WEST YOST ASSOCIATES

TECHNICAL MEMORANDUM

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TO: Stanislaus Regional Water Authority
Technical Advisory Committee

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SUBJECT: Revised Addendum to Water Supply Alternatives Evaluation Final Report

This Technical Memorandum (TM) is an addendum to the Stanislaus Regional Water Authority (SRWA) Water Supply Alternatives Evaluation Final Report (Report) (RMC and Carollo, February 2015), included herein as Attachment A. This TM provides a summary of the previous Report, and an updated evaluation of two water supply alternatives. This updated evaluation presented in this TM confirms that the proposed Regional Surface Water Supply Project (RSWSP) is the preferred SRWA alternative.

The sections in this document include:

- Background
  - City of Ceres
  - City of Turlock
- Summary of 2015 Alternatives Evaluation
- Summary of Updated (2018) Water Supply Alternatives
  - Updated Water Supply Alternative 1: Wellhead Groundwater Treatment and New Wells
  - Updated Water Supply Alternative 2: Regional Surface Water Supply Project
- Cost Estimates for Updated Water Supply Alternatives
  - Classification and Intended Use of Cost Estimates
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BACKGROUND

SRWA is comprised of the City of Ceres and the City of Turlock (collectively referred to as "Cities"). One of SRWA's goals is to develop a reliable drinking water supply to help meet the existing and future municipal and industrial demands of its communities. SRWA was formed to develop and implement the RSWSP. Currently, groundwater is the sole source of municipal water supply for both Cities, and there are both groundwater quality and groundwater reliability and sustainability challenges with the continued 100 percent dependence on groundwater. Previously stored surface water captured in Don Pedro Reservoir by the Turlock Irrigation District (TID) (an SRWA Project Partner) will be released into the Tuolumne River by TID for downstream diversion by SRWA. This will be the new raw water supply source for these communities.

This new surface water supply will allow the Cities to reduce reliance on groundwater for existing customers, expand the reliability and sustainability of their water supply portfolio, and help meet future development and economic growth demands. The Cities will be able to maximize water supply reliability over varying hydrological and meteorological conditions through conjunctive use, while increasing storage and improving water quality within the groundwater basin for the benefit of agricultural and urban users. SRWA estimates current and future demands for the Cities to be 35,800 acre-feet per year (AFY) by 2020 and 57,400 AFY at buildout (2035 for Ceres and 2040 for Turlock). A more detailed breakdown of each City's existing and projected demands is shown in Table 1 and Table 2.

Table 1. City of Ceres Existing and Projected Demands to be Met by Surface Water and Groundwater

	2015	2020	2025	2030	2035
Annual Potable Water Use, AFY[(a)]	6,500	9,800	12,500	15,100	17,900
Average Daily Water Use, million gallons per day (mgd)	5.8	8.8	11.1	13.5	16.0
Maximum Daily Water Use, mgd[(b)]	10.4	15.8	20.0	24.2	28.7
Minimum Daily Groundwater Use to Maintain Well Water Quality, mgd[(c)]	2.0	2.0	2.0	2.0	2.0

(a) City of Ceres projections provided by Jeremy Damas, May 2016.
(b) Maximum day demand estimated as 1.8 times average daily demand, per City of Ceres, 2011 Water Master Plan, Table 3-9.
(c) Based on input received from Jeremy Damas, Public Works Director for the City of Ceres, May 2018.

Table 2. City of Turlock Existing and Projected Potable and Raw Water Demands to be Met by Surface Water and Groundwater

	2015	2020	2025	2030	2035	2040
Annual Potable and Raw Water Use, AFY[(a)]	17,400	26,000	28,800	32,000	35,600	39,500
Average Daily Water Use, mgd	15.5	23.2	25.7	28.6	31.7	35.3
Maximum Daily Water Use, mgd[(b)]	25.6	38.3	42.5	47.2	52.4	58.2
Minimum Daily Groundwater Use to Maintain Well Water Quality, mgd[(c)]	4.2	4.2	4.2	4.2	4.2	4.2

(a) City of Turlock, 2015 Urban Water Management Plan, June 2016, Table 4-5. Includes landscape irrigation, industrial use, and industrial cooling water uses.
(b) Maximum day demand estimated as 1.65 times average daily demand, per City of Turlock, 2009 Water Master Plan Update, Table 4.3.
(c) Assumes continuous operation of Wells 4, 20 and 30, due to a history of water quality problems. City of Turlock projections provided by Garner Reynolds, May 2018.

City of Ceres

Currently, the City of Ceres relies solely on the Turlock Subbasin (Basin) groundwater to meet all water needs. The City of Ceres 2015 Urban Water Management Plan (UWMP) states the City owns and/or operates 29 wells in varying conditions:

- 12 active
- 2 drilled (not yet equipped)
- 4 inactive/abandoned
- 11 non-potable (irrigation only)

City of Turlock

Currently the City of Turlock solely relies on the Basin groundwater to meet all water needs. The City of Turlock's 2015 UWMP states the City owns and/or operates 44 wells in varying conditions:

- 18 active
- 1 standby
- 19 inactive/abandoned
- 6 non-potable (irrigation only)

Since 2010, the City of Turlock's groundwater supply has significantly declined. Several wells have been removed from active status due to water quality concerns and changing State regulations. For instance, the State's adoption of a Maximum Contaminant Level (MCL) for 1,2,3-trichloropropane (1,2,3-TCP) has impacted six (6) of the City's active municipal wells. Furthermore, the City of Turlock has discontinued using several wells for municipal use due to high sand production, casing failure, pump failure, and other water quality concerns.

Contamination sources have included tetrachloroethylene (PCE), arsenic, nitrates, manganese, carbon tetrachloride, hydrogen sulfide, and the newest contaminant is 1,2,3-TCP.

SUMMARY OF 2015 ALTERNATIVES EVALUATION

As stated above, this TM is an addendum to the 2015 SRWA Water Supply Alternatives Evaluation Final Report. At the time of the 2015 Report, potential Project alternatives were developed for the Cities of Modesto, Ceres, and Turlock. The goal of the Report was to support the development of an affordable Project, which would diversify the water supply portfolio of the participants and would allow SRWA to meet current and future demands while reducing reliance on groundwater. A total of 19 project alternatives were considered in the 2015 Report. Alternatives were evaluated based on: cost effectiveness, reliability, environmental constraints, regulatory feasibility, institutional complexity, legal viability, and implementation time. Of the 19 alternatives, 16 were eliminated from further study, as summarized in Table 3.

As Table 3 indicates, both the "Wellhead Treatment (Alternative 13)" and "New Wells (Alternative 14)" alternatives were eliminated from further consideration in the 2015 Report. This elimination occurred because, at the time, SRWA member agencies agreed that one of the primary purposes of the Project was to develop new water supplies that reduce reliance on groundwater. Therefore, those alternative projects that would continue to rely on continued groundwater would not meet this goal.

The 2015 Report identified three alternatives as preferred options warranting further evaluation:

- San Joaquin River Supply option;
- Stanislaus River Supply option; and
- Tuolumne River Supply option.

The San Joaquin River option consisted of obtaining San Joaquin River water rights equal to the wastewater discharged to the river by the Cities. This alternative was subsequently eliminated from further consideration because continued discharge of wastewater effluent to the San Joaquin River by the SRWA member agencies would be subject to significant increases in wastewater treatment and disposal costs, and a potential loss of revenue from the Del Puerto Water District due to the implementation of the North Valley Regional Recycled Water Program that the Cities of Modesto and Turlock are participating in.

The Stanislaus River option consisted of obtaining a new water supply from Oakdale Irrigation District (OID) and partnering in construction of a new water treatment plant (WTP) with the San Francisco Public Utilities Commission (SFPUC).

The Tuolumne River option consisted of obtaining a new water supply from TID, utilizing an existing diversion facility (infiltration gallery) in the Tuolumne River, and constructing a new WTP for delivering water to the member agencies.

The recommended alternative for SRWA in the 2015 Report was the Stanislaus River Supply, assuming a 50 percent capital cost share with SFPUC to build a new WTP, and a reasonable cost for raw water from OID. If SRWA was unable to receive a reasonable raw water cost or must pay

more than 50 percent capital costs for a new WTP, the 2015 Report stated the Tuolumne River Supply alternative would replace the Stanislaus River Supply as the recommended alternative.

Following publication of the 2015 Report, OID did not show interest in contributing water supply towards the SRWA project and SFPUC did not express interest in funding half the cost of a new WTP. Therefore, the Stanislaus River Supply alternative was not pursued and, instead, the Tuolumne River Supply project was pursued by the Cities.

Table 3. Water Supply Alternatives Eliminated from Further Consideration in 2015 Report[(a)]

Alternatives		Reason for Elimination
Demand Reduction		
1	TID Efficiency Projects	SRWA received feedback from TID staff. TID intends to implement efficiency improvements and will finance those through TID rate increases.
2	Water Conservation and Efficiency	SRWA member agencies are continuing to implement demand reduction measures specified in UWMPs. Conserved water is not considered a new source of supply.
3	Agricultural Efficiency Improvement Projects	SRWA received feedback from TID about lack of interest.
Recycled Water		
4	Exchanges with Local Irrigation Districts	High cost of winter storage (in the case of exchanges with TID) and the complexity of the agreements for involvement of other agencies.
5	Cannery Segregation	Seasonal cannery operations would not result in year-round supply. Institutional complexities as well as potential permitting and treatment requirements for end use.
6	TID and SRWA Exchange and 3rd party agreement with Del Puerto Water District	This option was eliminated due to the complex and uncertain nature of needed agreements.
7	Potable Reuse	Extremely high cost of advanced treatment of recycled water and the challenges of injecting the treated water into the confined aquifer beneath the Corcoran clays.
Transfer and Exchange		
8	Modesto Groundwater Transfer	Short-term solution only, and no new source of supply.
9	Oakdale Irrigation District (OID) to Modesto Irrigation District (MID) Transfer	Parties were reluctant to participate in transfer agreements.
10	Merced ID Transfer	Parties were reluctant to participate in transfer agreements.
11	Purchase Water from OID	SRWA was unable to partner with OID in a new surface water treatment plant.
Groundwater		
12	Shallow Aquifer Wells	SRWA member agencies are implementing shallow groundwater supply projects for parks and other facilities within their jurisdictions. Eliminated due to low potential potable demand offset (4,000 AFY - with significant operations and maintenance (O&M) issues). SRWA member agencies expressed concern that this alternative may impact production and/or water quality from existing production wells.
13	Wellhead Treatment	SRWA member agencies agreed that one of the primary purposes of the project is to develop new water supplies that reduce reliance on groundwater. This would not meet that goal.
14	New Wells	SRWA member agencies agreed that one of the primary purposes of the project is to develop new water supplies that reduce reliance on groundwater. This would not meet that goal.
Stormwater		
15	Stormwater Capture and Groundwater Augmentation	High cost of separating cross-connections between storm drains and sanitary sewers, unreliable seasonal supply, and uncertainty of percolating stormwater into the groundwater basin because of geologic feasibility.
Groundwater Banking/Conjunctive Use		
16	Develop Groundwater Bank	The groundwater basin is not managed by one entity and, therefore, it would be difficult to implement a groundwater bank given varied interests in the groundwater basin.

(a) SRWA Water Supply Alternatives Evaluation Final Report, February 2015, Project Alternative Screening Table.

SUMMARY OF UPDATED (2018) WATER SUPPLY ALTERNATIVES

Since 2015, the City of Modesto has left SRWA, and SRWA's primary objectives have been slightly modified. Among the 19 Project alternatives previously considered in the 2015 Report, two remain viable based on SRWA's goals to implement a water supply project that provides water supply reliability and sustainability, improves delivered water quality, reduces reliance on the groundwater basin as the sole source of supply, and is feasible from an environmental and regulatory perspective. These two alternatives are:

1. A hybrid of the "Wellhead Treatment (Alternative 13)" and "New Wells (Alternative 14)" alternative (referred to henceforth as the "Wellhead Groundwater Treatment and New Wells" alternative), and
2. The "Tuolumne River Supply" alternative (now referred to as the RSWSP).

The individual Wellhead Groundwater Treatment and New Wells alternatives were not recommended in the 2015 Report because they did not reduce reliance on groundwater. The 2015 Report states the Cities' primary objective was to develop new surface water supplies to help reduce reliance on groundwater. However, SRWA's primary objectives now include improving drinking water quality while also improving water supply reliability and sustainability through the implementation of a groundwater and surface water conjunctive use program. Since neither the proposed San Joaquin River or OID conjunctive use supply projects are possible, the only other supply alternative is use of the groundwater basin, achieved through the proposed hybrid Wellhead Groundwater Treatment and New Wells alternative. Therefore, this alternative is re-considered herein and compared to the RSWSP.

The RSWSP (based on the Tuolumne River Supply alternative) was not the recommended alternative in the 2015 Final Report. However, the previously recommended Stanislaus River Supply alternative was determined infeasible because SRWA could only obtain water 8 to 10 months of the year and would require negotiation of a long-term agreement with the SFPUC. Upon further discussion, OID and SFPUC were not interested in participating in this project. The RSWSP alternative meets both SRWA's primary objectives (improving drinking water quality and water supply reliability), and secondary objectives (limiting reliance on groundwater, providing environmental benefits to Tuolumne River aquatic species, diversifying the Cities' water supply portfolios, providing in-lieu aquifer recharge to support groundwater sustainability, and increasing operational flexibility).

All other previously explored alternatives are not feasible (do not meet SRWA's objectives) due to various parties' reluctance to participate, or overall infeasibility, and are not considered further in this TM.

Additional information about the updated alternatives is presented in the following subsections.

Updated Water Supply Alternative 1: Wellhead Groundwater Treatment and New Wells

The Wellhead Groundwater Treatment and New Wells alternative proposes that each City continue use of its underlying groundwater resources. This use of groundwater would be maintained by continuing use of existing production wells, drilling additional production wells,

and adding wellhead treatment, where necessary, to meet increasingly stringent drinking water quality standards for municipal uses. Both Cities' municipal water wells have experienced increasing concentrations of nitrates, total dissolved solids, arsenic, nitrate, iron and manganese, some pesticides and organic solvents, and the newest contaminant of concern, 1,2,3-TCP. Wellhead treatment will be necessary to allow both Cities to continue to operate their respective wells and extract additional groundwater to meet future municipal and industrial demands.

Based on the City of Ceres Proposition 218 Rate Study Analysis (November 2017), the City's continued reliance solely on groundwater will require construction of several new municipal supply wells, design and installation of wellhead treatment for approximately eight existing wells, and extensive rehabilitation of most other existing wells. As of January 2019, the City of Ceres anticipates rehabilitation and/or replacement of ten wells, and each well is likely to require wellhead treatment systems.

Based on the City of Turlock Proposition 218 Rate Study Analysis (November 2017), a water supply project involving only groundwater would include adding approximately five new municipal water supply wells, designing and installing wellhead treatment of five to six wells, and rehabilitation of three to four additional existing wells. Since that time, worsening groundwater quality and the impacts of the new TCP regulation mean that wellhead treatment of additional wells will be necessary. As of December 2018, the City of Turlock anticipates fifteen wellhead treatment systems and nine new wells to be required.

In both Cities, new and replacement wells would be developed after completion of surface and subsurface investigations that meet State Water Resources Control Board Division of Drinking Water (DDW) setback and water quality requirements, site access requirements, well construction space requirements for equipment, and well yield and capacity targets. If all necessary criteria are met, new production wells would be constructed and tested. It is assumed that the wells requiring wellhead treatment would use either oxidation/filtration or ion exchange technology.

Basin Description

Currently the Cities of Turlock and Ceres rely solely on groundwater from the Basin, a sub-unit of the San Joaquin Valley Groundwater Basin, to provide their water supply needs for municipal and industrial demands. The Basin underlies an area of approximately 347,000 acres with irrigated crops, native vegetation, and urban development as predominant land uses.

The Basin is not adjudicated (there are not currently any agency or individual groundwater pumping limitations or quotas). However, the users of the Basin do need to comply with the requirements listed in the Department of Water Resources (DWR's) 2014 Sustainable Groundwater Management Act (SGMA), through which groundwater pumping limitations could be set, depending on the decisions made by local entities. The first step in complying with SGMA required the formation of a Groundwater Sustainability Agency (GSA) for the Basin. In December 2016, the Cities of Turlock, Ceres, Modesto, the TID, and others formed the West Turlock Subbasin GSA (a Joint Powers Authorities [JPA]) to manage the groundwater resources in this Basin. DWR lists the Basin as a "high-priority basin" and the GSA is required to have a Groundwater Sustainability Plan (GSP) in place by January 2022.

Water Quality Constraints/Concerns

Groundwater supply reliability is limited by water quality and overdraft/sustainability concerns. Numerous groundwater contaminants in the area have been identified. Contaminants include: nitrate, salinity, arsenic, pesticides, organic solvents, iron and manganese, radio-nucleotides, bacteria and other petroleum hydrocarbons.

Groundwater Management

Groundwater conditions vary within the Basin. Groundwater levels in the eastern areas have declined significantly since the 1960s while levels in the western areas of the Basin are high, sometimes requiring pumping in certain areas to keep the groundwater from encroaching into the root zone of agricultural crops. Recent monitoring data indicate that a second cone of depression has developed in the center of the basin in the general Turlock area. Over the last 32 years, on average, groundwater levels beneath the City have declined by about 25 feet or approximately 0.8 feet per year. Both Cities and other members of the West Turlock Subbasin GSA are working diligently on preparing the GSP to ensure groundwater is sustainably managed and overdraft is prevented.

Turlock Groundwater Basin Association

The local agencies within the Basin, including the Cities, are now part of the West Turlock Subbasin GSA (formed in December 2016), which works with the recently formed East Turlock Subbasin GSA and the Turlock Groundwater Basin Association (TGBA), which was formed in 1995. The TGBA was originally formed to better understand the Basin groundwater system, coordinate groundwater monitoring, and develop and implement Groundwater Management Plans. The three GSAs now work together toward these goals.

In March of 2016, the TGBA published a Final Report Hydrogeological Characterization of the Eastern Turlock Subbasin. This report was conducted to evaluate potential future impacts to groundwater. The report summarized the results of three model scenarios designed to simulate future land use and pumping conditions for a 30-year simulation period, 2013-2042. Model results showed water levels declining 10 to 30 feet (ft) further and 100,000 acre-feet (AF) of future storage loss, assuming current pumping continues with no new irrigated lands developed.

Assuming future pumping increases, and there is an increase in irrigated lands (at the current development rate), the model results showed water levels declining an additional 200 ft in the far eastern parts of the Basin and 170,000 AF of future groundwater storage loss. In another scenario, model results showed water levels increasing up to 20 ft and only 50,000 AF of future storage loss, assuming pumping decreases and crops with a limited lifespan were not replaced. In the scenario where pumping increased in the Study Area, the model showed reduced subsurface outflow to the west and exacerbated water level declines in other parts of the Subbasin.

