California WaterFix Impacts on the City of Modesto

An Analysis of Unimpaired Flow Rate Requirement Impacts and Issues Raised by the Modesto Bee Editorial Board

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Table of Contents

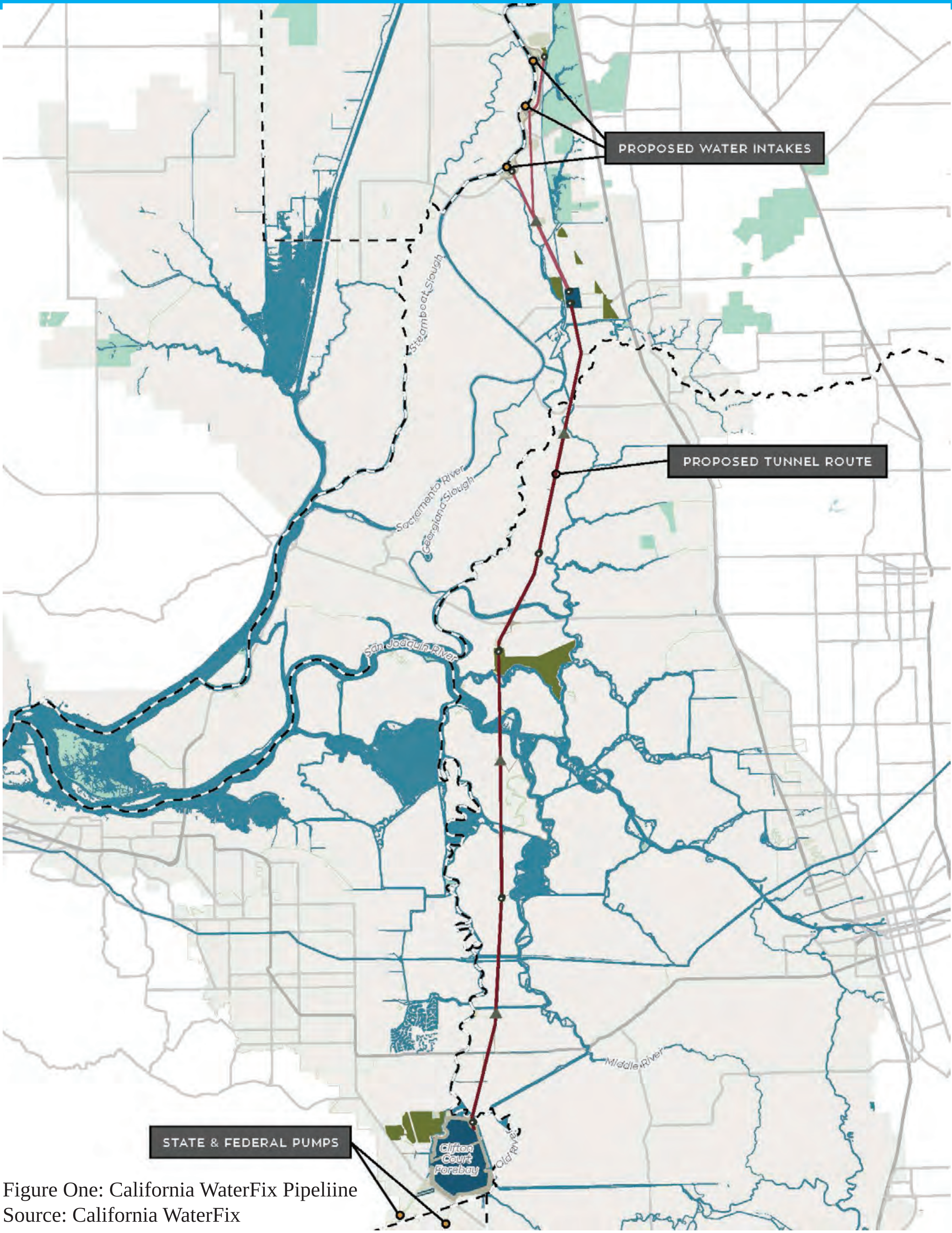


Figure One: California WaterFix Pipeliine
Source: California WaterFix

Introduction

The California WaterFix project is intended to serve as "a long overdue infrastructure upgrade that will improve the reliability and sustainability of California's aging water system, improve river flows and benefit the fragile Sacramento-San Joaquin Delta ecosystem" (California WaterFix, 2018). The Delta is dependent on a series of aging levees, which are vital to the area's water system, and there is much concern that climate change and inevitable seismic activity could rupture the levees and put California's freshwater supply at risk (Madrigal, 2014).

