		$2,461,493,913	$1,353,821,652	$2,461,493,913	$14,757,510	$26,831,837	$45,750,088	$83,181,978
6/1/51	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228		$2,461,493,913	$1,353,821,652	$2,461,493,913	$14,757,510	$26,831,837	$45,750,088	$83,181,978
6/1/52	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228		$2,461,493,913	$1,353,821,652	$2,461,493,913	$14,757,510	$26,831,837	$45,750,088	$83,181,978
6/1/53	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228		$2,461,493,913	$1,353,821,652	$2,461,493,913	$14,757,510	$26,831,837	$45,750,088	$83,181,978
6/1/54	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228		$2,461,493,913	$1,353,821,652	$2,461,493,913	$14,757,510	$26,831,837	$45,750,088	$83,181,978
6/1/55	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228		$2,461,493,913	$1,353,821,652	$2,461,493,913	$14,757,510	$26,831,837	$45,750,088	$83,181,978
6/1/56	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228		$2,461,493,913	$1,353,821,652	$2,461,493,913	$14,757,510	$26,831,837	$45,750,088	$83,181,978
6/1/57	$590,130,606	$570,384,800	$872,656,171	$389,534,109	$38,788,228		$2,461,493,913	$1,353,821,652	$2,461,493,913	$14,757,510	$26,831,837	$45,750,088	$83,181,978
6/1/58	-	$570,384,800	$872,656,171	$389,534,109	$38,788,228		$1,871,363,307	$1,029,249,819	$1,871,363,307	$11,219,472	$20,399,041	$34,781,738	$63,239,523
6/1/59	-	$570,384,800	$872,656,171	$389,534,109	$38,788,228		$1,871,363,307	$1,029,249,819	$1,871,363,307	$11,219,472	$20,399,041	$34,781,738	$63,239,523
6/1/60	-	-	$872,656,171	$389,534,109	$38,788,228		$1,300,978,507	$715,538,179	$1,300,978,507	$7,799,818	$14,181,487	$24,180,389	$43,964,344
6/1/61	-	-	-	$389,534,109	$38,788,228		$428,322,336	$235,577,285	$428,322,336	$2,567,941	$4,668,984	$7,960,932	$14,474,421
6/1/62	-	-	-	$389,534,109	$38,788,228		$428,322,336	$235,577,285	$428,322,336	$2,567,941	$4,668,984	$7,960,932	$14,474,421
6/1/63					$38,788,228		$38,788,228	$21,333,525	$38,788,228	$232,549	$422,816	$720,930	$1,310,782
6/1/64					$38,788,228		$38,788,228	$21,333,525	$38,788,228	$232,549	$422,816	$720,930	$1,310,782
6/1/65					$38,788,228		$38,788,228	$21,333,525	$38,788,228	$232,549	$422,816	$720,930	$1,310,782
6/1/66					$38,788,228		$38,788,228	$21,333,525	$38,788,228	$232,549	$422,816	$720,930	$1,310,782
						TOTAL	**$99,238,589,870**	**$54,581,224,429**	**$99,238,589,870**	**$594,969,781**	**$1,081,763,239**	**$1,844,479,152**	**$3,353,598,459**

Appendix B

SWP AND CVP OPERATIONS, THE INDICES THAT GOVERN THEM AND THEIR VALIDITY

By: Arve R. Sjovold
February 29, 2016

INTRODUCTION

In State Water Resources Control Board Decision 1485, an index was promulgated for the classifying of water year types. This index provides varied tables, and sets of values for a variety of Delta protection standards. No supporting analysis was cited to show how and why this index, and its, water year type derivative were established. The Water Year Index is specified by the following formula:

INDEX = 0.4*X + 0.3*Y + 0.3*Z

Where: X = Current calendar year's April-July Sacramento Valley unimpaired run-off

Y = Current calendar year's October-March Sacramento Valley unimpaired run-off

Z = Previous calendar year's index

Once an index has been calculated, its value is used to determine one of five water year types: Wet, Above Normal, Below Normal, Dry, and Critical. This water year type designation is then used to set a multitude of water quality and flow standards throughout the Delta. Variations on this type of designation (e.g. the Shasta Index, American River Index, and the Trinity River Index) are also used in a multitude of operational and flow release standards for reservoirs throughout the Sacramento Basin. All of these indexes are used as well in the CALSIM II model.