SGMA, ranked the Basin as a high priority basin using statewide rankings that include population and extent of irrigated agriculture. Two Groundwater Sustainability Agencies (GSAs) have formed within the Basin: the West Turlock Subbasin GSA and the East Turlock Subbasin GSA. The boundary separating the two GSAs is generally TID's eastern irrigation service area boundary. JPAs have been formed by the local agencies within each proposed GSA area. SGMA requires the Basin be covered by a DWR-approved GSP by January 2022. The Turlock GSAs are planning to adopt a single GSP covering the entire Turlock basin.

Updated Water Supply Alternative 2: Regional Surface Water Supply Project

The RSWSP alternative proposes treating water from the Tuolumne River to drinking water standards and conveying the treated water through separate transmission pipelines to the Cities. The RSWSP would provide the Cities with long-term water supply reliability through the conjunctive use of surface water and groundwater resources, reduce groundwater dependence, and improve delivered drinking water quality. In this alternative, previously stored surface water captured in Don Pedro Reservoir by TID, under TID's water right would be released into the Tuolumne River to be withdrawn downstream by an existing infiltration gallery. This infiltration gallery is located approximately 26 miles downstream of Don Pedro Reservoir, just west of the Geer Road Bridge over the Tuolumne River. The existing infiltration gallery was constructed by TID in the early 2000s and is located approximately four to five feet below the river bottom. Raw water will be extracted from the infiltration gallery by a new raw water pump station adjacent to the infiltration gallery and pumped to the WTP for treatment. Treated water from the new WTP would be pumped to the Cities in new finished water transmission mains. Together, these facilities would comprise the RSWSP's "regional facilities" owned and operated by SRWA.

The RSWSP would be constructed in two or more phases. The City of Turlock will initially receive 10 mgd of treated surface water in sub Phase 1, potentially increasing to 30 mgd at buildout. The City of Ceres will initially receive 5 mgd in sub Phase 1, potentially increasing to 15 mgd at buildout. The initial phase of the RSWSP is planned to be operational by late 2022. Buildout for the Cities is currently expected to occur around the year 2035 and 2040 for Ceres and Turlock, respectively.

In addition to the regional facilities, the RSWSP would include local facilities for the Cities, including terminal storage tanks, booster pump stations, pressure relief valves, and transmission/distribution system upgrades and infrastructure modifications specific to each city, which will allow the integration of this new supply source of drinking water into each distribution system.

Project Components

The raw water pump station will accommodate up to six vertical turbine pumps capable of providing a firm capacity of up to 65 mgd (100 cubic ft per second).

The raw water transmission main will convey raw water from the raw water pump station near the Tuolumne River to a flow split structure. Separate raw water pipelines will then connect the flow split structure with the WTP and the Ceres Main Canal. The Raw Water Transmission Main from the Raw Water Pump Station to the Flow Split Vault will have a capacity of 65 mgd, and is expected to be welded steel, 60-inches (in) in diameter, and approximately 2,500 ft long. From the Flow Split Vault a 24-in pipeline approximately 600 ft in length will extend to the WTP, and a separate 60-in pipeline approximately 1,400 ft long will connect to the Ceres Main Canal.

The WTP will include a conventional treatment process featuring ozone disinfection and granular media filters. The initial WTP capacity will be a total of 15 mgd, with 5 mgd allocated to Ceres and 10 mgd allocated to Turlock.

The finished water transmission main to Turlock, which will convey finished water from the WTP to the Turlock terminal tank in the northeastern corner of the City, will have a capacity of 30 mgd (consistent with Turlock's portion of the Project build-out capacity) and is expected to be 42-in diameter and approximately 38,400 ft (7.3 miles) long.

The Ceres finished water transmission main will convey finished water from the WTP to the Ceres terminal tank located at the Ceres River Bluff Regional Park. This pipeline will have a capacity of 15 mgd (consistent with Ceres' portion of the Project build-out capacity) and is expected to be 30-in diameter and approximately 26,300 ft (5.0 miles) long.

COST ESTIMATES FOR UPDATED WATER SUPPLY ALTERNATIVES

Cost estimates were developed for each of the two alternatives described above. These cost estimates are planning-level estimates and include design, construction and construction management. Additional information about the cost estimates are presented in the subsections that follow.

Classification and Intended Use of Cost Estimates

The cost information presented herein is considered to be a Class 5 estimate, per the Association for the Advancement of Cost Engineering (AACE). AACE's cost estimate classification matrix is shown in Table 4. Cost estimating contingencies have been applied to individual elements of each alternative, in accordance with the expected accuracy range for Class 5 estimates.

Table 4. AACE Cost Estimate Classification Matrix[(a)]

Estimate Class	Primary Characteristics	Secondary Characteristic		
	Maturity Level of Project Definition Deliverables	End Usage	Methodology	Expected Accuracy Range
Class 5	0% to 2%	Concept Screening	Capacity factored, parametric models, judgement or analogy	Low: -20% to -50% High: +30% to +100%
Class 4	1% to 15%	Study or Feasibility	Equipment factored or parametric models	Low: -15% to -30% High: +20% to +50%
Class 3	10% to 40%	Budget Authorization or Control	Semi-detailed unit costs with assembly level line items	Low: -10% to -20% High: +10% to +30%
Class 2	30% to 75%	Control or Bid/Tender	Detailed unit costs with forced detailed take-off	Low: -5% to -15% High: +5% to +20%
Class 1	65% to 100%	Check Estimate or Bid/Tender	Detailed unit costs with forced detailed take-off	Low: -3% to -10% High: +3% to +15%

(a) Source: AACE International Recommended Practice No. 18R-97, revised March 1, 2016

Estimated Costs for Wellhead Groundwater Treatment and New Wells Alternative

The estimated construction costs for the Wellhead Groundwater Treatment and New Wells alternative were developed by the Cities of Ceres and Turlock for their respective Proposition 218 Rate Study Analyses and additional, updated information subsequently provided by the Cities. The costs reflect the following estimating contingencies: 25% for new wells and well head treatment systems and 20% for all other capital costs (including well rehabilitation and specific project elements undertaken by the Cities of Turlock and Ceres as specified in Table 5). These contingencies reflect future, unknown risks to groundwater supplies, such as the discovery of new contaminants, more stringent groundwater quality regulations, and the requirement of more complex treatment systems for newly identified contaminants. A summary of the estimated design and construction costs is provided in Table 5. As shown in Table 5, the total capital cost for this alternative is estimated to be about $170.0 million.

Table 5. Estimated Design and Construction Costs for Wellhead Groundwater Treatment and New Wells Alternative

Project Element	Estimated Cost, dollars[e,f]
City of Turlock	
New Wells (9 wells)[a,b]	35,742,000
Well Head Treatment (15 wells)[a]	21,029,000
Well Rehabilitation[a]	12,660,000
Chlorination of Well Sites (2019 Only)[c]	573,000
City of Turlock Subtotal	**$70,004,000**
City of Ceres	
New Wells (10 wells)[b,d]	44,073,000
Well Head Treatment (7 wells)[d]	9,174,000
Well Rehabilitation (2 wells per year)[d]	9,495,000
Property Acquisition for 4 Well Sites (2020 Only)[d]	4,330,000
City of Ceres Subtotal	**$67,072,000**
Subtotal Design, Construction and CM Costs	**137,076,000**
Contingency[g]	32,914,000
Total Turlock and Ceres Design and Construction Costs	**$169,990,000**

(a) Source: Garner Reynolds, Regulatory Affairs Manager for City of Turlock, December 2018 and January 2019.
(b) Costs of new wells include wells and pump stations but not transmission mains and new storage facilities that may be needed.
(c) Source: City of Turlock Proposition 218 Rate Study Analysis, June 2018.
(d) Source: Jeremy Damas, Director of Public Works for City of Ceres, January 2019.
(e) Assumes 2% annual inflation.
(f) Costs shown in 2020 Dollars.
(g) Includes 25% estimating contingencies on new wells and well head treatment and 20% estimating contingencies on well rehabilitation and other capital costs.

Estimated Costs for Surface Water Supply Project Alternative

The estimated construction costs summarized herein for the RSWSP alternative have been developed as part of previous planning and design work for SRWA[1]. The initial Project costs assume a mid-point of construction occurring in June 2020. The estimates reflect an estimating contingency of 25 percent (except where otherwise noted), an assumed variable inflation rate based on published data from the Office of Management and Budget and United States Energy Information Administration, a construction contingency of 5 percent, and design and construction management fees equaling a combined 13 percent of construction costs. A summary of the estimated design and construction costs for the RSWSP alternative is provided in Table 6. As shown, the capital cost for this alternative is estimated to be about $171 million for Turlock, $100 million for Ceres, and $6 million for TID, for a total project cost of approximately $277 million.

[1] Overall RSWSP cost estimates are presented in the *Phase 1 Conclusion Project Definition TM* (West Yost Associates, November 2017). Actual contract for construction costs for the first phase of the raw water pump station (i.e., the wet well project) became known in December 2017 and are reflected in Table 6 of this TM.

Table 6. Estimated Design and Construction Costs for RSWSP

Project Element	Estimated Cost, Phase 1[(a)], millions of dollars
Legal/Administration	4.1
Program Management	5.1
Predesign and Procurement	2.3
Water Rights Permits	0.4
Environmental and Permitting	1.4
Land/ROW Acquisition	1.8
Construction Quality Assurance and Contract Compliance	8.2
Subtotal[(b)]	**23.4**
Capital Contingency[(c)]	0.6
Total Program Administration Costs	**$24.0**
Raw Water Pump Station – Wet Well Only	7.7
Raw Water Pump Station – Balance of Facility	10.1
Raw Water Transmission Main	8.0
WTP	101.6
Ceres Finished Water Transmission Main	22.9
Turlock Finished Water Transmission Main	40.4
Subtotal[(d)]	**190.6**
Inflation to Construction Midpoint[(e)]	13.2
Subtotal[(b)]	**203.8**
Construction Contingency[(f)]	10.2
Subtotal[(b)]	**214.0**
Capital Contingency[(c)]	5.3
Total Regional Facility Design and Construction Costs[(b)]	**$219.3**
Construction of Ceres Local Facilities	11.4
Construction of Turlock Local Facilities	14.6
Subtotal[(d)]	**26.0**
Inflation to Construction Midpoint[(e)]	1.8
Subtotal[(b)]	**27.8**
Construction Contingency[(f)]	1.4
Construction Subtotal[(b)]	**29.2**
Design of Ceres Local Facilities[(f)]	1.0
Design of Turlock Local Facilities[(f)]	1.3
CM of Ceres Local Facilities[(g)]	0.6
CM of Turlock Local Facilities[(g)]	0.8
Local Facility Subtotal[(b)]	**32.8**
Construction Contingency[(f)]	0.8
Total Local Facility Design, Construction and CM Costs	**$33.7**
Total Design, Construction and CM Costs	**$277.0**

(a) Includes estimating contingencies as follows:
1. Raw water pump station (wet well only) = 0%
2. Raw water pump station (balance of facility) = 10%
3. Raw Water Transmission Main = 10%
4. WTP = 25%
5. Ceres and Turlock Finished Water Transmission Mains = 10%
6. Ceres and Turlock Local Distribution System Improvements = 25%

(b) Future dollars (i.e., at assumed construction midpoint in June 2020).
(c) Assumes 2.5% of estimated costs at construction midpoint.
(d) August 2016 dollars.
(e) Assumes 2% annual inflation from August 2016 to assumed construction midpoint of June 2020.
(f) Assumes 5% of estimated construction costs at construction midpoint.
(g) Assumes 8% of estimated construction costs at construction midpoint.

Cost Comparison

As shown in Tables 5 and 6, the design and construction of the Wellhead Groundwater Treatment and New Wells alternative will cost approximately $170 million, while the design and construction of the RSWSP alternative will cost approximately $277 million.

The combined (i.e., for Ceres and Turlock) present-worth average annual O&M costs for the Wellhead Groundwater Treatment and New Wells alternative has been estimated to range from approximately $15.3 million in 2019 to a maximum of $17.5 million in 2029 and $15.9 million in 2042, in 2020 dollars. The O&M costs for the Wellhead Groundwater Treatment and New Wells alternative include costs of well operation and wellhead treatment systems of $100,000 per well per year, respectively, based on estimates from the Cities. The O&M costs also account for other expenses, such as labor, based on the Cities' Proposition 218 Rate Study Analyses (November 2017), additional cost information provided by the Cities in January 2019, and a 20 percent contingency on these other expenses to reflect possible future risks to groundwater, such as contaminants requiring more complex treatment.

The present-worth average annual O&M costs for the regional facilities comprising the RSWSP alternative is expected to range from approximately $3.9 million in 2023 (the first full year of operations) to approximately $4.2 million in 2042[2], in 2020 dollars. Because the RSWSP alternative involves conjunctive use of surface water and groundwater, the cost of continued use of groundwater was accounted for as 33 percent of the average annual present worth cost of the Wellhead Groundwater Treatment and New Wells alternative, including both design and construction and O&M costs. Therefore, an annual cost of $7.6 million, in 2020 dollars, is added to the annual costs of the RSWSP facilities. The resulting NPV costs for both alternatives over the respective time periods are shown in Table 7.

Table 7. NPV Costs for Alternatives (2019-2042)

Alternative	Estimated NPV, millions of dollars[(a,b)]
RSWSP	528
Wellhead Groundwater Treatment and New Well	554

(a) Reflects variable inflation rate data from Office of Management and Budget and United States Energy Information Administration.
(b) Costs shown are in 2020 dollars.

An approximately 20-year span was chosen because both alternatives are expected to have project lives of at least 20 years. The analysis period for the RSWSP facilities was chosen to start in 2022 when the construction and acceptance testing of the water treatment plant are expected to be completed. However, the analysis periods for both the RSWSP alternative and the Wellhead

[2] O&M costs for the RSWSP have been estimated using a life cycle cost analysis tool prepared for SRWA. The methodology and results of this tool were presented in a TM titled *Revised Summary of Life Cycle Cost Analysis Tool for the SRWA Regional Surface Water Supply Project* (West Yost Associates, January 2019).

Groundwater Treatment and New Well alternative were chosen to start in 2019 because the Cities plan to construct several new wells and install several well head treatment systems before 2022, as these components are necessary for the supply of groundwater.

As Table 7 shows, the total cost to design, construct, and operate the Wellhead Groundwater Treatment and New Well alternative is approximately $26 million more expensive after 22 years (2042), due to the alternative's higher estimated annual O&M costs. As such, the RSWSP is considered the most cost-effective option and remains the preferred alternative. Although the capital costs of the RSWSP alternative are greater than those of the Wellhead Groundwater Treatment and New Well alternative, because of the lower operating costs associated with the RSWSP alternative, even with the continued use of some groundwater supplies, SRWA will realize a net cost savings compared to the Wellhead Groundwater Treatment and New Well alternative after approximately 18 years, starting in 2038.

ALTERNATIVE ANALYSIS

As stated previously, SRWA's primary objectives for the preferred Project are to improve delivered water quality, reduce reliance on groundwater supply and improve water supply reliability and sustainability for the Cities. SRWA's secondary objectives include providing environmental benefits to Tuolumne River aquatic species, diversifying the Cities' water supply portfolios, providing in-lieu aquifer recharge to support groundwater sustainability, and increasing operational flexibility. The RSWSP alternative meets all the SRWA's primary and secondary objectives; the Wellhead Groundwater Treatment and New Wells alternative does not.

In addition to not meeting all the SRWA's objectives, the Wellhead Groundwater Treatment and New Wells alternative is not preferred because it could have substantial negative impacts on regional groundwater levels and water quality. It is not considered to be a sustainable or reliable alternative, particularly with potential groundwater pumping regulations that may be developed by the West Turlock Subbasin GSA in its GSP. Implementation of the Wellhead Groundwater Treatment and New Wells alternative could also accelerate additional, long-term degradation of subbasin groundwater quality. Overall, both the magnitude and the types of hydrology and water quality impacts under the Wellhead Groundwater Treatment and New Wells alternative would be substantially greater than those of the RSWSP.

Although the Wellhead Groundwater Treatment and New Wells alternative is $107 million less expensive in capital costs compared to the RSWSP alternative, it does not meet SRWA's Project goals and objectives, and is not the financially preferred alternative due to the higher annual O&M costs and lack of long-term sustainability. Groundwater wells and wellhead treatment systems dispersed throughout the Cities are expensive to build, maintain and operate compared to a conjunctive use water supply system with a regional WTP and other shared regional facilities.

In summary, the RSWSP is the preferred Project alternative as it improves delivered water quality and water supply reliability and sustainability, limits and reduces groundwater reliance, and helps diversify the Cities' water supply portfolios. The RSWSP will also provide the regional partners with long-term water supply reliability through conjunctive use of surface water and groundwater resources. Using surface water will improve groundwater conditions and allow the replenishment and storage of groundwater for use during emergencies and periods of drought. Such improvements

are needed as the Basin has been identified as a basin in danger of potentially becoming critically over-drafted if groundwater management is not adequately implemented. Finally, in addition to meeting SRWA's primary and secondary objectives, the RSWSP will lead to higher quality wastewater discharges from the Cities as the use of treated surface water for municipal and industrial water supplies will result in reduced concentrations of total dissolved solids (i.e., salt) in each City's wastewater discharge stream.

ATTACHMENT A

Stanislaus Regional Water Authority Water Supply Alternatives Evaluation Final Report, RMC and Carollo, February 2015

SRWA
Stanislaus Regional Water Authority

WATER SUPPLY ALTERNATIVES EVALUATION

FINAL REPORT

February 2015

RMC water and environment

carollo

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Stanislaus Regional Water Authority
Water Supply Study
Final Report

Prepared by:

RMC water and environment

In Association with:

carollo

February 2015

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Acknowledgements

The Stanislaus Regional Water Authority Water Supply Study was prepared by a core team of the Stanislaus Regional Water Authority (SRWA), RMC Water and Environment (RMC) staff, and Carollo Engineers with the input of a number of participants and stakeholders that we would like to acknowledge herein.