The Sacramento-San Joaquin Delta is "the hub of California's water supply" and "supplies two-thirds of the state's population and millions of acres of farmland" with freshwater (California Department of Water Resources [DWR], n.d.). In the Delta, San Francisco Bay water mixes with freshwater from tributaries, thus creating an estuarian ecosystem (DWR, n.d.). Water from the Delta is conveyed from the northern end of the state to the south, through the Central Valley Project and the State Water Project. The California WaterFix project is a proposed dual tunnel system that would divert water from the Sacramento River around the Delta and to pumping stations into both state and federal water projects (DWR "Agreement Regarding Construction," 2015, p. 3). Figure 1 displays the proposed tunnel path around the Delta and connection to the pumping stations.

The majority of the land in the Delta is below sea level and is reliant on 1,100 miles of levees to maintain their existence (Water Education Foundation

[Water Education], n.d.). These levees are identified as a risk, by the State, as they are 50 years old and at risk of vulnerability from natural disaster (CA WaterFix, 2018). The land and waterways in the Delta support multiple uses including residential communities, agriculture, and recreation. The estuarian habitats are essential for the survival of various fish and wildlife species (DWR, n.d.).

The Delta is formed where the Sacramento and San Joaquin River converge, just south of Sacramento (Water Education, n.d.). At this location the two rivers interact with tributaries and tidal flows (Water Education, n.d.). The Sacramento River runs from headwaters near Mount Shasta to the Delta where it converges with the San Joaquin River. The Sacramento River itself provides 31 percent of the state's water supply. The Sacramento and San Joaquin together carry about 42 percent of the State's total runoff (Water Education Foundation "Sacramento River," n.d.). The San Joaquin River forms in the Sierra Nevada Mountains and flows 100 miles west and then turns to flow north for another 260 miles until it joins the Sacramento River (United States Environmental Protection Agency [EPA], n.d.). The San Joaquin River is fed by a series of tributary rivers which are, from south to north, the Fresno, Chowchilla, Merced, Tuolumne, Stanislaus, Calaveras, Mokelumne, and Cosumnes Rivers (EPA "San Joaquin River Watershed," n.d.). The Merced, Tuolumne, and Stanislaus Rivers are considered the "LSJR (Lower San Joaquin River) Tributaries" with respect to the Bay Delta Plan and are the three rivers affected by the policies (SWRCB "Water Quality," 2018, p. 23).

The Modesto Irrigation District (MID), shares senior water rights on the Tuolumne River with the Turlock Irrigation District (Modesto Irrigation District [MID]

“Senior Water Rights,” 2019). There are two dams built along the Tuolumne River with direct relation to the Modesto Irrigation District and the City of Modesto, the first being the Don Pedro Dam. The Don Pedro Dam creates the Don Pedro Reservoir, which was a joint partnership, and is jointly owned by the Modesto Irrigation District and the Tuolumne Irrigation District (MID “Water Storage,” 2019). The reservoir provides water storage, power generation, and recreation facilities and has a capacity of over two million acre-feet (MID “Water Storage,” 2019). The second reservoir of consideration is the La Grange Dam, which is downstream of the Don Pedro Dam (Figure 2). The La Grange dam does not store much water and is used as a diversion point for the Tuolumne River into the canal systems of the Modesto and Turlock Irrigation Districts (MID “Agricultural Water Management Plan [AWMP],” 2015, p. 16). At the La Grange Dam water can go in three directions: into the Modesto Irrigation District Upper Main Canal (Figure 3), into the Turlock Irrigation District canals, or into the Tuolumne River (MID “AWMP,” 2015, p. 16).

The City of Modesto, being an agricultural community, requires both municipal and agricultural water supplies. Municipal water is acquired through city owned wells for ground water and through a conjunctive agreement for surface water with the Modesto Irrigation District (MID “AWMP,” 2015, p. 36). Water from the Tuolumne River and MID storage facilities is treated at the Modesto Regional Water Treatment Plant (MRWTP) and is then distributed to municipal customers. After the Phase II expansion in 2012, the MRWTP is estimated to contribute about 67,200 acre feet per year (AFY) (MID “Urban Water Management Plan, 2011, p. ES-4). Agricultural water is acquired both through surface