D-1485 also specifies that when it is too early in the water year to have observations in hand for April-July and October-March, run-off forecast values should be based on "normal" precipitation for the unknown parts of the water year. "Normal" precipitation is not precisely defined, nor is it specified how it is to be used to calculate a value for run-off.

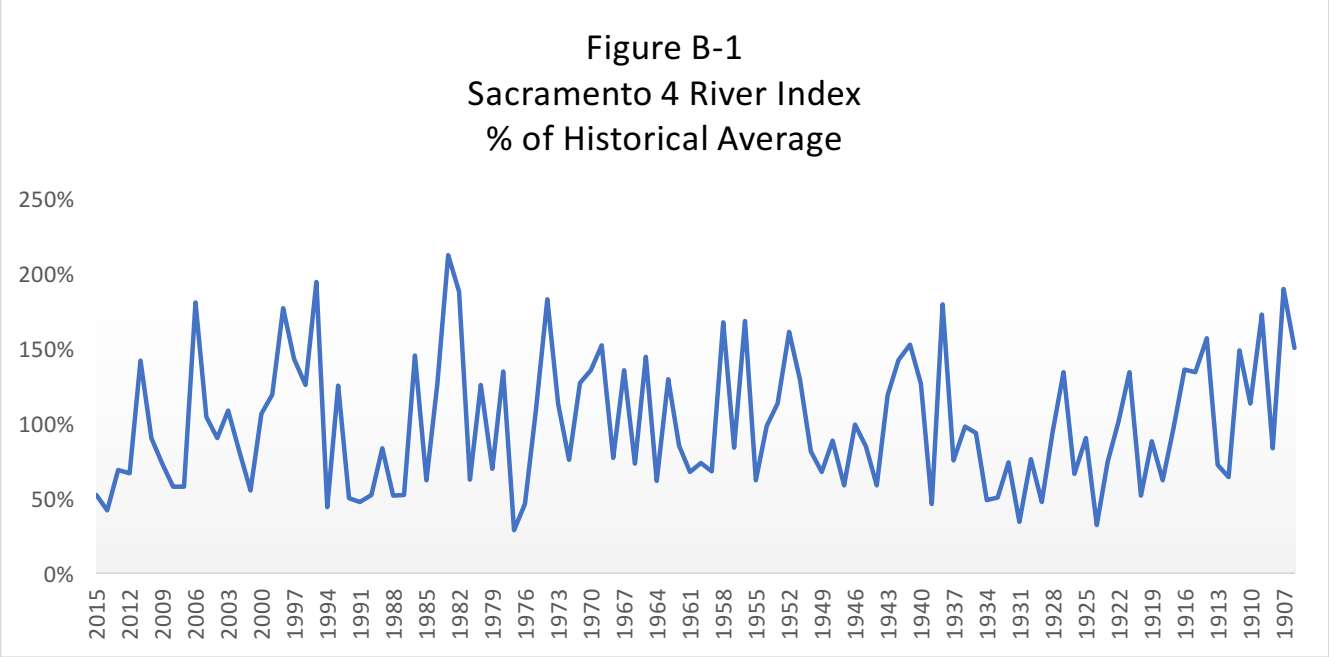
It is clear from a careful examination of the requirements of D-1485 that water year type is a very important parameter in managing the water resources of the Delta. Because of that high level of importance, it is fair to question both the reliability of this index and the wisdom of using it to manage the operation of the SWP and CVP.

SACRAMENTO BASIN HYDROLOGY

It is clear that the Water Year Index is profoundly dependent on the characteristics of the Sacramento Basin Hydrology. The three most important derivatives of that hydrology - particularly in regard to forecast reliability - are run-off flows for April-July and October-March, the reliance of the previous year's Water Year Index, and the notion of "normal" precipitation. If we take the statement "normal" precipitation to mean "normal" run-off, then we may perform some analyses to address these important characteristics.

A careful, quantitative examination of Sacramento Basin Hydrology was performed using the 4-river index as a surrogate for total Sacramento Basin run-off. Figure B-1 is a graph of the run-off history based on the 4-river index. A rudimentary look at the distribution of annual run-off from the 98-year record shows that the data divides into distinct groups; a drier year group comprising 56% of the years and a wet year group comprising 44% of the years as shown in figure B-2. Very few years are found near the average or "normal" value, in fact, the average value is at the relative minimum between the drier group and the wet group. Each of these groups does exhibit characteristics of a more normal distribution when taken separately.