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List of Abbreviations

AF	Acre-foot
AFY	acre-feet per year
AWMP	Agricultural Water Management Plans
Bay-Delta	Sacramento-San Joaquin Delta
CDFW	California Department of Fish and Wildlife
DMC	Delta Mendota Canal
DPR	Direct Potable Reuse
DPWD	Del Puerto Water District
EIR	Environmental Impact Report
gpd	gallons per day
gpm	gallons per minute
ID	Irrigation District
JPA	Joint Powers Agreement
MAU	Multi-Attribute Utility Analysis
mgd	million gallons per day
MID	Modesto Irrigation District
MRWTP	Modesto Regional Water Treatment Plant
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NVRRWP	North Valley Regional Recycled Water Program
NWR	National Wildlife Refuge
O&M	Operations and Maintenance
OID	Oakdale Irrigation District
ROW	right of way
RSWSP	Regional Surface Water Supply Project
SFPUC	San Francisco Public Utilities Commission
SJRRP	San Joaquin River Restoration Program
SRWA	Stanislaus Regional Water Authority
SSJID	South San Joaquin Irrigation District
SWRCB	State Water Resources Control Board
TID	Turlock Irrigation District
USFWS	United States Fish and Wildlife Service
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

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Executive Summary

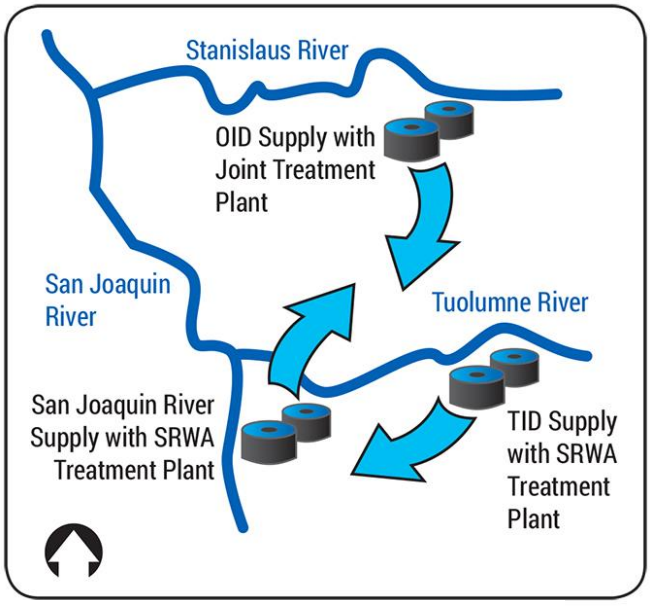
The Stanislaus Regional Water Authority (SRWA) was formed by the cities of Ceres, Modesto, and Turlock in 2011 with the intention of working together to develop a reliable drinking water supply to meet the municipal and industrial needs of the three communities. Historically, Tuolumne River water from the Turlock Irrigation District (TID) has been considered to be the principal source for a new water supply for these communities. In addition to the potential for a Tuolumne River supply from TID, this study identifies alternatives to a TID water supply.

The results of the study indicate there are viable alternative water supply sources potentially available to the SRWA. In particular, the study identified two leading alternatives to a TID supply. Therefore, including a potential supply from TID, there are three water supply options that the SRWA should consider. The three options are:

- Obtain rights to water from the San Joaquin River that are equivalent to the wastewater discharged to the river by the three cities (recognizing that Ceres discharges to the river via flows treated at both Turlock and Modesto treatment plants). Use this new water right to divert water from the San Joaquin River, and then treat and deliver that water to the SRWA member agencies.
- Obtain a new water supply from Oakdale Irrigation District (OID), partner in construction of a new water treatment plant near the City of Riverbank, and then deliver treated water to the SRWA member agencies.
- Obtain an agreement for a water supply from TID, utilize the existing diversion facility in the Tuolumne River, and then treat and deliver this new supply to the SRWA member agencies.

The development of a new surface water supply will allow the three cities to both reduce their reliance on groundwater and meet projected water demands resulting from future development and economic growth in the urban areas south of the Tuolumne River. SRWA estimates the surface water demands for its member agencies at 30,240 acre-feet per year (AFY) by 2021, 43,680 AFY by 2035, and 57,120 AFY at buildout in the year 2045.

The primary goal of this Water Supply Study (Study) is to develop an affordable water supply portfolio that allows the SRWA to meet current and future demands while reducing reliance on groundwater.



SRWA has three viable options for a new water supply to meet the needs of the SRWA member agencies.

Background

Prior to the creation of the SRWA, the member agencies had been working with TID to develop a Regional Surface Water Supply Project (RSWSP) that would divert water from the Tuolumne River, treat it for potable use, and deliver it to SRWA member agencies. In addition, TID would also provide raw water to its local agricultural customers. TID had made some progress in implementing the RSWSP. For instance, TID constructed an infiltration gallery for the facility's raw water intake on the Tuolumne River in 2001, prepared an Environmental Impact Report (EIR) in 2006, and purchased the property for the proposed Water Treatment Plant (WTP) in 2008. SRWA participated in the water supply development costs with TID. To date, the total amount paid by the SRWA to TID for water supply development efforts is approximately $7,892,000.

The SRWA was formed to facilitate the development of the RSWSP. Negotiations between TID and the SRWA on a drinking water sales agreement slowed in 2012-13 as TID faced uncertainties over the water supply it could make available to the SRWA. Therefore, this Study was commissioned by the SRWA Board of Directors to consider alternatives to a RSWSP, should TID be unable to commit to providing a reliable drinking water supply or should the two parties be unable to come to terms on a water purchase agreement. On July 9, 2014 TID issued a memorandum to its board of directors proposing terms for a water purchase agreement with SRWA. Under this proposed agreement, SRWA could purchase up to 30,000 acre-feet per year (AFY) of Tuolumne River water provided that SRWA provide "offset water" to TID during water years when surface water supply availability is less than full allocation. This study considers project alternatives that could be implemented with or without a TID provided water supply.

Identification of Alternative Supply Options

The initial phase (Phase 1) consisted of identifying conceptual alternatives to meet water supply demands. A total of 18 conceptual alternatives were identified and considered. A definition of each conceptual alternative was developed, along with identification of potential challenges, yield, and benefits. The following table categorizes the conceptual alternatives by type of project (demand reduction, transfer and exchange, recycled water, groundwater, stormwater, groundwater banking/conjunctive use) and provides a brief description and discussion for each identified alternative supply option.

Alternative	Description	Discussion
Demand Reduction		
TID Efficiency Improvement Projects	Invest in efficiency improvements within the TID system and share in the water savings	TID intends to invest in its own system improvements and is not interested in sharing the investment/savings
Water Conservation and Efficiency	Continued investment in water conservation and efficiency programs within the three cities.	On-going efforts by each of the three cities will continue. Not an added supply option.
Agricultural Efficiency Programs	Invest in on-farm efficiency improvement programs with individual land-owners. Landowners have no vested right to any water saved, so this would have to be through (and managed by) TID.	Seen as an extension of TID efficiency improvements and not-supported by TID
Transfer and Exchange		
Modesto Groundwater Transfer	Use banked groundwater underlying the City of Modesto as an interim supply.	Inconsistent with Modesto's surface water/groundwater program. This could be a short-term transfer option during emergencies.
OID to MID Transfer	Obtain water from OID and transfer it to MID at Modesto Reservoir, treat at MID treatment plant and deliver through existing system with an extension south to Ceres and Turlock.	Limited interest by MID in pursuing exchange opportunities
OID to MID to TID Transfer	Enter into transfer agreement with OID or SSJID to transfer Stanislaus River water through MID to the Tuolumne River, and exchanging that water with TID to allow a Tuolumne River diversion.	Limited interest by MID in pursuing exchange opportunities
Merced ID Transfer	Purchase a water supply from Merced ID, transfer to TID canal system for an exchange with TID for Tuolumne River water, or divert downstream off San Joaquin River.	Only available in normal to wet years, potentially high cost.
Purchase Water from OID	Purchase a water supply from Oakdale Irrigation District (OID) and participate in construction of a new water treatment plant near the City of Riverbank. A sub option is to purchase raw water from OID with SRWA constructing its own water treatment plant.	OID and SFPUC are engaged in discussion of a joint project to potentially aid SFPUC in rehabilitating its Mountain Tunnel, which could provide an opportunity for SRWA to obtain a reliable water supply at a reasonable cost.
Recycled Water		
Exchange with Local Irrigation Districts	Deliver tertiary treated recycled water to TID in exchange for surface water.	High cost, and need to store recycled water during non-irrigation season. Storage, however, may not be necessary if DPWD were included in such an arrangement as DPWD would have the ability to take water during winter months.
Use of Cannery Segregation Flows	Deliver cannery wastewater to TID in exchange for surface water.	Potentially high cost of treatment and/or considerable regulatory complexity.

Alternative	Description	Discussion
Recycled Water (cont')		
TID and SRWA Exchange and third-party agreement with DPWD	Obtain surface supply from TID, provide TID recycled water as "offset" water, and backfill that amount delivered to TID with a third party long-term exchange agreement for delivery to Del Puerto Water District.	Somewhat complex arrangement with third party involvement by Del Puerto Water District and another agency providing a long-term transfer.
Potable Reuse	Provide advanced treatment of recycled water for injection into groundwater aquifer.	Very high cost and regulatory complexity.
River Discharge and Section California Water Code Section 1485 Water Rights	Continue discharging recycled water to the San Joaquin River, obtain a California Water Code Section 1485 right to take a similar amount from the river, treat and deliver to the SRWA member agencies.	Provides long-term water supply linked to quantities of recycled water discharge to the San Joaquin River. Exposes cities to potential increasing water treatment requirements to continue with river discharge.
Groundwater		
Shallow Aquifer Wells	Use shallow, non-potable aquifer wells for non-potable / irrigation uses.	Relatively limited opportunity for use. Already being implemented by all three cities, and is inconsistent with reducing groundwater sustainability and reliance goals.
Wellhead treatment	Install wellhead treatment as required to meet drinking water standards.	Does not meet objective of new/non-groundwater supply, and it is inconsistent with reducing groundwater reliance goals.
New Wells	Install new wells in areas of appropriate water quality to meet increasing demands.	Does not meet objective of new/non-groundwater supply, and it is inconsistent with reducing groundwater reliance goals. Further, recently adopted groundwater legislation and future regulation coming from this legislation will likely constrain this option.
Stormwater		
Stormwater Capture and Groundwater Recharge	Capture stormwater flows and recharge the groundwater aquifer with the captured flows.	Limited availability of flow and recharge locations due to underlying Corcoran clay layer.
Groundwater Banking/ Conjunctive Use		
Develop Groundwater Bank	Enter into a banking operation utilizing a surface water supply to provide in-lieu groundwater banking.	Too complex given lack of existing groundwater management mechanism.

Evaluation of Alternative Supply Options

The identified water supply options were evaluated based on an agreed upon set of criteria, including cost effectiveness, reliability, environmental constraints, regulatory feasibility, institutional complexity, legal viability, and time to implement. The following table summarizes the water supply alternatives that were eliminated from further consideration, and the reason for their elimination.

Project Alternative Screening – Alternatives Eliminated from Further Consideration

Alternative	Reason for Elimination
Demand Reduction	
TID Efficiency Projects	• This alternative was eliminated based on feedback from TID staff that TID intends to implement efficiency improvements and will finance those through TID rate increases.
Water Conservation and Efficiency	• SRWA member agencies are continuing to implement demand reduction measures (i.e., water conservation) specified in the Urban Water Management Plans. As such, SRWA member agencies do not consider conserved water by the cities as a new source of supply for this study. • Analysis conducted during Phase 2 showed that the potential yield of this alternative is approximately 570 AFY. The member agencies will continue to implement demand reduction measures to achieve this level of water use reductions.
Agricultural Efficiency Improvement Projects	• This alternative was eliminated based on feedback from TID about its lack of interest in any programs that involve SRWA investment in water savings within the TID service area.
Recycled Water	
Exchanges with Local Irrigation Districts	• These options were eliminated due to the high cost of winter storage (in the case of exchanges with TID) and the complexity of the agreements for involvement of other agencies. This may not be a constraint if Del Puerto WD is involved.
Cannery Segregation	• Seasonal cannery operations would not result in year-round supply. • Institutional complexities as well as potential permitting and treatment requirements for end use.
TID and SRWA Exchange and third-party agreement with DPWD	• This option was eliminated due to the complex and potentially uncertain nature of the necessary agreements.
Potable Reuse	• This alternative was eliminated due to the extremely high cost of advanced treatment of recycled water and the challenges of injecting the treated water into the confined aquifer beneath the Corcoran clays.
Transfer and Exchange	
Modesto Groundwater Transfer	• This is a potential short-term solution only, and does not constitute a new source of supply.
OID to MID Transfer	• This alternative was eliminated due to the reluctance of the parties to participate in transfer arrangements.
Merced ID Transfer	• This alternative was eliminated due to the reluctance of the parties to participate in transfer arrangements.
Purchase Water from OID	• This option is on hold until it can be determined if SRWA can partner with OID in a new surface water treatment plant since a joint partnership on a treatment plant project is more cost-effective than SRWA constructing its own water treatment plant.

Alternative	Reason for Elimination
Groundwater	
Shallow Aquifer Wells	• SRWA member agencies are implementing shallow groundwater supply projects for parks and other facilities within their jurisdictions. • This alternative was eliminated due to low potential potable demand offset (4,000 AFY) with significant operations and maintenance (O&M) issues. SRWA member agencies' expressed concern that this alternative may impact production and/or water quality from existing production wells.
Wellhead Treatment	• SRWA member agencies agree that one of the primary purposes of the project is to develop new water supplies that reduce reliance on groundwater. Adding additional wellhead treatment would not meet this goal.
New Wells	• The SRWA member agencies agree that one of the primary purposes of the project is to develop new water supplies that reduce reliance on groundwater. Adding additional wellhead treatment does not meet this goal.
Stormwater	
Stormwater Capture and Groundwater Augmentation	• This alternative was eliminated due to the high cost of separating cross connections between storm drains and sanitary sewers, unreliable seasonal supply, and uncertainty of percolating stormwater into the groundwater basin because of geologic feasibility (the type of soils, i.e., Corcoran clay in the area may not be conducive to percolation).
Groundwater Banking/Conjunctive Use	
Develop Groundwater Bank	• For this alternative to be successful, the groundwater basin must be managed by one entity. The groundwater basin underlying the project area is neither adjudicated or under the control of any single entity. It would be difficult for this concept to be implemented in a reasonable time-frame given the diverse set of interests involved in groundwater pumping.

It should be noted that the water supply options not recommended for further consideration at this time may become feasible in the future.

Preferred Water Supply Alternatives

The three water supply alternatives recommended for further consideration are:

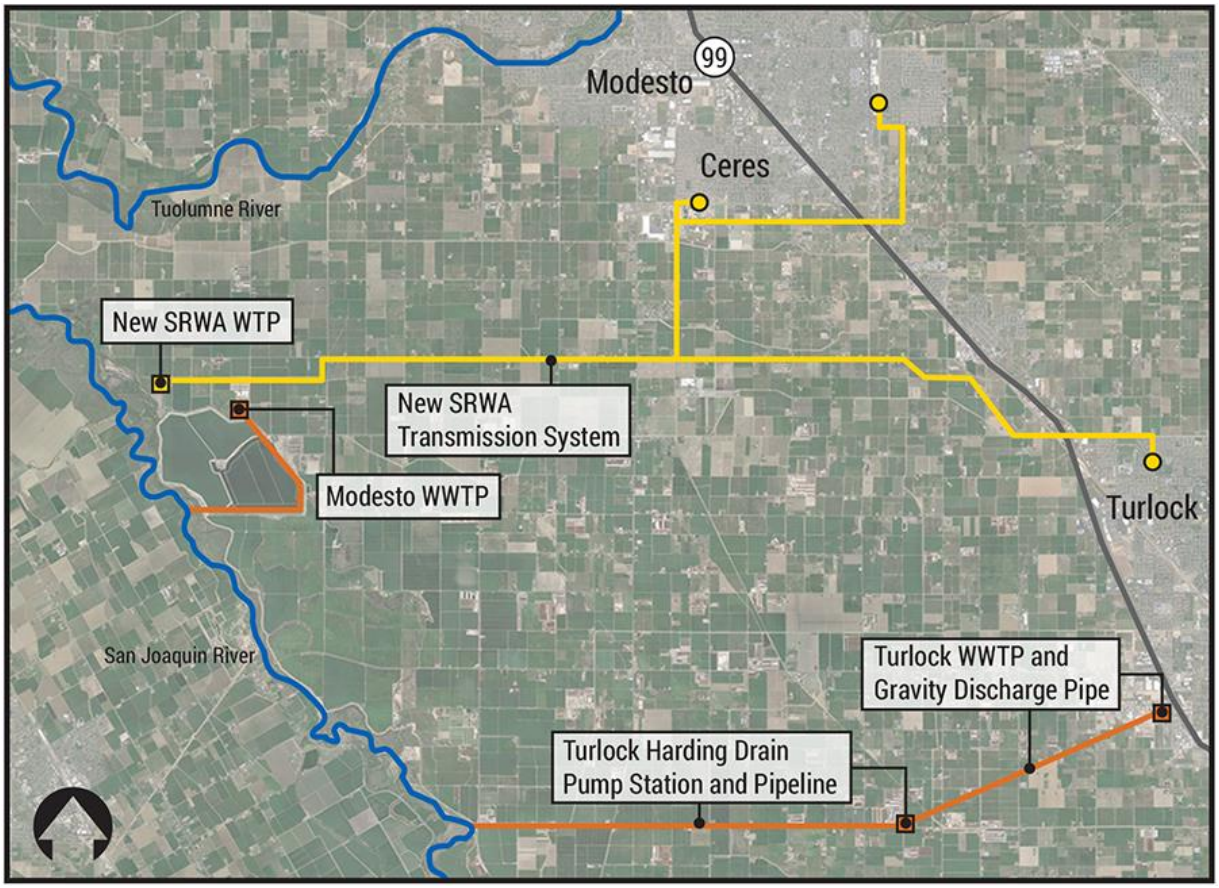
- **San Joaquin River -** Obtain rights to water from the San Joaquin River that are equivalent to the wastewater discharged to the river by the three cities (recognizing that Ceres discharges to the river via flows treated at both Turlock and Modesto treatment plants). Use this new water right to divert water from the San Joaquin River, and then treat and deliver that water to the SRWA member agencies.
- **Stanislaus River -** Obtain a new water supply from OID, partner in the construction of a new water treatment plant near the City of Riverbank, and then deliver treated water to the SRWA member agencies.
- **Tuolumne River -** Obtain an agreement for a new water supply from TID, utilize the existing diversion facility in the Tuolumne River, and then treat and deliver this new supply to the SRWA member agencies.

San Joaquin River Supply

The basis of this supply option is for Modesto and Turlock to continue wastewater discharges to the San Joaquin River. Both cities would obtain a California Water Code Section 1485 water right that would allow them to divert an amount of water from the San Joaquin River that is equal to their wastewater discharges. A new diversion facility, located downstream of both diversions, a multi-barrier water treatment plant, and the piping necessary to deliver the treated water to all three cities would be constructed.