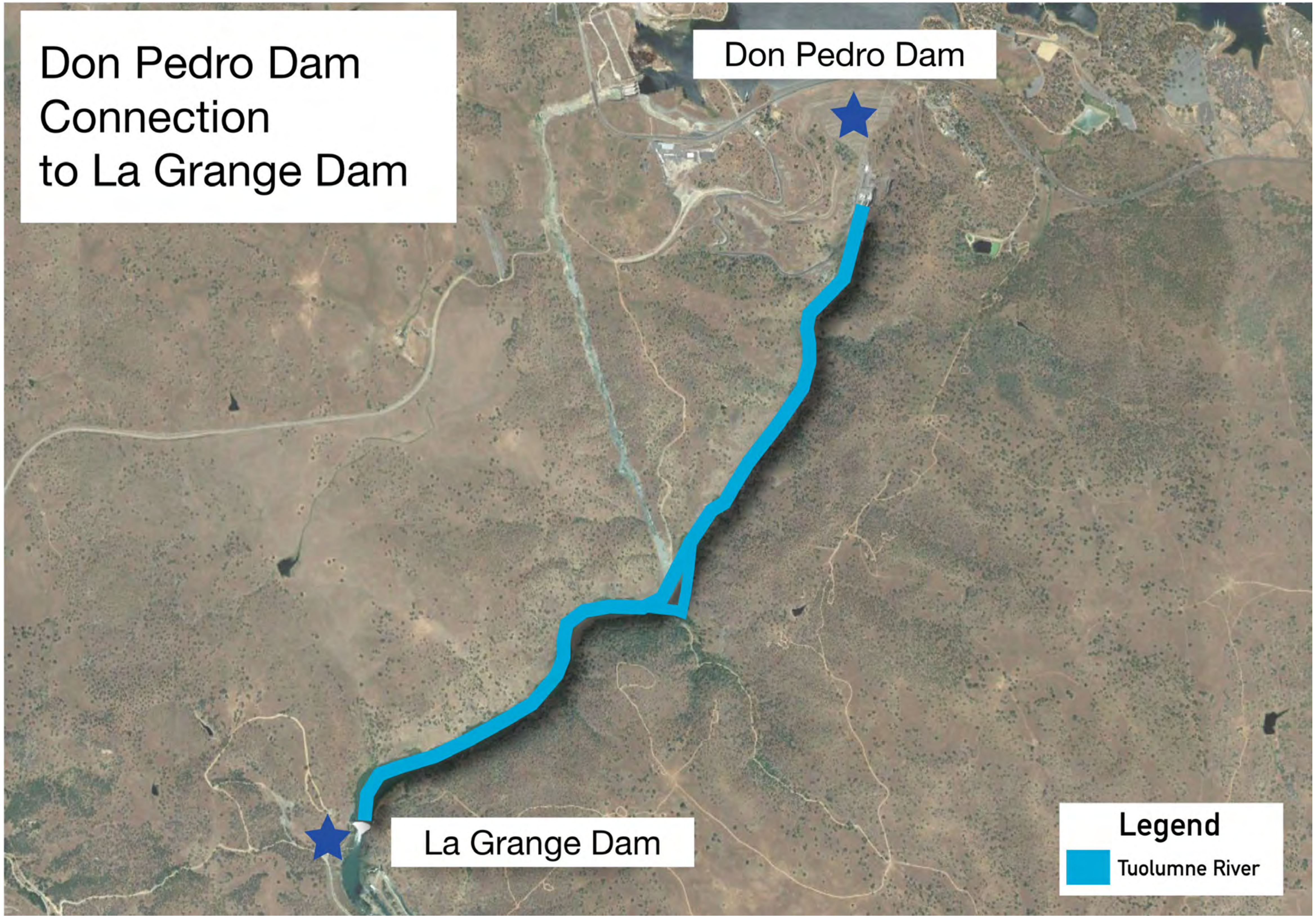


Figure 2: Don Pedro Dam Connection to La Grange Dam
Base Map Source: Google Earth