Accordingly, each group was analyzed as a separate distribution and a statistical test was performed to determine the likelihood that they might actually be drawn from a single population. Table B-3 presents the characteristics of each of these groups.



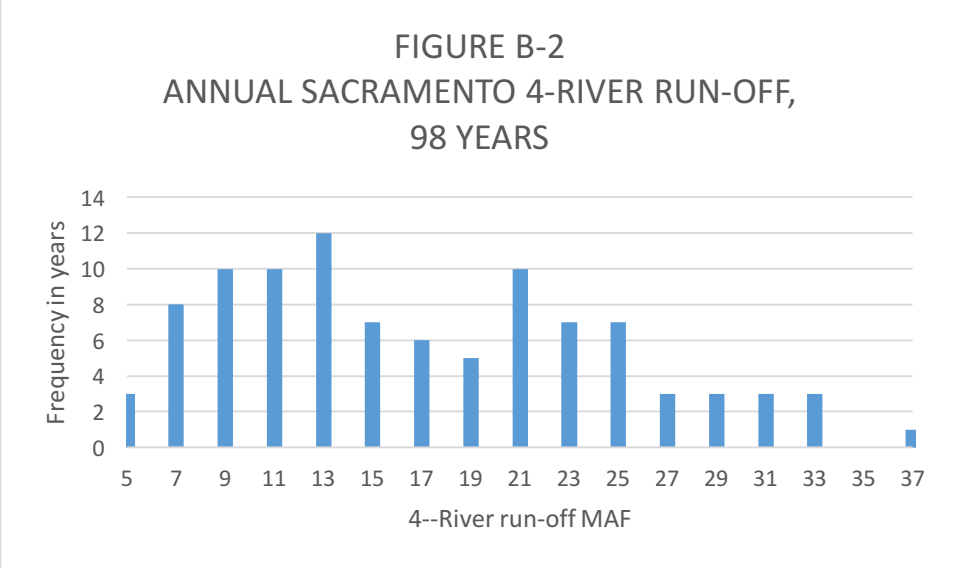


Table B-3
Statistical Characteristics of Wet and Dry Groups
4-River Index (MAF)

Dry	Wet

Mean	12.18	25.55
Standard Deviation	3.27	4.65
Std. Error of Mean	.441	.709

The standard t-test between means showed less than a 1% chance that the means of these two distributions came from a single population.

VALIDITY OF INDEXES

The water year index formula comprises three terms, two dealing with the current water year run-off and the third being a weighted run-off of the previous year's water year index. We investigated the validity and reliability of the three terms as predictors of the current water characteristics.

Influence of Previous Water Year

To test the validity of using the previous year's water year index, we determined if there was any significant serial correlation between successive years within the 98-year record of annual run-off. The serial correlation co-efficient [R] was found to be 0.084, which indicates no significant serial correlation, even though drought sequences of up to 5 years and wet sequences of several years were noted. (The probability that there was a real correlation was much less than 1%). The persistence of wet and dry sequences probably reflects shifts in the jet stream that may be stable for several years before shifting. This, in turn reflects typical Pacific, synoptic weather patterns. With such an insignificant correlation co-efficient we must conclude there is very little chance that a previous year's run-off has any effect on predicting the run-off of a successive year. *This conclusion requires that the last term in the formula for water year index must be eliminated from the equation.* If we eliminate the last term in the equation there is little need to use any weighting coefficients because the remaining two terms comprise all but about 4% of the expected total run-off for the current water year. The remaining task is to estimate run-off for the unknown months to come.

Forecasting Future Months of the Water Year

The ability to forecast run-off accurately for future months depends on the information at hand. Upon entering a new water year, there is very little information available, especially given the fact that data from the previous water year is not relevant. There is potential information in the measurements of snow pack but snow in the Sierra Nevada and southern Cascades only begins to accumulate in late winter and early spring. The only factual information early in the water year is the current measure of run-off, which in the fall is extremely low. Since the distribution of annual run-off really comprises two independent distributions, it is virtually impossible to designate in which domain, dry or wet, the coming water year falls.

Each of these distributions has its own “normal” begging the question: which one should be chosen for forecasting purposes? D-1485 states that when a forecast value is needed for the formulation it should be based on the value for normal precipitation. *We have shown that there is no "grand normal" for run-off.* (Usually the average or mean value is meant by this term); it is therefore very likely that there is no such thing as a "grand normal” for precipitation. Precipitation data exhibits extreme variation, and because the physical relationship between precipitation and run-off is not linear and is dependent on such parameters as antecedent moisture in the soil, precipitation is probably not a good choice for basing a forecast.