One advantage of this alternative water supply option is it is the only option that does not involve a third party, since the SRWA would be dealing only with its member agencies. A potential disadvantage is the continued discharge to the San Joaquin River could leave the cities open to significant increases in wastewater treatment and disposal costs in the event future regulations require more advanced levels of treatment, particularly if some level of salt removal is required.

Another disadvantage of this option is it precludes the sale of recycled water to the Del Puerto Water District, resulting in a loss of potential recycled water sales revenue to the cities of Modesto and Turlock.



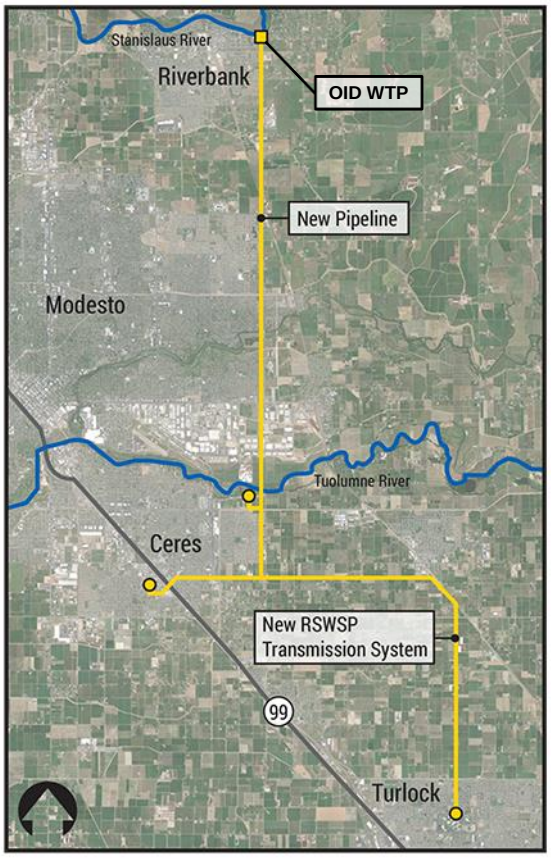
The San Joaquin River supply option would include a river diversion, treatment and delivery east to the Cities of Modesto, Ceres and Turlock.

Stanislaus River Supply

Stanislaus River water is potentially available via the Oakdale Irrigation District (OID). OID is in the process of developing a "white paper" regarding its desire to sell excess water supplies outside of its services area. One option that appears available is to enter into an agreement with OID to participate in a new surface water treatment plant that would be located near Riverbank. This project may involve the San Francisco Public Utilities Commission (SFPUC), which has a need to rehabilitate its Mountain Tunnel, a part of its Hetch Hetchy water delivery system. Through this arrangement, the SFPUC would obtain treated water from OID during the low demand winter months when the Mountain Tunnel could be out of operation.

This approach would have OID provide treated water to the SFPUC for 2 to 4 months each winter over a period of approximately 10 to 12 years. By partnering in this project, SRWA could obtain treated water for 8 to 10 months each year, which would be adequate to meet its near-term water supply needs. SRWA would negotiate a long-term agreement that would continue after the Mountain Tunnel rehabilitation is complete.

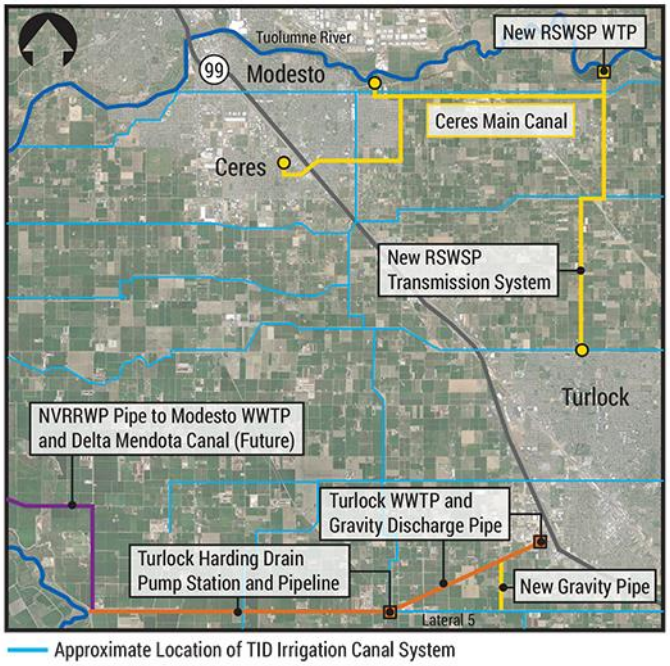
One advantage of this option is the potential for sharing in the cost of a new water treatment plant, and depending on how SFPUC participates, the sharing of the cost of the treated water pipeline from the treatment plant to the intersection of that pipeline with the Hetch Hetchy Aqueducts. Also, this option seems to provide a highly reliable long-term water supply.



The Stanislaus River supply option would include a diversion from the Stanislaus River and the construction of a water treatment plant near the City of Riverbank. Treatedwater would be piped south to the Cities of Modesto, Ceres and Turlock.

Tuolumne River Supply

This water supply option would provide a raw water supply from TID, with treatment and delivery by SRWA. This alternative includes the provision of "offset" water in less than full allocation TID water years. Based on TID agricultural water allocations over the last 22 years, the average allocation is approximately 11% below the full allocation of 48 inches per year. Based on the proposed terms of an agreement adopted by the TID Board of Directors, this would require SRWA to supply, on average, approximately 6,000 AF of "offset" water, which would be 20% of the total SRWA contract allocation. Offset water would be provided by constructing an intertie between the Turlock effluent outfall pipeline and TID Lateral 4 or 5.

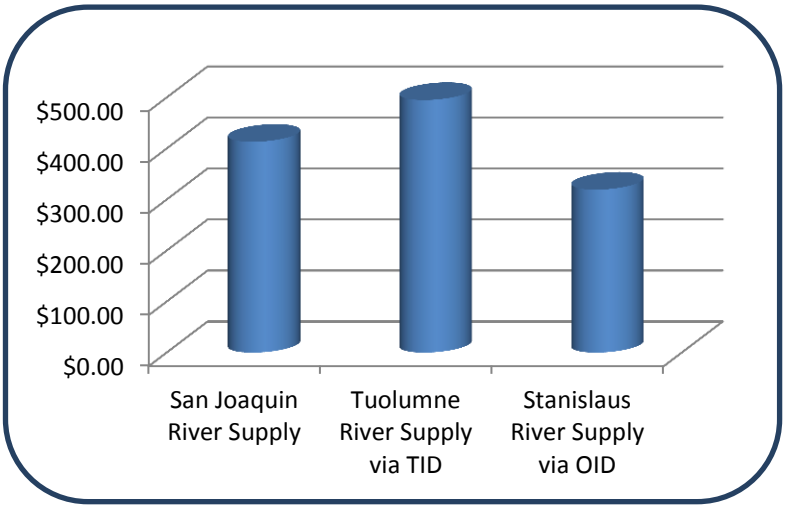


The Tuolumne River supply option would use the existing TID diversion to provide water to the proposed RSWSP treatment plant. Treated water would be piped to the Cities of Modesto, Ceres and Turlock. This alternatve also includes an interconnection of the recycled water system with TID's Lateral 4 or 5.

The advantage of this water supply option is the access to Tuolumne River water through an agreement with TID. One disadvantage of this option is the lack of reliability of supply – SRWA supplies would be cut back in water short years similar to agricultural cutbacks. The City of Modesto and Turlock have initiated the Environmental Review Process and Facility Planning Phase for the North Valley Regional Recycled Water Project (NVRRWP). The NVRRWP is intended to deliver the City of Modesto and Turlock's recycled water to Del Puerto Water District for irrigation purposes and would conflict with potentially delivering recycled water to TID as "offset water." Since the City of Modesto has indicated a reluctance to provide recycled water to TID, Turlock would only be able to supply a limited amount of offset water during the irrigation season. This limitation could be reduced if TID were able to provide for non-irrigation season storage. Even with storage, there may not be enough recycled water available from Turlock alone to offset for all SRWA member agencies. Another disadvantage is it is not clear that a water supply agreement beyond the initial agreement for up to 30,000 AFY can be obtained.

Comparison of Alternatives

The three alternative water supply options were compared based on capital and operating costs, resulting in an estimated cost per acre-foot of treated water. The estimated costs, however, presented in the figure below, *exclude* raw water supply costs. What this analysis shows is the Stanislaus River supply via OID is the least cost alternative without consideration of the raw water cost. Of critical importance is how the costs of the treatment plant would be allocated (between the SRWA and the SFPUC), and the degree of cost-sharing for the portion of the pipeline from the treatment plant to the crossing of the Hetch Hetchy Aqueducts. For cost comparison purposes it is assumed that SFPUC would pay for 50 percent of treatment plant capital costs and 10 percent of treated water conveyance pipeline capital costs.



Recommendations

The apparent best alternative for the SRWA is the Stanislaus River supply option assuming that a 50 percent capital cost share with SFPUC and a reasonable cost for raw water could be attained. It is therefore recommended that SRWA initiate discussions/negotiations with OID to determine a price for the raw water supply, cost sharing arrangements for treatment and delivery, schedule for implementation, and other terms of a long-term water supply agreement. At the same time, the SRWA should continue discussions with TID for a Tuolumne River Supply. A Tuolumne River supply option vis TID remains a viable supply option. This information can then be used in the SRWA's decision-making process in determining which alternative is best suited to meet its collective long-term interests.

Chapter 1 Introduction

1.1 Purpose

The purpose of the Stanislaus Regional Water Authority Water Supply Study (Study) is to develop a water supply portfolio that allows the Stanislaus Regional Water Authority member agencies to meet current and future demands while protecting the groundwater basin at an affordable cost. The Study considers alternatives that transfer water from the Turlock Irrigation District (TID) as well as alternatives that can be implemented independently of TID.

1.2 Background

This section provides a brief history of the SRWA and the Regional Surface Water Supply Project (RSWSP), describes water supply challenges in the region, and summarizes urban water demand projections for the SRWA member agencies.

1.2.1 Stanislaus Regional Water Authority

The cities of Modesto, Turlock, and Ceres formed the Stanislaus Regional Water Authority (SRWA) through a joint powers agreement (JPA) in 2011 with the intention of working together to develop a reliable water supply to meet the potable water demands of the three cities. Groundwater is currently a key potable water supply in the region. The cities of Turlock and Ceres rely solely on groundwater and the City of Modesto relies on groundwater to meet its demands south of the Tuolumne River. Groundwater supplies south of the Tuolumne River serve an urban and agricultural demand, which has led to significant levels of groundwater overdraft in the region. The groundwater basin also has several areas of concern related to contamination from nitrates and arsenic.

The development of a new surface water supply will allow the cities of Turlock, Ceres, and Modesto (member agencies) to reduce their reliance on groundwater for existing customers, expand their water supply portfolio, and meet projected demands resulting from future development and economic growth in the urban areas south of the Tuolumne River. A new surface water supply will also allow member agencies to maximize water supply reliability over varying hydrological and meteorological conditions through conjunctive use, while increasing storage and improving water quality within the groundwater basin for the benefit of agricultural and urban users. SRWA estimates the current and future demands for its member agencies at 30,240 acre-feet per year (AFY) by 2021, 43,680 AFY by 2025, and 57,120 AFY at buildout.

1.2.2 Regional Surface Water Supply Project

Prior to the creation of the SRWA, the member agencies were working with Turlock Irrigation District (TID) to develop a Regional Surface Water Supply Project (RSWSP) that would divert water from the Tuolumne River, treat it for potable use, and deliver it to SRWA member agencies, as well as delivery by TID to agricultural customers. TID conceptualized this project in the late 1980s. As originally conceived TID would provide treated (potable) surface water to Modesto, Turlock and Ceres as well as other communities. TID made some initial progress in implementing the RSWSP by constructing an infiltration gallery for the facility's raw water intake on the Tuolumne River in 2001, preparing an Environmental Impact Report (EIR) in 2006, and purchasing the property for the water treatment plant (WTP) in 2008.

The SRWA was formed for the purpose of making responsible decisions related to the development and operation of the future RSWSP. The member agencies are interested in finding and evaluating surface water supply options and facilities to serve municipal and industrial water to the customers within their service areas. This study was commissioned by the SRWA Board of Directors on April 24, 2014 with the purpose of developing a water supply portfolio that allows the SRWA to meet current and future demands while protecting the groundwater basin at an affordable cost.

TID issued a memorandum[1] to its board of directors on July 9, 2014 proposing additional terms for a transfer agreement with SRWA. Under this proposed agreement, SRWA could purchase up to 30,000 acre-feet per year (AFY) of Tuolumne River water provided that SRWA provide "offset water" to TID during critically dry years when surface water supplies are limited. TID stated that SRWA would be required to supply "offset water" in any year that the agricultural allocation is less than 48 inches.

The full TID water allocation is 48 inches per year, which is more than the average per-acre agricultural use. Based on the TID agricultural allocation for the past twenty-two years, the average allocation is 11 percent below the full allocation. Additionally, TID officials have recently made public statements that they expect the surface water available for allocation to agricultural entities to decrease further in the future. The TID Board Resolution addresses SRWA's 30,000 AFY request for Phase 1 of the RSWSP and does not provide the additional surface water required for Phase 2 and Phase 3 (ultimate) demand.

1.2.3 Water Supply Challenges

This section discusses several water supply challenges that were considered while developing the project alternatives.

- Diminishing groundwater quality and supply
- Availability of water rights
- Potential pressure on increased levels of in-stream flow requirements on the Tuolumne and other tributaries of the San Joaquin River
- Potential challenges related to regulatory processes and environmental and institutional constraints associated with alternative water supplies
- Obtaining a highly reliable and affordable water supply

Groundwater

- The SRWA member agencies have recognized the diminishing water quality and reliability of supply of the groundwater basin. Modesto, Turlock, and Ceres have all decommissioned potable groundwater wells because of the degrading water quality.
- The eastern portion of the Turlock sub-basin is over-drafted. Recent drought conditions have forced many in the region to rely even more heavily on groundwater as surface water supplies are limited, further lowering groundwater elevations and increasing pumping costs.
- Land owner's desire to convert seasonal cattle pasture land to higher value permanent crops has led to declining groundwater levels, which is one consideration driving the need for restoring and maintaining groundwater conditions in the eastern portion of the Turlock sub-basin.

Water Rights

- MID and TID hold pre-1914 water rights on the Tuolumne River under License 11058, however a considerable portion if not the majority of water rights are post-1914. Currently all water received by MID is under post-1914 water rights. In 2004, MID petitioned for a license change in order to facilitate a long term transfer agreement with the City of Modesto for up to 67,200 AFY of Tuolumne River water. In order to access surface water on the Tuolumne River, SRWA must enter into a transfer agreement with either TID or MID and overcome any resulting institutional challenges.

[1] TID Water & Power Water Resources Administration. Memorandum: Terms for Transfer of Water to Stanislaus Regional Water Authority. July 9, 2014. Tou Her

- Oakdale Irrigation District (OID) and South San Joaquin Irrigation District (SSJID) hold water rights on the Stanislaus River. Merced Irrigation District (Merced ID) holds water rights on the Merced River. Currently these entities lack the infrastructure to facilitate a water transfer with SRWA. However these entities are considered potential sources in this study.

Institutional Challenges

- MID and TID currently have an agreement defining the place of use for their shared rights on the Tuolumne River. The City of Modesto is able to use surface water treated at the Modesto Regional Water Treatment Plant (MRWTP) within the existing place of use intended for MID. Under this agreement MID's authorized place of use is 102,316 gross acres North of the Tuolumne River and TID's authorized place of use is 197,281 gross acres South of the Tuolumne River. The City of Modesto is not authorized to use any MID water south of the Tuolumne River and therefore utilizes city produced groundwater to supply South Modesto, which is located south of the Tuolumne River. In order for SRWA member agencies to use Tuolumne River water south of the river; some form of agreement must be made with TID. TID's agreement with MID also states that both Districts will utilize their local groundwater to the extent possible within the basin safe yield.
- Merced ID has a significant history of water transfers, and has experience working with TID and MID on exchange agreements, particularly flow augmentation agreements.
- TID has stated as part of ongoing negotiations with SRWA that "offset water" must be provided in the form of recycled water during dry years in order for SRWA to purchase up to 30,000 AFY of Tuolumne River water from TID. Although TID has expressed the importance of keeping this valuable resource within the watershed, the conditions of this resolution do not provide a beneficial use for all of the recycled water that is produced by SRWA member agencies, which presents the challenge of identifying management strategies for recycled water during winter months and normal/wet years.
- OID is currently evaluating the implementation of a project that would facilitate water transfers and exchanges in the region, and plans to release a white paper describing the potential opportunity.

Modesto and Turlock Recycled Water

- Modesto currently treats the majority of its wastewater to secondary standards and produces up to 2.3 MGD of tertiary effluent, which is blended with secondary effluent and reused for agricultural irrigation. Modesto is currently constructing Phase 2 treatment plant improvements that will increase tertiary production by 12.6 MGD; to a total of approximately 15 MGD tertiary effluent. Currently, secondary effluent is seasonally discharged to the San Joaquin River under a National Pollutant Discharge Elimination System (NPDES) Permit during the non-irrigation season.
- Turlock currently treats approximately 10 MGD of wastewater to tertiary standards and discharges into the San Joaquin River under its NPDES Permit.
- As Turlock and Modesto's treatment facilities are expanded, up to approximately 60,000 AFY of Title 22 water could become available for unrestricted reuse by 2045 (build out).
- Modesto and Turlock have a goal of eliminating discharge into the San Joaquin River for two reasons: first, to avoid increasingly stringent discharge requirements and second, to utilize the valuable resource for beneficial reuse.
- Modesto and Turlock are both committed to evaluating the feasibility of the North Valley Regional Recycled Water Program (NVRRWP), which will provide a year round beneficial use of recycled water to Del Puerto Water District (DPWD). The NVRRWP proposes to transfer

recycled water from Modesto and Turlock's wastewater treatment plants to the Delta Mendota Canal (DMC) for use by DPWD. This report identifies potential alternatives that utilize recycled water in dry years.

Regulatory and Environmental Constraints

- Several of the alternatives would require the construction of new intakes and diversion structures to divert raw water from certain surface water systems to SRWA. These structures would involve additional permits from the United States Army Corps of Engineers (Section 404), which will require consultation with the United States Fish and Wildlife Service (USFWS and National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries) regarding impacts to aquatic resources and the State Historic Preservation Officer regarding impacts to cultural resources. In addition, permits from the Regional Water Quality Control Board (Section 401 Water Quality Certification), California Department of Fish and Wildlife (CDFW) (Streambed alternation agreement and incidental take permit) would be needed. The intakes must comply with NOAA Fisheries requirements for design (e.g., for mesh size and approach velocity) and operation. CDFW may have more stringent requirements for construction. The implementation of a new intake is expected to have more environmental impacts requiring mitigation than the typical infrastructural project that does not involve this component, and would involve acquisition of more permits which have longer lead times. However, these projects would still be feasible in terms of regulatory and environmental constraints.
- NOAA Fisheries released a Recovery Plan for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead. This recovery plan sets goals and prioritizes actions for the Sacramento-San Joaquin Delta and its watersheds, laying out steps to achieve species' recovery[2]. The strategy consists of restoring habitat and reintroducing populations into their historical habitats. The SRWA Water Supply Study includes potential alternatives that involve the diversion of water from San Joaquin River, Merced River, Tuolumne River, and Stanislaus River. Analyses will need to be conducted for the selected alternative(s) to ensure that proposed facilities and actions would not affect salmonids.[3]
- The State Water Resources Control Board (SWRCB) is developing flow objectives to protect the public trust resources and beneficial uses of water, such as agriculture, municipal, and hydropower uses. The SWRCB requested the Delta Science Program to provide recommendations for identifying methods to determine instream flow criteria for the tributaries to the Sacramento-San Joaquin Delta (Bay-Delta). Flow criteria, which provide a technical basis for the development of flow objectives, will consider the needs of each watershed's flow dependent aquatic organisms, with an emphasis on protection of threatened or endangered species, or species likely to become threatened or endangered in the foreseeable future. Flow objectives will be tailored to each individual tributary to address the unique hydraulic/geomorphic characteristics, public trust resource considerations, and beneficial uses of water. As the SRWA Water Supply Study considers diversion of water from major tributaries of the Bay Delta, the

[2] NOAA Fisheries. 2014. *Central Valley Chinook Salmon & Steelhead Recovery Plan*. Summer. Available at: <http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/california_central_valley/cv_chin_stlhd_r_plan_fs_071614.pdf> Accessed on August 19, 2014.

[3] NOAA Fisheries. 2014. *Central Valley Chinook Salmon & Steelhead Recovery Plan*. <http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/california_central_valley/california_central_valley_recovery_plan_documents.html> Accessed on August 19, 2014.

potential impact of these flow objectives must be considered in the analysis of the selected alternative(s)[45].

- The USFWS prepared an Environmental Assessment proposing to expand the San Joaquin River National Wildlife Refuge (NWR) by acquiring up to 22,156 additional acres from willing sellers. The San Joaquin River NWR is located west of Modesto, within the historic floodplain of the confluences of the San Joaquin, Stanislaus, and Tuolumne Rivers. USFWS is considering expanding the Refuge in two sections; north and south of the existing boundary along the San Joaquin River. The northern portion of the study area includes a 15-mile reach of the San Joaquin River from the existing boundary of the Refuge north to a point west of Manteca, in San Joaquin County. The southern portion lies between the San Joaquin River National Wildlife Refuge and the San Luis National Wildlife Refuge, 26 miles to the south. The purpose of expanding the NWR is to protect and restore habitat and associated species, develop habitat for migratory birds, and protect and restore floodplains.[6] If the project is approved by USFWS, analyses will need to be conducted for the selected alternative(s), as needed, to ensure the selected alternative(s) would be consistent with the plan.
- The San Joaquin River Restoration Program (SJRRP) is a comprehensive long-term effort to restore flows to the San Joaquin River from Friant Dam to the confluence of the Merced River and restore a self-sustaining Chinook salmon fishery in the river while reducing or avoiding adverse water supply impacts from restoration flows. The SJRRP is a direct result of a Settlement reached in September 2006 on a lawsuit to provide sufficient fish habitat in the San Joaquin River below Friant Dam near Fresno, California. While our study area is located downstream of the SJRRP, the selected alternative(s) should consider the effect on the SJRRP.[7]

1.2.4 Demands

The SRWA member agencies have recognized a long term regional solution is necessary to provide a sustainable water supply that will meet current and projected urban demands. SRWA members project significant urban growth that will result in a 66 percent increase in population by the year 2035. Turlock and Ceres general plans project buildout to occur in years 2020 and 2022, respectively, while Modesto's Urban Water Management Plan reports urban demand to remain flat after 2015. Demand projections associated with population growth accounting for the impact of water conservation are shown in **Figure 1-1**.

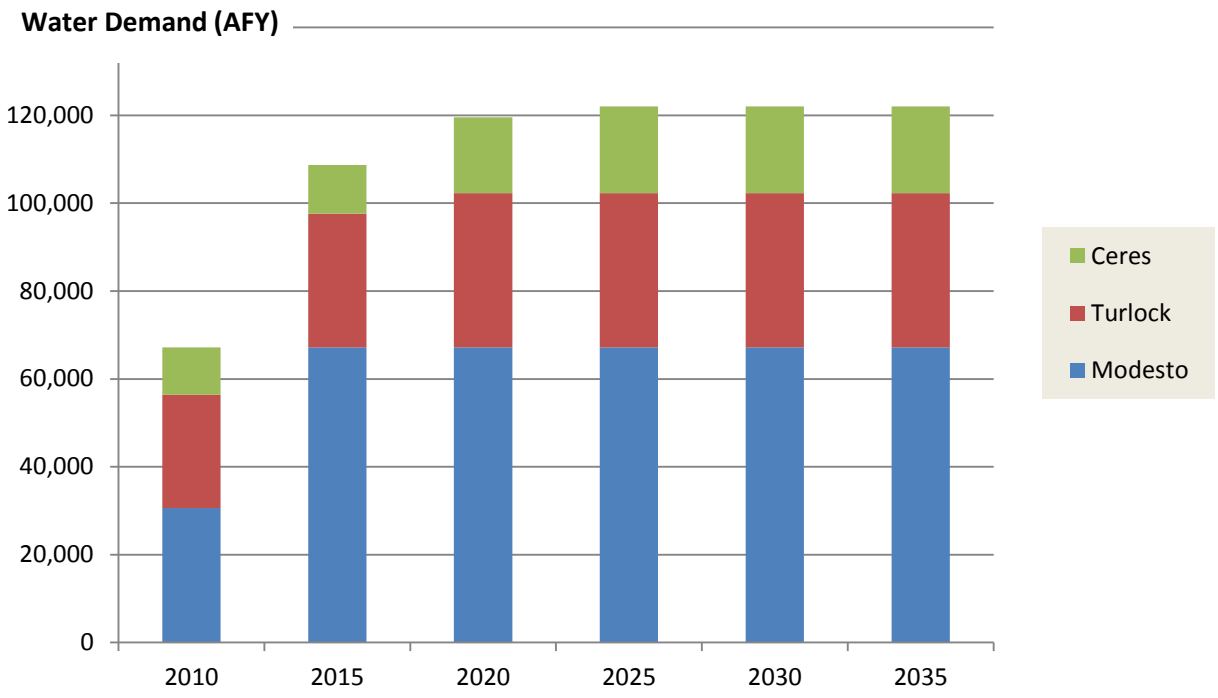
[4] SWRCB. Development of Flow Objectives (Phase 4 of Bay-Delta Effort). 2014. Available at: < http://www.swrcb.ca.gov/waterrights/water_issues/programs/bay_delta/flow_objectives/index.shtml> Accessed on August 20, 2014.

[5] Delta Stewardship Council Delta Science Program. 2014. Recommendations for Determining Regional Instream Flow Criteria for Priority Tributaries to the Sacramento-San Joaquin Delta A report to the California State Water Resources Control Board. February. Available at: < http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/flow_objectives/docs/delta_science_rpt_022014.pdf>

[6] USFWS. Proposed Expansion San Joaquin River National Widllife Refuge. Environmental Assessment, Land Protection Plan, and Conceptual Management Plan.

[7] San Joaquin River Restoration Program. 2011. San Joaquin River Restoration Program. November 28. Available at: <http://www.restoresjr.net/background.html Accessed on August 19, 2014>

Figure 1-1: Urban Water Demand Projection[8]



It should be noted that Modesto's urban demands presented above reflect the entire service area, while additional surface water supply is only required for the urban areas located South of the Tuolumne River. Urban demand proportions across member agencies are not representative of requested surface water proportions.

In 2005, SRWA members approved the "First Drinking Water Agreement" with TID for the initial stages of RSWSP. This agreement established water delivery requests for SRWA members based on the non-groundwater supplied buildout demand from each agency's respective General Plan areas. These delivery requests are summarized in **Table 1-1.** For the purpose of this study, SRWA's request is to develop a water supply strategy to meet Phase 1 demands of 30,000 AFY and Buildout demands of 58,000 AFY.

Table 1-1: Projected Annual Delivery Requests (AFY)[9]

SRWA Member Agency	1st Phase (2021)[10]	2nd Phase (2035)	3rd Phase (Buildout)
City of Ceres	6,720	13,440	22,400
City of Modesto	6,720	13,440	17,920
City of Turlock	16,800	16,800	16,800
Total Water Delivery	**30,240**	**43,680**	**57,120**

[8] City of Modesto & Modesto Irrigation District Joint 2010 UWMP, May 2011; City of Turlock 2009 Water Master Plan, May 2009; City of Ceres 2012 Water and Sewer System Master Plans, December 2012.
[9] Regional Surface Water Supply Project White Paper; Cities of Ceres, Modesto, and Turlock; January 21, 2011; http://www.stanrwa.org/documents/
[10] 1st Phase modified to year 2021 per SRWA

1.3 Phases of Work

The study was composed of three phases of work that identified, developed, and evaluated several water supply alternatives. A brief description of each phase of the study is provided below:

1. **Phase 1 - Identify Alternatives**: The initial phase identified thirteen conceptual alternatives at the project kickoff meeting with SRWA (Workshop No. 1) on May 5, 2014. Fact sheets were developed to summarize the opportunities, challenges, potential yield, and benefits of the each alternative. While developing fact sheets four additional sub-alternatives were identified, resulting in a total of 17 alternatives. A subsequent meeting between SRWA member agencies and the project team resulted in the reduction of alternatives to 13 for further evaluation.

2. **Phase 2 - Develop Alternatives**: The second phase consisted of refining the alternatives selected in Phase 1 by identifying the infrastructure required, yield, characterizing other parameters for each alternative, and determining availability of water supply from outside agencies.

   Workshop No. 2 was held on July 21, 2014 to discuss the results of this task, and a further narrow the alternatives with input from the SRWA member agencies. Four alternatives were removed from further consideration and one more was added as a result of this workshop.

3. **Phase 3 - Evaluate Alternatives:** The final phase consisted of a final alternative screening before the remaining alternatives were then evaluated against the criteria determined during the initial phase of the study to compare implementation feasibility from technical, cost, legal, institutional, and environmental perspectives. The evaluation process quantified each alternative's performance relative to these criteria, providing a basis for future decision making while identifying important considerations involved with implementation.

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Chapter 2 Project Alternative Development

2.1 Project Alternative Identification

The purpose of Phase 1 of this study was to identify project alternatives. The project team conducted a workshop with SRWA member agencies to brainstorm conventional and "outside of the box" project alternatives. The project alternatives fall within the following six broad categories.

1. **Demand Reduction Projects:** Supply would be made available by implementing projects and practices that increase water use efficiency.
2. **Transfer and Exchange Projects:** Supply would be purchased from another entity for direct use or exchange with another agency.
3. **Recycled Water Projects:** Title 22 treated-wastewater would be used for non-potable reuse or indirect potable reuse. Recycled water would be exchanged with TID for rights to surface water from the Tuolumne River.
4. **Groundwater Projects:** Groundwater would be pumped and treated as necessary for potable or irrigation use within the three cities.
5. **Stormwater Capture and Groundwater Augmentation:** Stormwater within the three cities would be diverted and treated as necessary for percolation and/or injection into the aquifer, for later use by the three cities.
6. **Groundwater Banking and Conjunctive Use:** Groundwater would be banked locally for out of watershed agencies. The groundwater basins would then be conjunctively used and water would be provided to other agencies during dry/critically dry years. This alternative could require the use of aquifer storage and recovery wells.

The conceptual alternatives identified were developed to identify potential challenges, opportunities, and benefits associated with implementation. The conceptual alternatives considered in this Study are described briefly below.

2.1.1 Demand Reduction Projects

- **Alternative 1a – TID Efficiency Improvement Projects:** TID has identified several projects that increase the efficiency of the TID irrigation delivery system. SRWA would support TID in implementing some or all of these projects in direct exchange for a surface water supply from the Tuolumne River, to be treated at a SRWA-owned WTP (the same as that evaluated in the RSWSP EIR, herein referred to as the RSWSP WTP). Water would be conveyed to the SRWA member agencies via the pipeline alignments identified in the RSWSP (herein referred to as the RSWSP transmission system).
- **Alternative 1b – Water Conservation and Efficiency:** SRWA member agencies would continue to implement water conservation efforts to reduce demands and make an equal amount of conserved supply available for domestic use.
- **Alternative 1c – Agricultural Efficiency Program:** SRWA would work with TID to assist TID agricultural customers in implementing on-farm efficiency improvements that would result in measurable agricultural demand reductions, and thereby obtain a surface water supply from the Tuolumne River. Water would be treated at the RSWSP WTP and distributed through the RSWSP distribution system. It should be noted that during Phase 1, the project team considered agricultural efficiency opportunities within the service areas of multiple irrigation districts. However, it was later determined that since TID holds Tuolumne River rights necessary to serve SRWA member agencies, this water supply study should focus on a TID on-farm efficiency program. A similar analysis could be performed within the service areas of other irrigation

districts, which would require further evaluation as it is expected an entirely different set of facilities would be needed to divert, treat, and distribute surface water depending on the location of local surface water relative to SRWA's planned RSWSP facilities.

2.1.2 Transfers and Exchange Projects

- **Alternative 2a – Modesto Groundwater Transfer with Ceres and Turlock:** SRWA would construct interties between Turlock and Ceres' distribution systems by installing a pipeline below the Tuolumne River. This would allow groundwater to be transferred from North Modesto to the South County members as a temporary measure while additional long-term water supply alternatives are being implemented.

- **Alternative 2b –MID / Oakdale Irrigation District (OID) / South San Joaquin Irrigation District (SSJID) Transfer/Exchange:** SRWA would purchase water from MID, OID or SSJID and construct treatment and conveyance facilities. This alternative includes the following three options:

  Alternative 2b1 – Purchased water from OID would be transferred to Modesto Reservoir, treated at the Modesto Regional Water Treatment Plant (MRWTP), and conveyed to SRWA members through MID's conveyance pipeline to a new SRWA pump station and transmission main crossing the Tuolumne River, and connection to the RSWSP transmission system.

  Alternative 2b2 – Purchased water from OID would be transferred to Modesto Reservoir in exchange for MID surface water from the Tuolumne River. MID would then enter into a transfer agreement with TID, who would then transfer water to SRWA to be treated at the RSWSP WTP and delivered through the RSWSP transmission system.

  Alternative 2b3 – Purchased raw water from OID would be conveyed directly from the Stanislaus River through a new SRWA-constructed raw water pipeline, treated at the RSWSP WTP, and conveyed through the RSWSP transmission system.

  Alternative 2b4 – Purchased treated water from OID would be conveyed directly from a new OID WTP to SRWA member agencies through a new treated water distribution system. SRWA would share the capital and O&M costs associated with raw water transition and water treatment with a third party.

- **Alternative 2c – Merced Irrigation District (Merced ID) Transfer:** SRWA would purchase water from Merced ID and construct required treatment and conveyance facilities. This alternative incorporates the following three sub-options:

  Alternative 2c1 – Purchased water from Merced ID would be transferred to TID's irrigation canal system in exchange for TID surface water from the Tuolumne River. Water would be treated at the RSWSP WTP and conveyed through the RSWSP distribution system.

  Alternative 2c2 – Purchased water from Merced ID would be conveyed from the Merced River through an SRWA-constructed raw water pipeline and treated at a new SRWA surface WTP and delivered through a new SRWA transmission system.

  Alternative 2c3 – Purchased water from Merced ID would be diverted from the San Joaquin River (which is downstream of the Merced River) and treated at a new SRWA surface WTP and delivered through a new SRWA transmission system.

2.1.3 Recycled Water Projects

- **Alternative 3a – Traditional and Advanced Treatment:** SRWA would construct facilities required for exchange of recycled water with other local agencies. This alternative requires differing operations and facilities during the irrigation and non-irrigation seasons and therefore includes the following sub options:

  Alternative 3a1 (irrigation season) – Recycled water would be transferred to TID during the irrigation season in exchange for surface water from the Tuolumne River that is treated at the RSWSP WTP.

  Alternative 3a2 (non-irrigation season)[11] - Recycled water would be stored in the groundwater basin during the non-irrigation season. Storage of water would require either percolation ponds or aquifer storage and recovery wells that directly inject advanced-treated recycled water into the groundwater basin

- **Alternative 3b – Cannery Segregation:** SRWA would construct facilities required to exchange Modesto's local cannery wastewater with TID. This option would allow a TID exchange for surface water from the Tuolumne River that is treated at the RSWSP WTP.

- **Alternative 3c – TID and SRWA Exchange and third-party agreement with DPWD:** TID issued a memorandum to its Board of Directors proposing terms of a transfer agreement with SRWA (dated July 9, 2014). In general, the memorandum states TID would provide 30,000 AFY to SRWA during normal/wet years; and SRWA would be required to provide offset water to TID in less than full water allocation years. The stipulations of the agreement have not been negotiated at this time, but this alternative considers opportunities to provide recycled water from SRWA member agencies to TID as offset water in less than full water allocation years. This alternative also considers shared facilities with the NVRRWP.

- **Alternative 3d – SRWA Member Agencies continue river discharge with option for Direct Potable Reuse (DPR):** SRWA member agencies would continue to discharge tertiary effluent into the San Joaquin River and withdraw an equivalent amount of water for treatment and delivery by a new SRWA WTP and distribution system. This alternative also considers implementation of direct potable reuse (DPR).

  Alternative 3d2 – SRWA Member Agencies continue river discharge with Advanced Wastewater Treatment and Brine Disposal: SRWA member agencies would increase treatment levels required to meet anticipated salt management regulations and continue to discharge effluent into the San Joaquin River, while withdrawing an equivalent amount of water for treatment and delivery by a new SRWA WTP and distribution system.

2.1.4 Groundwater Projects

- **Alternative 4a – Shallow Aquifer Wells:** SRWA would construct new shallow aquifer wells to irrigate high demand parks, golf courses, and cemeteries in Modesto, Turlock and Ceres. This option would reduce pumping from the deep aquifer, and make the supply available for potable use.

- **Alternative 4b – Wellhead treatment:** SRWA would reactivate production wells decommissioned in Modesto and Turlock due to water quality issues and provide necessary wellhead treatment to improve water quality for potable or agricultural use. Developed water would either meet SRWA demands directly or exchanged for TID surface water from the Tuolumne River that is be treated at the RWSP WTP.