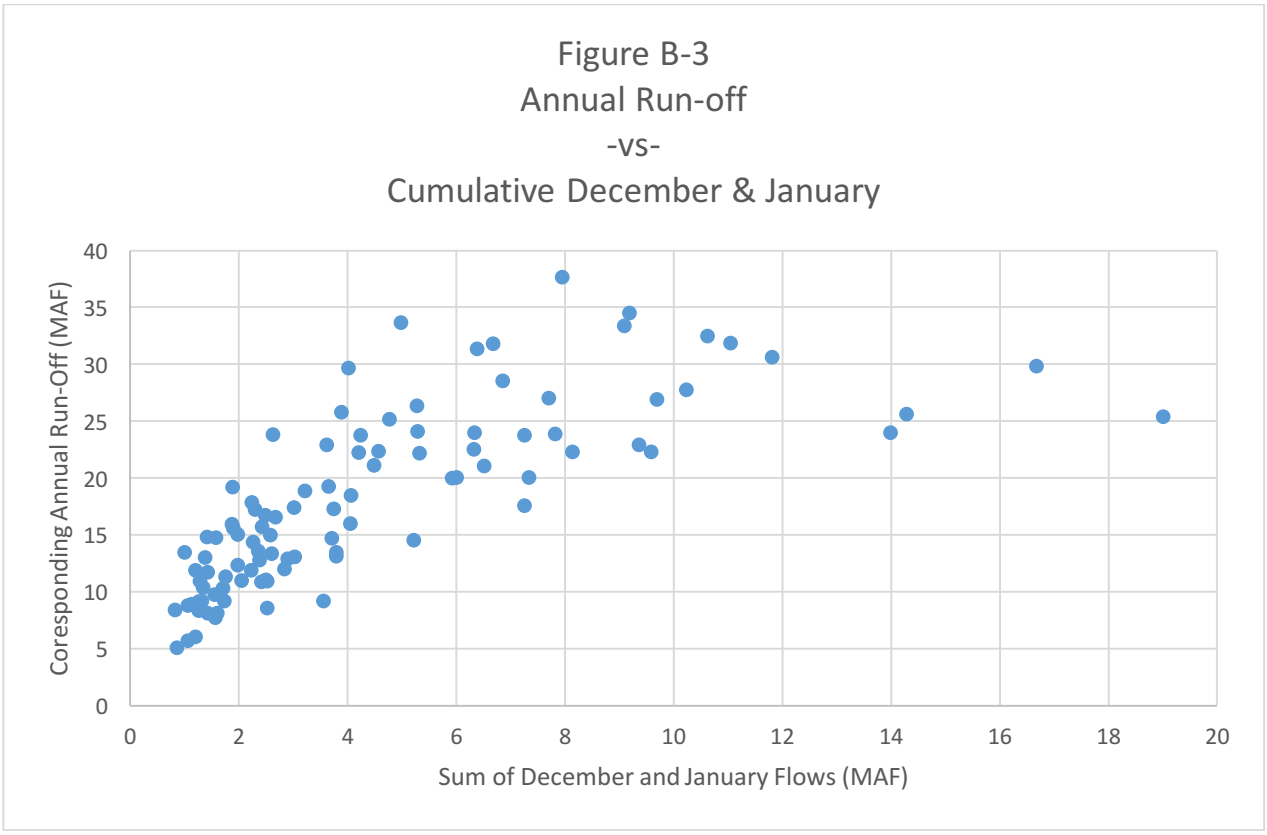
The most prudent choice is to assume that the coming water year will be dry until there is sufficient data to state otherwise. Assuming that the coming water year will be wet runs a 56% or higher chance of being wrong, hardly a prudent assumption given the importance of obtaining a reliable supply from the SWP. If the average for the dry group is chosen for the initial forecast there will be roughly a 25% chance of over-estimating the subsequent run-off. Prudence would dictate that perhaps a 5% chance of such a mistake would be tolerable. At a 5% chance the basis for the forecast would produce annual run-off in the range of 7-8 MAF. In terms of the 4-river index; actual run-off would be 20% to 25% higher. In effect, *a forecast*

range this low would likely cause a suspension in SWP and CVP operations for the first few months of the new water year, though some export might be possible if there is reservoir storage to support it in these early months.