[11] This alternative provides beneficial use of recycled water for the entire year.

- **Alternative 4c – New Wells:** SRWA would construct new groundwater production wells within Modesto, Turlock and Ceres. This new supply would be exchanged for TID surface water from the Tuolumne River that is treated at the RWSP WTP.

2.1.5 Stormwater Capture and Groundwater Augmentation Projects

- **Alternative 5:** SRWA would implement projects to complete separation of stormwater and wastewater collection systems. The stormwater could then be conveyed to a new groundwater basin for percolation, or injected directly. This option would offset potable water demand from the groundwater basin.

2.1.6 Groundwater Banking and Conjunctive Use Projects

- **Alternative 6:** SRWA would implement a groundwater accounting system for water stored in the basin and enter into an in-lieu groundwater banking agreement with a Hetch Hetchy Aqueduct retailer. SRWA would construct facilities required for obtaining Hetch Hetchy Aqueduct water.

2.2 Project Alternative Screening

Several of the conceptual alternatives listed above were removed from further consideration as a result of conversations with SRWA and/or during workshop discussions. **Table 2-1** summarizes alternatives that were removed and provides the rationale for their removal.

Table 2-1: Project Alternative Screening – Alternatives Removed from Further Consideration

Alternative	Reason for Removal from Further Consideration
Alternatives Eliminated Prior to Phase 2 (May 23, 2014 teleconference)	
2a: Modesto Groundwater Transfer	• This is a potential short-term solution only, and does not provide any long-term solution.
3b: Cannery Segregation	• Because the canneries only operate from April – September during the canning season this option would not provide a year-round supply. • SRWA has indicated that implementing this alternative would be impractical because it would require permits on all land to which the recycled water is applied.
4b: Wellhead Treatment	• SRWA member agencies agree that one of the primary purposes of the project is to develop water supplies that do not impact the groundwater basin. Adding wellhead treatment to increase groundwater pumping would be counter to this goal.
4c: New Wells	
Alternatives Removed During Phase 2, at Workshop #2 (July 21, 2014)	
1b: Water Conservation and Efficiency	• SRWA member agencies are continuing to implement demand reduction measures (i.e., water conservation) specified in the Urban Water Management Plans. As such, SRWA member agencies do not consider water conserved by the cities as a source of supply for this study. • Analysis conducted during Phase 2 showed that the potential yield of this alternative is approximately 570 AFY. The member agencies will continue to implement demand reduction measures to achieve this level of water use reductions.
4a: Shallow Aquifer Wells	• SRWA member agencies are implementing shallow groundwater supply projects for parks and other facilities within their jurisdictions. • This alternative was removed from further consideration due to low potential potable demand offset (4,000 AFY) with significant operations and maintenance (O&M) issues. SRWA member agencies' expressed concern that this alternative may impact production and/or water quality from existing production wells.
5: Stormwater Capture and Groundwater Augmentation	• This alternative was removed from further consideration due to the high cost of separating **cross connections from storm drains to sanitary sewers**, unreliable seasonal supply, and uncertainty of percolating stormwater into the groundwater basin because of geologic feasibility (the type of soils, i.e., Corcoran clay, in the area may not be conducive to percolation).
6: Groundwater Banking and Conjunctive Use	• For this alternative to be successful, the groundwater basin must be managed by one entity. The groundwater basin underlying the project area is neither adjudicated or under the control of any single entity. It would be difficult for this concept to be implemented in a reasonable time-frame given the diverse set of interests involved in groundwater pumping. As such, SRWA agreed to remove this alternative from further consideration.

Alternative	Reason for Removal from Further Consideration
Alternatives Removed During Phase 3, at Workshop #3 (September 8, 2014)	
1a: TID Efficiency Improvements Projects	• TID has indicated that they will not consider this alternative until the TID Integrated Water Supply Study is completed, which is estimated to be between March and September of 2016.
1c: Agricultural Efficiency Program	• TID has given no indication that they would consider this type of project and has not committed associated surface water savings to SRWA regardless of who finances the program.
2b1 & 2b2: Transfer / Exchange with MID & OID	• MID has indicated that they are not interested in having its facilities used to wheel water from one district to another.
2c1, 2c2, & 2c3: Transfer / Exchange with Merced ID	• Merced ID has indicated that there may be variable wet weather flows available for transfer. These alternatives are removed from further consideration due to the unconfirmed availability and cost.
3a1: TID Supply with Recycled Water exchange	• This alternative provides a recycled water use for the irrigation season only and was removed from further consideration.
3a2: TID Supply with Recycled Water exchange and groundwater basin storage	• Planning level cost estimates for advanced wastewater treatment, brine disposal, and injection wells have proven this alternative to be too costly and it was therefore removed from further consideration.

2.3 Project Alternative Development Process

Eleven conceptual alternatives were developed to provide a better understanding of the required infrastructure, costs, risks, and implementation constraints. This analysis was conducted using information provided by SRWA regarding existing and off-line wells in the cities of Modesto and Turlock, limited information regarding TID efficiency projects provided from TID to SRWA, publically available information, including the RSWSP EIR, Turlock Water Master Plan update, urban water management plans, agricultural water management plans (AWMP), stormwater management plans, maps of irrigation district service areas from websites, and the project team's experience working with the three cities. Conceptual facility sites and pipeline routes were established based on aerial photography and proximity to existing or planned facilities required for implementing an alternative, while considering capital and O&M costs associated with that site. Preliminary sizing of facilities is based on the volume of water that might be available through institutional arrangements or SRWA's desired delivery to meet demands when such data is not readily available. In order to provide a meaningful evaluation process in the third phase of this study, each project alternative is developed to the same level of detail while considering the facts relative to the following development criteria described below.

Cost Effectiveness

Planning level cost estimates were developed for each project alternative to estimate the capital and O&M costs. The overall capital cost, O&M cost, and the cost per unit of water ($/AF) considering a 30 year financing of capital costs at 5 percent interest as well as annual operational costs are provided. The project alternative cost estimates are a Class V budget estimate with an accuracy range of +30 percent or –50 percent of the actual project cost.

Reliability

The reliability of a water supply alternative relates to the probability of system failure that would result in a loss of this supply for any reason, such as a natural occurrence, structural inadequacy, or human influence. **Table 2-8** provides a brief discussion of issues related to reliability for each alternative, and characterizes each alternative based on its ability to provide a high, moderate, or low level of reliability.

Environmental Constraints

Preliminary environmental constraints associated with construction/operation of the project alternative have been identified. All projects would result in temporary, construction-related impacts from construction activities, but some projects have more environmental impact than others.

Because this is a planning level analysis, it is assumed that all proposed pipelines would be located within the road rights of ways (ROWs). Where the proposed pipeline alignments would cross sensitive resources (e.g., rivers) and major transportation corridors (e.g., railroads, highways), it is assumed that trenchless construction methods would be employed. The major difference in terms of environmental constraints for the alternatives is primarily related to whether a project would have potential effects on sensitive biological resources in and around a new proposed intake / diversion facility or in the vicinity of lakes/reservoirs. Environmental constraints also include wetlands or other sensitive biological resources in or near waterways or undeveloped areas (e.g., at the edge of rivers, on floodplains, and potentially some large expanses of agricultural areas) and known or unknown cultural resources.

This Study categorizes the alternatives as having a high, moderate, or low level of environmental constraint. Because this is a planning level document, no detailed environmental analysis impacts were conducted, but the alternatives were evaluated with a high-level analysis.

Regulatory Feasibility

This criterion relates to the regulatory permitting requirements that would likely be required, and as such is related to the environmental constraints. As discussed above, it is assumed that proposed pipeline alignments would be located mostly in road ROWs, and that crossing in sensitive areas would be avoided through trenchless construction methods to the extent possible. The primary difference between alternatives is whether a project would require additional permits where sensitive biological resources could occur (e.g., at the locations of intakes/diversion structures and/or near other water bodies). This Study provides a brief discussion of the anticipated regulatory feasibility for each alternative, and characterizes each alternative's regulatory feasibility as high, moderate, or low.

Institutional Complexity

The institutional complexity of each alternative was evaluated in order to identify specific agreements that may be required for a particular party's involvement in implementing a project. Involved parties may include water agencies, sanitary districts, irrigation districts, municipalities, commercial, industrial, or agricultural businesses, and local residents. Several of the alternatives require institutional agreements to be implemented, which has financial, political, or social implications. This Study provides a brief discussion of these arrangements and possible challenges, and characterizes each alternative's institutional complexity as high, moderate, or low.

Legal Viability

For the purposes of this study, an alternative's legal viability is determined based on the complexity of water rights issues. This Study provides a brief discussion of the legal viability and characterizes each alternative's legal viability is described as high, moderate, or low for each alternative.

Time to Implement

For each alternative, a conceptual evaluation of the project implementation schedule was performed taking into account regulatory, institutional, and environmental constraints along with the planning,

design, and construction schedule required for implementation. The time to implement presented in this Study is conceptual in nature and appropriate for the level of detail provided for each project.

2.4 Preferred Project Alternatives

The alternative screening process resulted in the following three alternatives. The titles of the alternatives were revised based on discussions with OID and others. The three remaining alternatives will be referred to as follows for the remainder of the report.

- **San Joaquin River Supply** (previously Alternative 3d)
- **Stanislaus River Supply** (previously Alternative 2b4)
- **Tuolumne River Supply** (previously Alternative 3c)

This section provides a detailed description of these alternatives and an analysis of potential implementation considerations relative the development criteria identified above.

2.4.1 San Joaquin River Supply

The basis of this supply option is for Modesto and Turlock to continue wastewater discharges to the San Joaquin River. Both cities would obtain a Section 1485 water right that would allow them to divert an amount of water from the San Joaquin River that is equal to their wastewater discharges. A new diversion facility located downstream of both diversions, a multi-barrier water treatment plant, and the piping necessary to deliver the treated water to the three cities would be constructed. **Figure 2-1** shows a schematic of this alternative.

One advantage of this alternative water supply option is it is the only option that does not involve a third party, since the SRWA would be dealing only with its member agencies. A potential disadvantage is the continued discharge to the San Joaquin River could leave the cities open to significant increases in wastewater treatment and disposal costs in the event future regulations require more advanced levels of treatment, particularly if some level of salt removal is required.

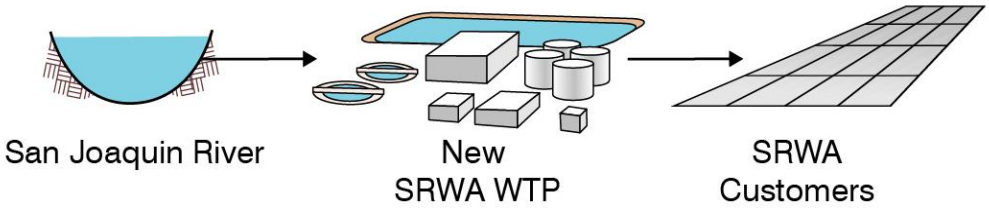
Another disadvantage of this option is it precludes the sale of recycled water to the Del Puerto Water District, resulting in a loss of potential recycled water sales revenue to the cities of Modesto and Turlock.

It may be possible to eliminate discharge to the San Joaquin River in the future by implementing a direct potable reuse (DPR) project. This would avoid negotiating the water rights for recycled water currently discharged to the San Joaquin River.

Figure 2-1: San Joaquin River Supply Schematic

Modesto and Turlock Continue Discharge to San Joaquin River:

SRWA Secures Recycled Water Rights to Supply the SRWA WTP with San Joaquin River Water:

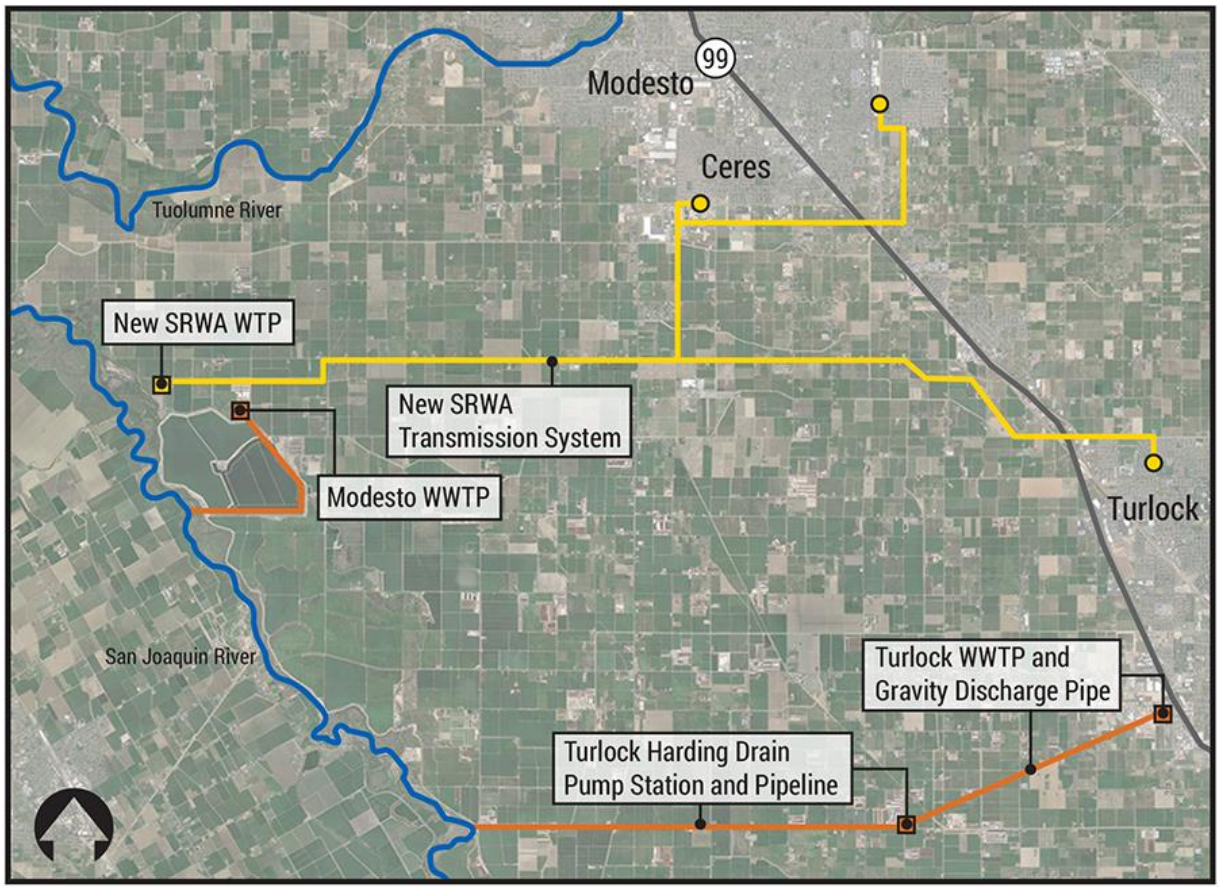


Project Location and Facilities

Figure 2-2 shows new facilities required for this alternative in yellow and existing facilities in orange. A brief summary of the facilities required is provided below:

- **SRWA WTP and Distribution System:** The SRWA would construct a new WTP on the San Joaquin River. The Distribution System would convey water from the WTP to SRWA customers.
- **DPR Treatment Plant:** Instead of constructing a new surface WTP, it is possible to construct a new advanced water treatment plant for direct potable reuse (DPR) of Modesto and Turlock's wastewater effluent. Implementing DPR would avoid future stringent regulations for San Joaquin River discharge; however, the treatment standards for DPR will likely be even more stringent than those required for river discharge. The California DPR regulations are not developed at this time, but are scheduled to be developed by 2016.Although this is a potential future option, implementing DPR is not considered a viable option at this time. Constructing a DPR WTP would avoid the requirement of securing the 1485 water right.

Figure 2-2: San Joaquin River Supply Facilities



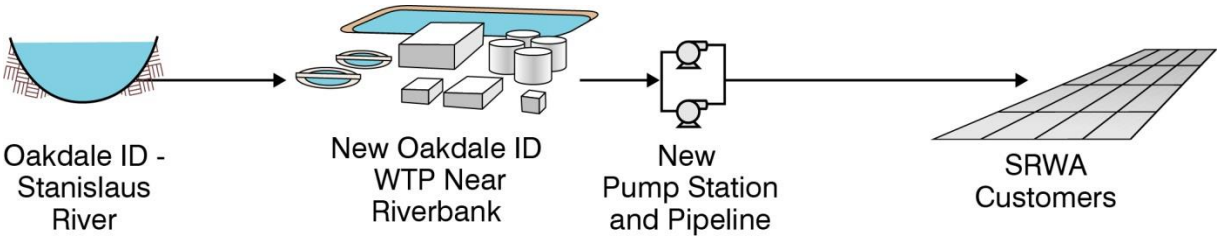
2.4.2 Stanislaus River Supply

Stanislaus River water is potentially available via the Oakdale Irrigation District (OID). OID is in the process of developing a "white paper" regarding its desire to sell excess water supplies outside of its service area. One option that appears available is to enter into an agreement with OID to participate in a new surface water treatment plant that would be located near Riverbank. This project may involve the San Francisco PUC, which has a need to rehabilitate its Mountain Tunnel, a part of its Hetch Hetchy water delivery system. Through this arrangement, the SFPUC would obtain treated water from OID during the low demand winter months when the Mountain Tunnel could be out of operation.

This approach would have OID provide treated water to the SFPUC for 2 to 4 months each winter over a period of approximately 10 to 12 years. By partnering in this project, SRWA could obtain treated water for 8 to 10 months each year, which would be adequate to meet its near-term water supply needs. SRWA would negotiate a long-term agreement that would continue after the Mountain Tunnel rehabilitation is complete.

One advantage of this option is the potential for sharing in the cost of a new water treatment plant, and depending on how SFPUC participates, the sharing of the cost of the treated water pipeline from the treatment plant to the intersection of that pipeline with the Hetch Hetchy Aqueducts. Also, this option seems to provide a highly reliable long-term water supply. **Figure 2-3** shows a schematic of this alternative.

Figure 2-3: Stanislaus River Supply Schematic



Project Location and Facilities

Figure 2-4 shows the new facilities for this alternative in yellow; a brief summary of these facilities is provided below.

- **OID WTP near Riverbank:** The OID is considering constructing a new intake, pump station on the Stanislaus River to feed a new surface water WTP near Riverbank. SFPUC is considering partnering with OID on the project, with a goal of augmenting its supply while the Mountain Tunnel is out of operation 2-4 months each winter over a period of approximately 10 to 12 years. The SFPUC and OID would likely construct a new pipeline from the WTP to the SFPUC Hetch Hetchy pipelines
- **Pipeline to New Transmission System**: The SRWA would construct a new pipeline to a new transmission system conveying potable water to SRWA member agencies. The pipeline would begin at the SFPUC Hetch Hetchy pipelines and connect to the new transmission system.