How soon in the water year can it be stated with some confidence how the water year will play out? October and November produce little to no excess run-off. The first month with the potential for large run-off is December followed by an even more likely run-off in January, February, March, April, and May when snow melt really begins in earnest (and possibly June) are the main run-off producers. Therefore, we must look at the earliest run-off months for an indicator.

An investigation was begun to find early indicators to assess the likelihood of a dry or wet future water year. We first examined whether the run-off of December alone would suffice. Our findings were inconclusive. The same DWR data base from which the annual run-off data was used to generate the graph in Figure 1, also contains the record of monthly run-offs which was used in this investigation. That was inconclusive. We then examined the sum of December and January run-off, and *we found that the sum of December and January could reliably predict if the coming water year would be dry*. A maximum threshold of 3.9 MAF for the sum would capture all but 2 of 55 dry years, which indicates a less than 5% chance of error. That same threshold also falsely designated 6 of 43 wet years as dry. However, that error is not critical since the unfolding water year could easily allow positive corrections in operations.

A scatter plot of the map of total annual run-off versus the sum of January and December run - off is presented in Figure B-3 on the following page. Axes are drawn vertically at a value of 3.9 and horizontally at the grand average of total run-off, creating four quadrants labeled dry winter-wet spring, wet winter-wet spring, wet winter-dry spring, and dry winter-dry spring. Most of the data points are found in either the dry winter-dry spring or wet winter-wet spring designations, which effectively constitute the dry and wet groups used in our analysis. The lack of data points in the other two quadrants confirms that these two groups are distinct. The figure also shows the few data points not in the populated quadrants, demonstrating the low likelihood of error in using the 3.9 MAF locus as a decision basis for declaring a dry winter-dry spring in the early part of the water year.



With further examination of the dry group distribution, we found a bounding locus that contains the entire dry group set except for two points. The equation of this locus is:

RUN-OFF = 2.877*DEC-JAN + 2.67

Where: **RUN-OFF** = minimum annual run-off, MAF

DEC-JAN = sum of December and January run-off, MAF

provided **DEC-JAN** is less than or equal to 3.9 MAF

This equation provides a minimum run-off for the dry group with only about a 5% chance of a lower run-off. With this equation, prudent SWP operations can be devised for the months past January until subsequent run-off data can supersede it. It may be possible to find additional bounding equations to guide SWP operations, assuming December and January data are already known. This process may be repeated for successive months and should converge on the actual run-off by the end of the run-off season.

The analyses above establish several constraints in developing prudent SWP operations:

1) No reliance can be placed on a previous water year's run-off in forecasting run-off for a given water year.

2) If run-off through January for a given water year is low (less that 3.9 MAF) it is very likely that the remainder of the water year will be low.

3) There is no meaningful value in referring to the grand average of the hydrologic record as "normal". The record indicates strongly that there are two distinct groups that cluster below and above the grand average, each with its characteristic average or normal value.

4) The equation for calculating the Water Year Index is without merit; the same applies to its derivative, Water Year Type.

POTENTIAL EFFECTS ON SWP OPERATIONS

Winter Pumping

Because low winter run-off through January indicates the very strong likelihood of a dry year overall, winter pumping through January should be minimal if not altogether suspended until further run-off data shows that pumping can be done without jeopardizing the reliability of future deliveries or threatening Delta health. The prudent level of pumping from the Delta during such low periods of winter run-off remains to be investigated.

Overall Project Yield

Since dry years predominate the record, and no confident statement can be made at the beginning of a water year concerning expected project yield, the project yield should be base-lined on the amount that can be reliably exported given the expectation that the ensuing water year will be dry. *This finding necessarily will lead to an export level that is much lower than the current value of 4.1 MAF*. The project can now be studied to determine the amounts of surplus water that can be safely delivered until winter run-off is sufficient to conclude that the total water year will be wet. This implies that the safe level of export will be continuously evaluated as the water year progresses.

Reservoir Operations

Because the designations of water year type are based on a calculated water year index which has been shown to have no validity, *all reservoir operations must be re-examined to determine prudent levels of release*

and storage.

SWRCB Regulations and Constraints

Because so many of the regulations and constraints that have been promulgated by the SWRCB are based on the flawed water year type, *all such regulations and constraints must be re-visited.*

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Appendix C

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