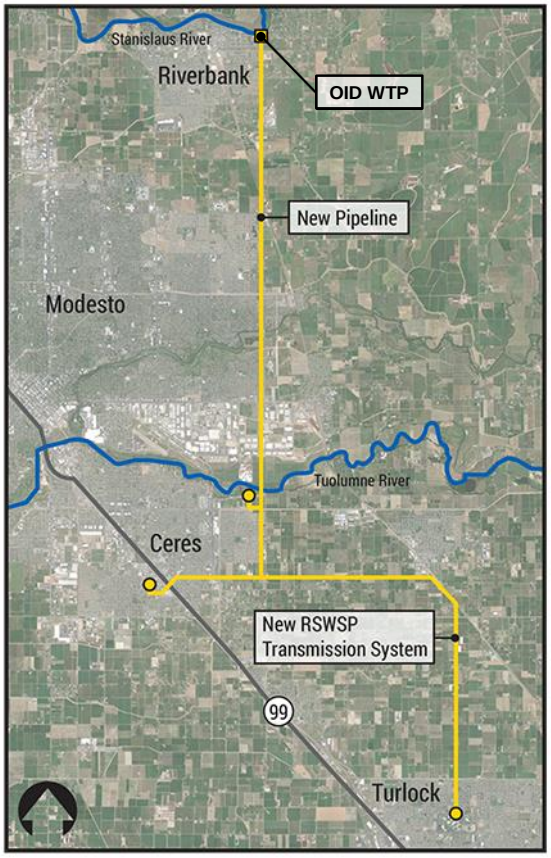


Figure 2-4: Stanislaus River Supply Facilities

2.4.3 Tuolumne River Supply

This water supply option would provide a raw water supply from TID and assumes SRWA would construct a new surface water treatment plant on the Tuolumne River and deliver treated water to SRWA customers. This alternative includes the provision of "offset" water in less than full allocation TID water years. Based on TID agricultural water allocations over the last 22 years, the average allocation is approximately 11% below the full allocation of 48 inches per year. TID's Board Resolution dated July 9, 2014 confirms TID's willingness to provide surface water from the Toulumne River to SRWA, outlines

TID's terms of the agreement and states SRWA would be required to provide offset water to TID in less than full water allocation years as shown in Table 2-2.

Table 2-2: TID Board Resolution

	0% Reduction	25% Reduction	50% Reduction	75% Reduction	100% Reduction
Total Available Water to SRWA (AFY)	30,000	22,500	5,000	7,500	0
Total Offset Water by SRWA* (AFY)	0	11,250	15,000	7,500	0
Shortage from SRWA 's request of 30,000 AF	*0*	*7,500*	*15,000*	*22,500*	*30,000*

"% Reduction" refers to a reduction in the amount of available water from a normal irrigation water year and applicable to both irrigation water customers and SRWA

****Calculation formula = 2 x "% Reduction" x "Total Available Water to SRWA" Offset water by SRWA must be supplied to TID during the irrigation season***

The "% Reduction" table is only a sampling, the calculation formula can be applied to any "% Reduction" "Total Offset Water by SRWA" can not exceed "Total Available Water to SRWA"

SRWA will be charged the amount of water equal to the net of "Total Available Water to SRWA" minus "Total Offset Water by SRWA"

To provide "offset water" to TID in less than full water allocation years, this alternative includes an intertie between the Turlock effluent outfall pipeline and TID Lateral 4 or 5. The City of Turlock currently produces an average dry weather flow of 11.3 mgd of Title 22 recycled water at the Turlock Regional Water Quality Control Facility (TRWQCF). Turlock recently updated the TRWQCF Wastewater Treatment Master Plan (Carollo, July 2014) and the plan estimates the recycled water discharged to the San Joaquin River as shown in Table 2-3. This water could be available as "offset water" to TID.

Table 2-3: Turlock Recycled Water Production

	Current (2012) Flow (mgd)	Current (2012) Flow (AFY)	Projected 2034 Flow (mgd)	Projected 2034 Flow (AFY)
Avg. Dry Weather Flow (ADWF)	9.7	10,870	21.7	24,320

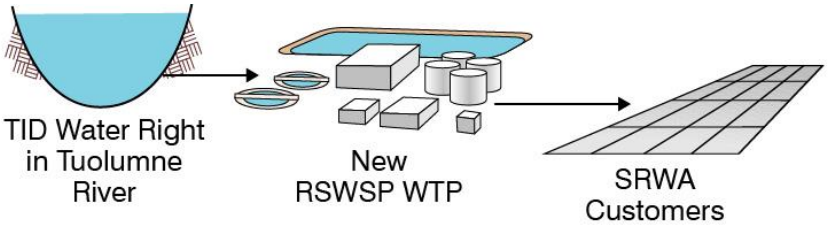
As noted above, the average percent reduction has been approximately 11% over the past 22 years. At this level of reduction, the SRWA would be required to provide an average of 5,874 acre-feet per year to TID as offset water, which is feasible based on Turlock's current recycled water. Considering Turlock currently produces 10,870 AFY, the City could potentially provide adequate offset water up to an approximate 24% allocation reduction in the near-term. Additional offset water may be available in the future as Turlock's recycled water production is also expected to increase to approximately 24,320 acre-feet per year by 2034.

This water supply alternative includes the following challenges that would need to be resolved prior to implementation:

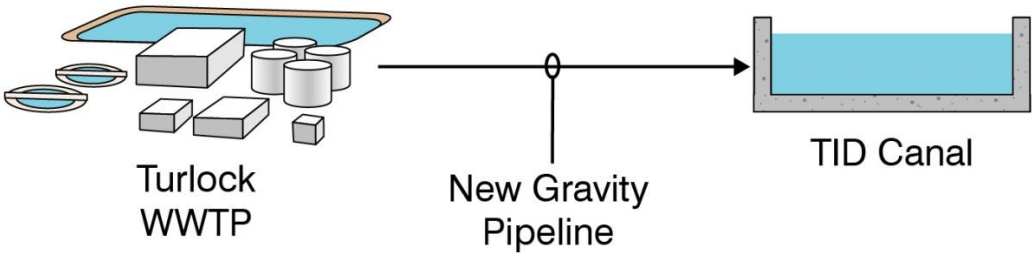
- The City of Modesto and Turlock have initiated the Environmental Review Process and Facility Planning Phase for the NVRRWP, which is intended to deliver the City of Modesto and Turlock's recycled water to DPWD for irrigation purposes and would conflict with potentially delivering recycled water to TID as "offset water." Modesto has indicated a preference to provide recycled water to DPWD.
- The City of Turlock recently constructed the Harding Drain Bypass Pump Station and Pipeline to deliver recycled water to the San Joaquin River. The terms of the Project SRF loan require the Harding Drain Pump Station and Pipeline to remain in continual use. The City of Turlock would need to seek a revision to the SRF loan requirements if they are planning to deliver recycled water to TID as "offset water" during the irrigation season.
- The TID Board resolution states that offset water must be provided during the irrigation season. This limitation must be considered while evaluating Turlock's available recycled water.
- Turlock currently supplies 2,240 AFY of recycled water to TID's Walnut Energy Center for cooling. This recycled water use is considered in the flow projections listed in Table 2-3. However, future recycled water agreements should be considered when determining the available recycled water supply.
- The TID Board Resolution stated TID would provide 30,000 AFY of surface water supply initially. However, the TID Board Resolution did not clarify if additional surface water would be available in the future. The SRWA demand at buildout is 57,120 AFY in the year 2045.

Figure 2-5: Tuolumne River Supply Schematic

TID provides surface water rights on the Tuolumne River during normal/wet years:



Turlock delivers recycled water to TID as offset water during dry years:

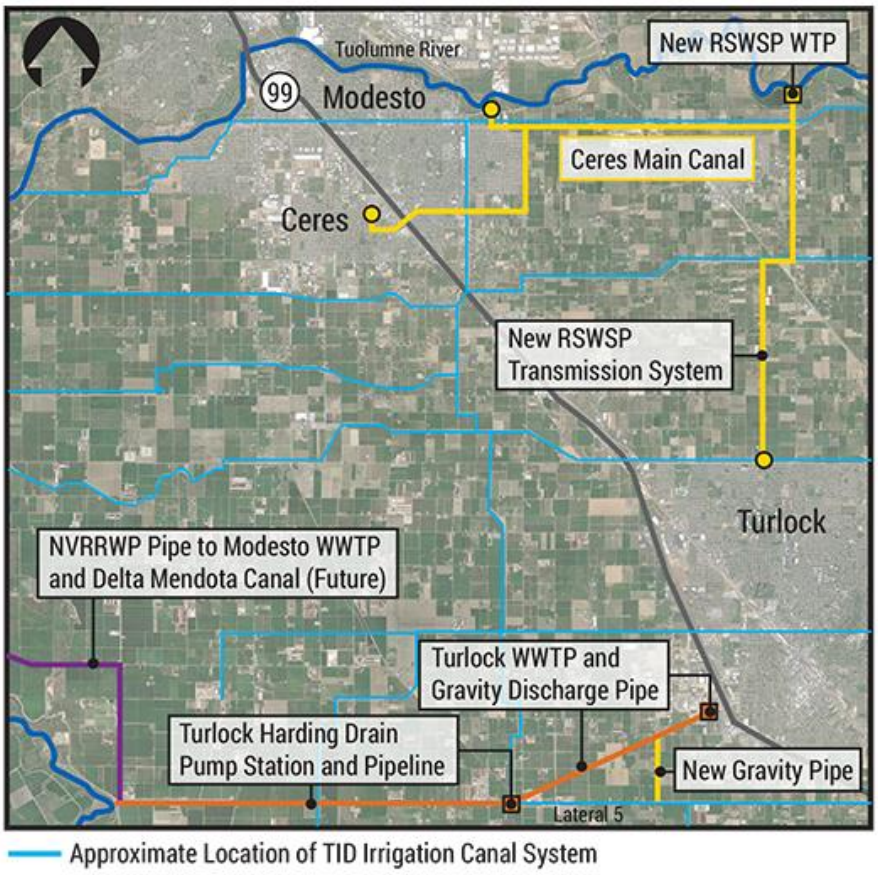


Project Location and Facilities

Figure 2-6 shows the facilities for this alternative in yellow, existing facilities in orange and possible future facilities associated with the NVRRWP in purple. A brief summary of the facilities required is provided below:

- **RSWSP WTP and Transmission System:** The WTP and transmission facilities are assumed to be similar to the facilities described by Brown and Caldwell in the Water Treatment Plant - Preliminary Design Report and Finished Water Pipeline - Preliminary Design Report (i.e., RSWSP WTP and distribution system). The WTP would treat surface water from the Tuolumne on normal/wet years.
- **Connection to TID Lateral 5**: The Turlock WWTP currently discharges treated effluent by gravity through two 36-inch diameter pipelines to the Harding Drain Pump Station. A new junction structure and pipeline would be constructed to divert Turlock's recycled water flow to TID's Lateral 5 for distribution to TID customers. This pipeline could be used to divert Turlock recycled water to TID to provide offset water. At this time, Turlock could provide approximately 10 MGD of offset water to TID, which would allow Modesto's recycled water to continue to be delivered to DPWD.
- **NVRRWP Pipeline (Future):** One of the NVRRWP project alternatives includes construction of a new pipeline from the Turlock Harding Drain Bypass Pipeline Outfall Site to the Modesto wastewater treatment plant to convey flow to the DMC and DPWD. It is assumed that this pipeline would be constructed under the NVRRWP and would not be a new facility constructed by SRWA.

Figure 2-6: Alternative 3c Facilities



2.4.4 Cost Estimates

This section summarizes the approach to estimating construction and annual operation and maintenance costs for the three alternatives.

Cost Estimate Class

The Association for the Advancement of Cost Engineering International (AACE International, formally known as the American Association of Cost Engineers) has suggested levels of accuracy for five estimate classes based on level of project development. These five estimate classes are presented in the AACE International Recommended Practice No. 18R-97 (Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries) and are summarized in **Table 2-4**. The different classes are necessary because as a project progresses from the conceptual phase to the study phase, preliminary design and final design, the quantity and quality of information increases, thereby providing data for development of a progressively more accurate cost estimate. For the projects developed as a part of this study, cost estimates are developed following the AACE International Recommended Practice No. 18R-97 estimate Class 5.

Table 2-4: Classes of Cost Estimates

Estimate Class	Primary Characteristic	Secondary Characteristic			
	Level of Project Definition Expressed as % of complete definition	End Usage Typical purpose of estimate	Methodology Typical estimating method	Expected Accuracy Range Typical Variation in Low and High Ranges (2)	Preparation Effort Typical Degree of Effort Relative to Least Cost Index of 1 (3)
Class 5	0% to 2%	Concept Screening	Capacity Factored, Parametric Models, Judgment, or Analogy	L: -20% to -50% H: +30% to +100%	1
Class 4	1% to 15%	Study or Feasibility	Equipment Factored or Parametric Models	L: - 15% to -30% H: +20% to +50%	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Semi-Detailed Unit Costs with Assembly Level Line Items	L: - 10% to -20% H: +10% to +30%	3 to 10
Class 2	30% to 70%	Control or Bid/Tender	Detailed Unit Cost with Forced Detailed Take-Off	L: - 5% to -15% H: +5% to +20%	4 to 20
Class 1	50% to 100%	Check Estimate or Bid/Tender	Detailed Unit Cost with Detailed Take-Off	L: - 3% to -10% H: +3% to +15%	5 to 100

Notes:

(1) Table is based on the AACE International Recommended Practices, No. 18R-97.

(2) The state of process technology and availability of applicable reference cost data affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for a given scope.

(3) If the range index value of "1" represents 0.005% of project costs, then an index value of 100 represents 0.5%. Estimate preparation effort is highly dependent upon the size of the project and the quality of estimating data and tools.

Construction Costs

The construction costs presented below include contractor's overhead and profit, and construction contingencies, such as change orders. Costs to the owner, such as engineering, legal, administrative, project contingencies, and construction management costs are not included in the construction costs. While the estimated construction costs represent the average bidding conditions for many projects, variations in bidding climate at the time the facilities are constructed can affect actual construction costs. Further, the size and configuration of the facilities may be refined during preliminary design based on the

most current operational information available. For these reasons, the actual construction costs may be lower or higher than estimated herein.

Construction costs were estimated and used herein for the purposes of comparing the remaining alternatives. It is important to understand that to budget for the selected alternative, additional project costs (design engineering, legal, administration, permitting, and construction management) need to be included. Project costs are often estimated to be 20 percent to 25 percent higher than construction costs.

Water Treatment Plant Costs

The costs for the construction of the 30 mgd and 60 mgd water treatment plants were estimated from construction costs of similar facilities. Construction costs for 19 water treatment plants were compiled and normalized to July 2014 dollars and to the project location in the San Joaquin Valley. The majority of the water treatment plants that were used in this analysis were constructed in California, with the exception of three facilities, one of which was located in Colorado and the other two in Arizona.

Approximately half of the facilities were conventional water treatment plants with flocculation and sedimentation followed by multimedia filtration. The other half were membrane filtration facilities. A quarter of the water treatment plants included ozonation in their treatment process.

The normalized water treatment plant costs are shown in **Figure 2-7** in dollars per gallon of capacity. The majority of the water treatment plants have construction costs at or below $3.0/gal, with the exception of five water treatment plants. These outliers are discussed below.

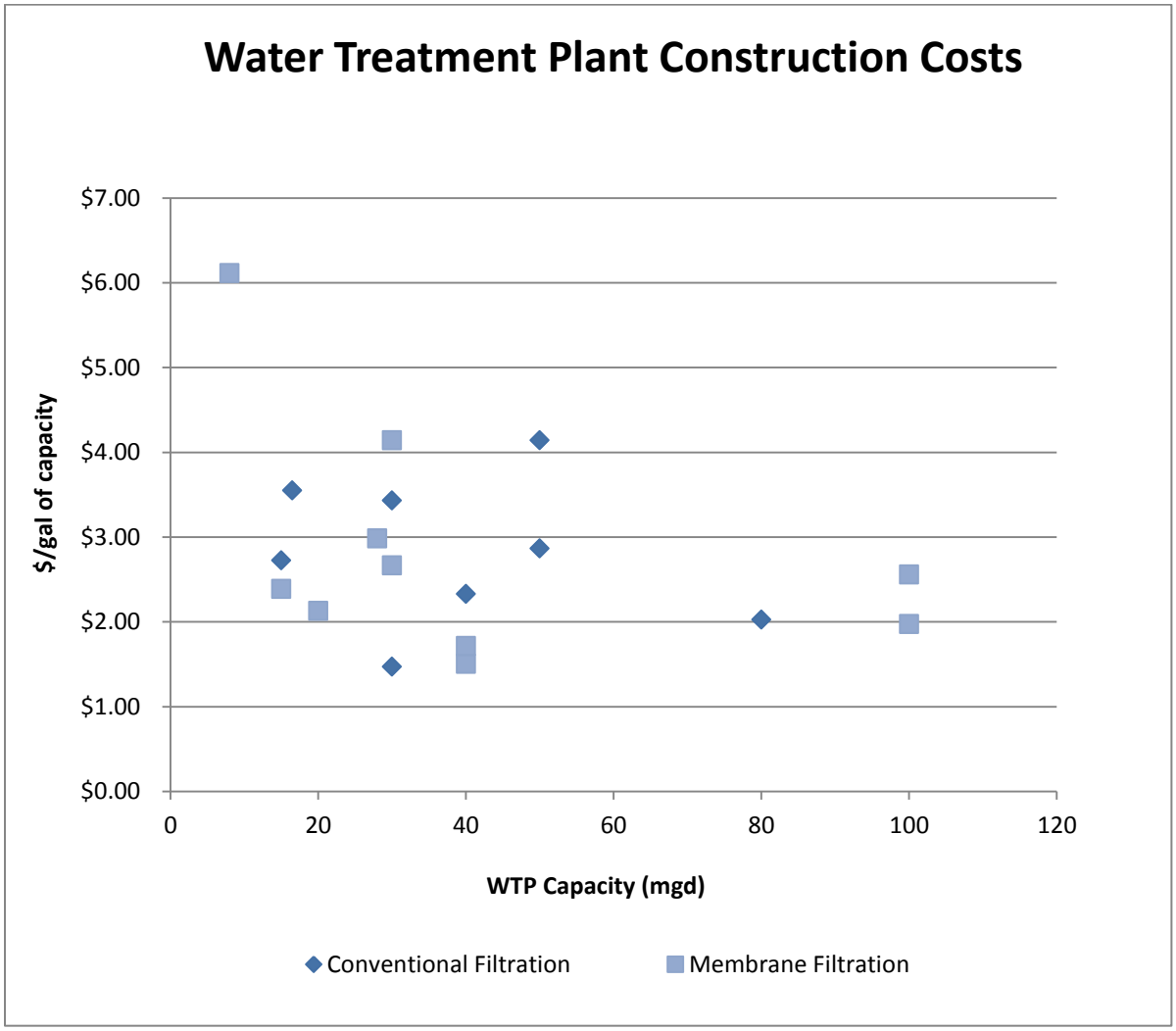
- City of Lodi WTP ($6.11/gal) – This facility is an 8 mgd WTP and the relatively low capacity appears to distort the per gallon construction cost.
- Chaparal WTP ($4.14/gal) – This 30 mgd WTP included extensive architectural and landscape improvements to allow the facility to fit in with an upscale neighborhood in a highly visible location.
- SCWA Vineyard WTP ($4.14/gal) – This 50 mgd WTP was designed to be expandable to 100 mgd, which may have increased the initial construction cost of the facility.
- Woodland-Davis WTP ($3.43) – This 30 mgd WTP was procured through a design build operate bidding process with a single bidder which makes it, difficult to determine whether the construction cost was inflated due to lack of competition from other construction contractors.
- CCWD/Brentwood WTP ($3.55/gal) – This 30 mgd WTP was designed to be expandable to 40 mgd, which may have increased the initial construction cost of the facility.

Based on a review of the construction costs for the remaining 14 water treatment plants and the more expensive water treatment plants described above, a construction cost of $3.0/gal appears reasonable for a 30 MGD WTP in the San Joaquin Valley. This correlates to a $90 M construction costs of a 30 mgd WTP. For a 60 MGD WTP, a construction cost of $2.5/gal was assumed. An adder of $0.25/gal was included for a 60 mgd WTP with ozone. This correlates to a construction cost of $150 M for a 60 mgd WTP without ozone and $165 M for a 60 mgd WTP with ozone.

Raw Water Intake and Pump Station

The raw water intake and pump station was based on the construction cost of the City of Stockton's recently constructed raw water intake and pump station for their relatively new WTP. The 30 mgd intake and pump station, expandable to 60 mgd, has a normalized construction cost of $29.1 M.

Figure 2-7: Normalized Construction Costs for California, Colorado, and Arizona WTPs



Pipelines

The raw and finished water pipeline cost estimates were developed based on unit costs developed for similar projects in the San Joaquin Valley and discussions with Ranger Pipelines, a major California pipeline contractor. The cost estimates assume that the pipelines will be constructed using welded steel pipe (WSP) installed via conventional open trench construction and road surfaces will be restored to original conditions. The pipelines were sized based on a target velocity of 5 feet per second. The per linear foot (LF) unit costs are as follows:

- $750/LF for 60-inch diameter WSP
- $650/LF for 48-inch diameter WSP
- $550/LF for 36-inch diameter WSP

Operations and Maintenance Cost

Annual Operations and Maintenance (O&M) costs for the WTP were based on survey of the O&M costs for four similar WTPs and EPA estimates for a 40 mgd WTP. All O&M costs were normalized to July

2014 dollars and a 30 mgd facility. For the 60 mgd WTP, the O&M costs were escalated using a 0.8 scaling factor to recognize some economies of scale with operating a larger facility. The O&M costs are summarized below.

- The City of Stockton's 30 mgd WTP has an annual O&M cost of $4.6 M per year.
- The Davis/Woodland 30 mgd WTP has annual O&M cost of approximately $6 M per year.
- A 2007 O&M estimate, prepared by Carollo Engineers, for the proposed City of Fresno WTP when escalated to 2014 and scaled to 30 mgd is $3.8 M.
- Based on EPA guidance a 40 mgd WTP would have an annual O&M cost of $2.3 M when escalated to 2014 and scaled to 30 mgd.
- The San Diego County Water Authority's Twin Oaks 100 mgd WTP has annual O&M cost of $2.5M when escalated to 2014 and scaled to 30 mgd.

For this project, the annual O&M cost was assumed to be the average of the annual O&M costs for these five estimates, $3.84 M. For a 60 mgd WTP, using .8 economy of scale factor, the annual O&M cost would be $7.1 M.

Construction costs and O&M costs for each Alternative

The estimated construction and annual O&M costs for the three alternatives are shown in **Table 2-5**, **Table 2-6**, and **Table 2-7**. The tables include details on the assumptions related to the cost estimates for each major component of the alternative. In addition the total annualized cost is provided. The construction cost is annualized based on a 5 percent interest rate and a 30 year amortization period.

Table 2-5: San Joaquin River Supply Cost Summary

Project Component	Cost ($M)	Notes
Capital Costs		
Raw Water Intake/Pump Station	$29.1	Based on Stockton WTP Intake/Pump Station
San Joaquin WTP	$165.0	60 mgd WTP at $2.75/gal
RSWSP Treated Water Conveyance	$74.8	43,000 LF of 60" WSP, 12,500 LF of 48" WSP, & 62,500 LF of 36" WSP
Total Construction Cost	$268.9	
Annualized	$17.5	
O&M Costs		
San Joaquin WTP O&M	$7.1	Based on average of existing WTP, EPA, and Carollo O&M estimates.
Total Annual O&M	$7.1	
Total Annualized Cost	**$24.6**	

Table 2-6: Stanislaus River Supply Cost Summary

Project Component	Cost ($M)	Notes
Capital Costs		
Raw Water Intake/Pump Station	$29.1	Based on Stockton WTP Intake/Pump Station
Raw Water Pipeline	$1.9	2,500 LF of 60" WSP
OID WTP	$75.0	60 mgd at $2.5/gal. Assumes 50/50 Cost Split with SFPUC. If construction contract is subject to SFPUC Labor Agreement, cost may increase.
RSWSP Treated Water Conveyance	$69.7	Assumes 1.5 out of 15.6 miles of pipeline paid for by SFPUC.
Total Construction Cost	$175.7	
Annualized Construction Cost	$11.4	
O&M Costs		
RSWSP WTP O&M	$7.1	Based on average of existing WTP, EPA, and Carollo O&M estimates.
Total Annual O&M	$7.1	
Total Annualized Cost	**$18.5**	

Table 2-7: - Tuolumne River Supply Cost Summary

Project Component	Cost ($M)	Notes
Capital Costs		
Gravity Pipeline to TID Lateral 5	$4.5	6,000 LF of 60" WSP at $750/LF. Assumes no cost split on NVRRWP pipeline assigned to this project.
RSWSP WTP	$90.0	30 mgd WTP at $3.0/gal
RSWSP Treated Water Conveyance	$50.3	30,000 LF of 48" WSP & 56,000 LF of 36" WSP
Total Construction Cost	$144.8	
Annualized Construction Cost	$9.4	
O&M Costs		
RSWSP WTP O&M	$3.8	Based on average of existing WTP, EPA, and Carollo O&M estimates.
Total Annual O&M	$3.8	
Total Annualized Cost	**$13.2**	

2.4.5 Development Criteria

Table 2-8 provides a summary of each alternative relative to the development criteria summarized in Section 2.3.

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Table 2-8: Development Criteria

Criteria	San Joaquin Supply	Stanislaus River Supply	Tuolumne River Supply
Yield (AFY)	59,500[3]	58,000	26,700[4]
Capital Cost[1]	$268.9 million	$175.7 million	$144.8 million
O&M Cost[2]	$7.1 million	$7.1 million	$3.8 million
Unit Cost ($/AF)	$413[5]	$319	$495
Risk	**Moderate** • Recycled water is a reliable year round supply. • Involves SRWA member agencies only. • Potential for increased cost for continued discharge to San Joaquin River. • No additional cost of water	**Low** • OID has available surface supply • Unknown cost of water	**Moderate** • Requires long-term transfer agreement. • TID wants to receive offset water during dry years when less surface water is available. • Unknown costs of water from TID as well as water associated with third party long term agreement
Reliability	**High** • Reliable year round supply • Secures rights to San Joaquin River water	**High** • OID has rights to surplus surface water. • OID is currently planning for potable water transfer project and is receptive to raw water transfer opportunity.	**Moderate** • TID holds Tuolumne River water rights . • TID to provide water for purchase with less than TID requested offset water requirements.
Environmental Constraints	**Moderate –** this option involves a typical infrastructure project with pipelines, a pump station, and a WTP. In most cases, environmental impacts would be avoided but there is always a possibility that sensitive resources could occur.	**Moderate –** this option involves a typical infrastructure project with pipelines and pump stations. However, this option includes an intake/diversion from the Stanislaus River, which could have additional effects on aquatic resources. Implementation could also have impacts on other biological resources and buried unrecorded cultural resources. The long pipeline alignment may impact construction-related land use effects.	**Moderate –** this option involves a typical infrastructure project with pipelines, a pump station, and a WTP. In most cases, environmental impacts would be avoided but there is always a possibility that sensitive resources could occur.
Regulatory Feasibility	**Moderate -** this is a typical infrastructural project, some permits would be needed, but none that are anticipated to substantially affect the alternative's feasibility.	**Moderate** – This option would require a direct intake from the Stanislaus River requiring additional permits. The need for additional permits associated with the intake would not substantially affect the alternative's feasibility, but may increase the time to implement for permit acquisition.	**Moderate** – This option would be similar to Alternative 3a1. As this is a typical infrastructural project, some permits would be needed, but none that are anticipated to substantially affect the alternative's feasibility.
Institutional Complexity	**Low –** This alternative does not require an agreement between SRWA and any other entity. Implementation is dependent on SRWA's ability to secure water rights on the San Joaquin River. ***Challenges:*** • Potential increased wastewater treatment requirements for continued discharge to the San Joaquin River and associated increased treatment costs.	**Low** – The following agreements are required: • SRWA water purchase agreement with OID	**Moderate** – The following agreements are required: • SRWA long-term transfer agreement and associated agreements with DPWD for the North Valley Regional Recycled Water Program ***Challenges:*** • Will impact ability of Turlock to supply recycled water to DPWD • Dry years will result in more groundwater pumping. Normal/wet year conjunctive use operations will recharge the groundwater basin.
Legal Liability	**Moderate** • SRWA must secure water rights on the San Joaquin River in order to withdraw surface water downstream of their discharge points.	• **Moderate** – OID must petition for a long term inter-watershed transfer with a change in place and purpose of use with SWRCB.	**Moderate** • TID/MID agreement currently limits TID use of Tuolumne River water south of the river. • Petition for long-term transfer agreement with a change in place of use.
Time to Implement	5 years	5-7 years	5 years

Notes:

1. Refer to the Section 2.4.4 for the basis of the Capital (i.e. Construction) Cost estimates.
2. Refer to the Section 2.4.4 for the basis of the Annual O&M costs.
3. Yield is estimated based on the recycled water flow at buildout from Turlock and Modesto wastewater treatment facilities.
4. Yield is estimated based on TID's average historical deliveries of 89% of allocation.
5. Unit cost does not account for lost revenue opportunity associated with sale of recycled water to DPWD under the NVRRWP.

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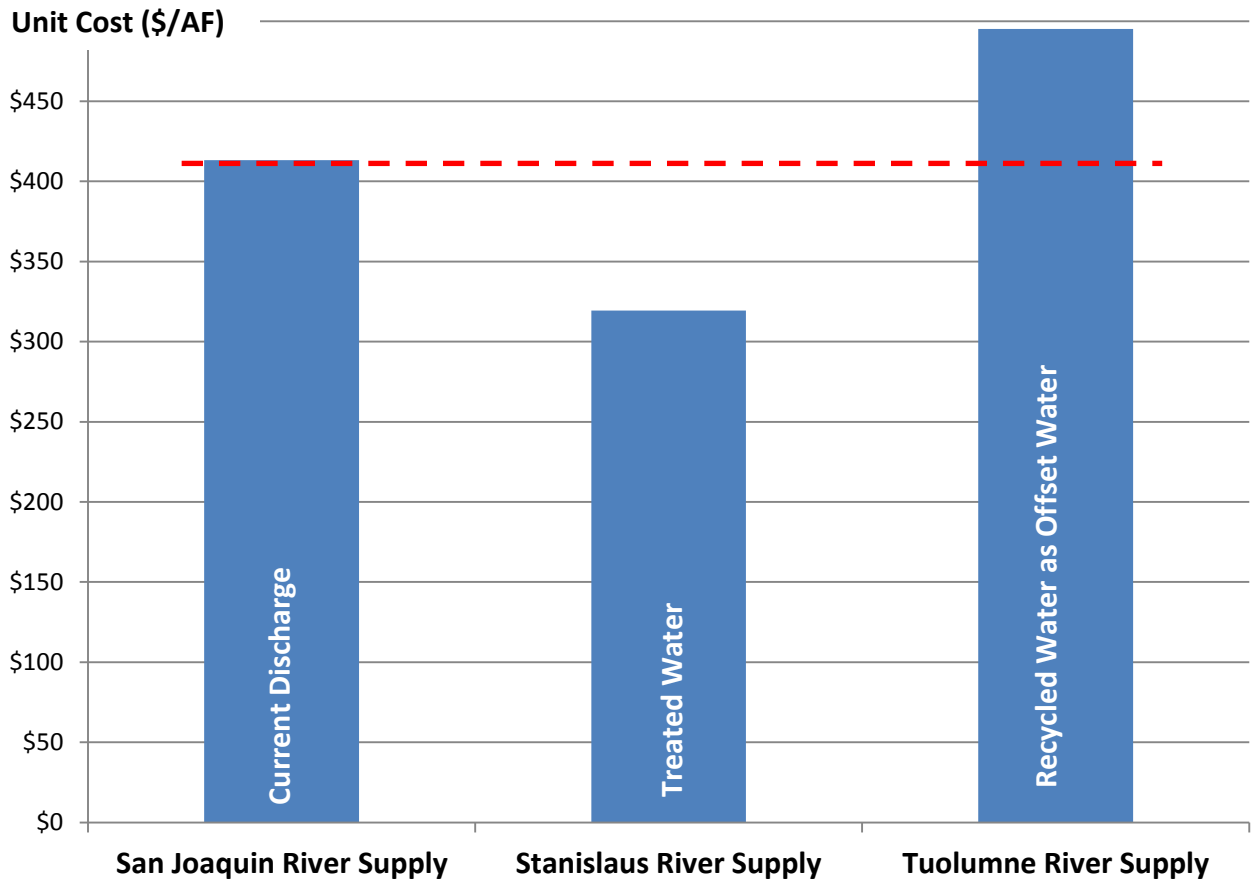
Chapter 3 Alternatives Evaluation

3.1 Cost Comparison

The short list of water supply alternatives identified in this study resulted from a comprehensive alternative identification and development process. The project workshops conducted with SRWA provided a forum for continuous refinement of supply alternatives relative to SRWA's goals as well as a screening process to remove alternatives from further consideration that are not considered feasible relative to the development criteria outlined in **Table 2-8**. The three preferred alternatives were further evaluated relative to each other in order to determine how these alternatives should be ranked based on implementation cost. Although each alternative water supply option can be differentiated by a variety of criteria, including environmental, permitting, institutional complexity, among other criteria, each of these criteria ultimately manifests itself in terms of project costs and time to implement. As such, it was determined that the most appropriate basis of evaluation of the three primary alternatives should be project costs.

The cost of each alternative, including construction and annual operations and maintenance costs, were compared based on unit cost of water provided. Unit costs for each alternative were calculated based on cost estimates summarized in Section 2.4.4 and each alternative's potential yield. Relative unit costs for the three short listed supply alternatives are illustrated in **Figure 3-1.**

Figure 3-1: Unit Costs



The Stanislaus River Supply alternative is the lowest cost alternative based on this cost comparison. It should be noted that for these three supply options, the cost of raw water supply is not included since that will be a negotiated term when establishing transfer agreements. The San Joaquin River Supply alternative has no associated cost of water while the cost of water has yet to be determined for the Stanislaus River (OID) and Tuolumne River (TID) supplies. Additionally, the San Joaquin River Supply alternative has a lost revenue opportunity associated with the potential for sale of recycled water to DPWD under the NVRRWP.

It should also be noted that the Tuolumne River Supply alternative is limited by its potential yield. This alternative may become more attractive if SRWA were able to negotiate a larger volume of supply that would enable them to meet buildout demands as this would lower the unit cost of supply with regards to required capital and O&M costs.

This relative cost of comparison should serve as a basis for determining a reasonable cost of water during negotiations with OID and/or TID.

3.2 Conclusion

Several implementation considerations have been identified as a result of the supply alternative development process. These considerations are an essential component to SRWA's future decision making and negotiation with other water agencies. **Table 3-1** provides a summary of the short list of alternatives listed in order of preference along with the pros and cons associated with each.

The apparent best alternative for the SRWA is the Stanislaus River supply option due to its lower cost and its ability to potentially meet a higher level of reliability and long-term supply needs.

It is therefore recommended that SRWA initiate discussions/negotiations with OID to determine a price for the raw water supply, cost sharing arrangements for treatment and delivery, schedule for implementation, and other terms of a long-term water supply agreement. At the same time, the SRWA should continue discussions with TID for a Tuolumne River Supply as this remains a viable supply option. This information can then be used in the SRWA's decision-making process in determining which alternative is best suited to meet its collective long-term interests.

Table 3-1: Supply Alternative Implementation Considerations[1]

Rank	Project Alternative	Yield (AFY)	Unit Cost ($/AF)	Pros	Cons
1	Stanislaus River Supply	58,000	$319	• Supply meets SRWA's ultimate demands • Cost sharing opportunity with SFPUC • Does not restrict potential revenue from recycled water	• Unknown cost of water • Requires long-term agreement with extensions for price stability • Increased institutional complexity with potential SFPUC involvement
2	San Joaquin River Supply[2]	59,500	$413	• No cost of raw water • No interagency agreements • Secures San Joaquin River water rights • Supply meets SRWA's ultimate demands	• Exposure to potential increased wastewater treatment costs due to future salt management regulations • Eliminates potential revenue source from recycled water sales
3	Tuolumne River Supply	26,700	$495	• Provides the ability to move forward with the NVRRWP with limitations • Supply meets short term demands	• Unknown cost of water • Least reliable variable supply • Supply does not meet SRWA's ultimate demands • Reduces potential revenue source from recycled water sales • Requires third party long-term transfer agreement to make DPWD whole during dry years under the NVRRWP

Notes:

1. The unit cost ($/AF) estimates include the new facilities required to transfer, treat, and distribute water. The cost of purchasing raw water from OID and/or TID is not included.
2. There is no anticipated cost of water associated with this alternative. The lost revenue opportunity associated with the potential sale of recycled water to DPWD under the NVRRWP is not included.

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