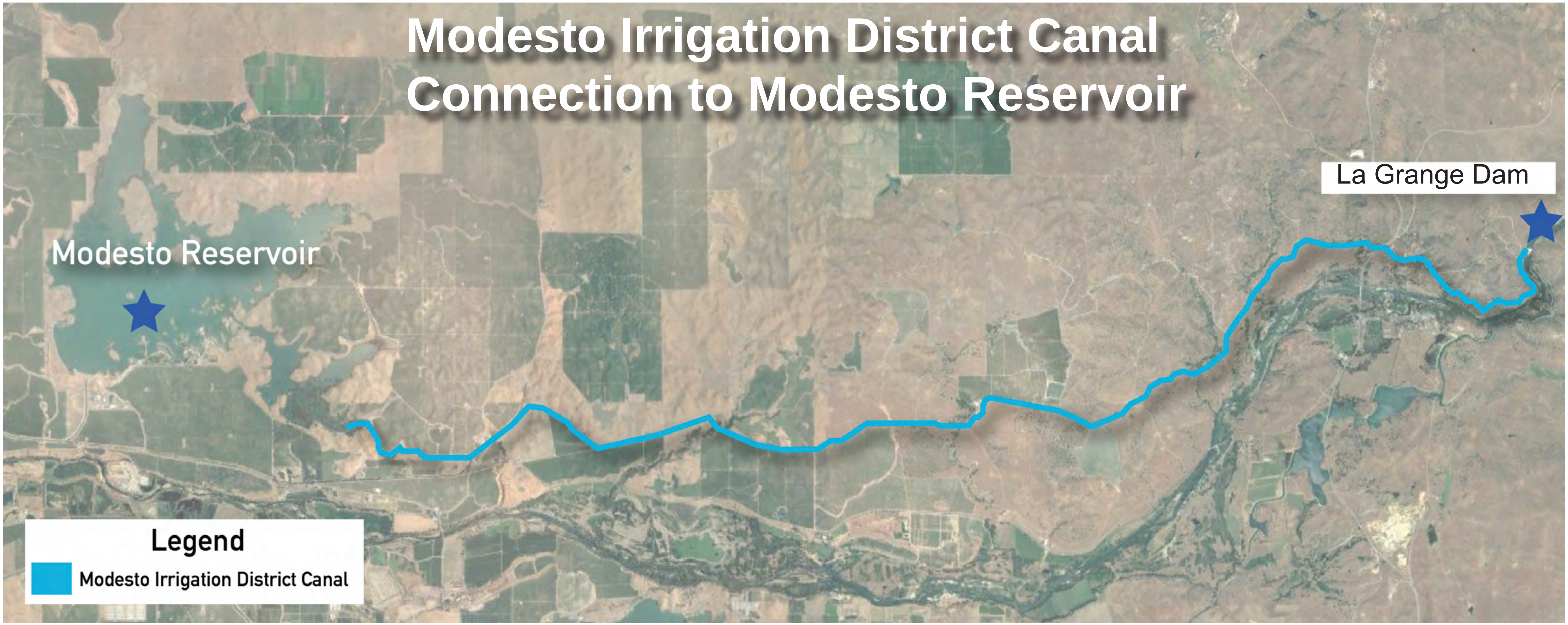


Figure 3: Modesto Irrigation District Canal Connection to Modesto Reservoir
Base map Source: Google Earth

water diversions from the Tuolumne River and groundwater pumping (MID "AWMP," 2015, p. 41). Modesto receives no water from the State Water Project or Central Valley Project canal systems.

Many Central Valley communities have expressed concern with the implementation of the California WaterFix project, and how it will impact their local water supplies and local economies. This paper seeks to analyze the impacts that the City of Modesto will face based on the specific concerns raised by the Modesto Bee Editorial Board, through an editorial piece titled, "If Delta 'tunnels' are built, we're the biggest losers" from April 7, 2018. In the piece, the Editorial Board outlines a series of concerns about how the project, and the new flow-rate requirements associated with the project, will impact the City of Modesto.

Modesto Bee Editorial

The issues raised and assertions made by the Editorial Board are as follows (Modesto Bee Editorial Board [Modesto Bee], 2018):

1. The similarity between the California WaterFix tunnels and the peripheral canal.
2. The risk of saltwater intrusion due to the decrease in flow from the Sacramento River, and that increased flows from the San Joaquin River, and its tributaries, would be needed to thwart off the potential for saltwater to flow into the Central Valley.
3. The State justifying increased flows as a method of protecting fish, while the Editorial Board argues that increased flows are not the only method of protection and that attention to habitat improvement, increased wetlands, less predation, and allowing natural signals are the key to more salmon, according to peer-reviewed studies.
4. Hydropower production would be reduced by the decreased amount of water stored behind MID owned facilities.
5. If the State does not build the tunnels, there would be more incentive for them to dedicate resources to habitat restoration.
6. Decreased water availability would impact municipal and agricultural water supplies.
7. Decreased agricultural water resources would lower agricultural property values in the Modesto area, which will impact public ser-

vices that are reliant on property tax.

8. Groundwater supplies will not be able to support the highly profitable tree crops in the region.

In order to unpack and understand each of these issues, further discussion into the California WaterFix Project and the flow rate requirements, as outlined in the *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* and the *Substitute Environmental Document*, is required.

As previously mentioned, the California WaterFix project was proposed as an upgrade to address the susceptibility of the Delta. In a scientific report on the Delta system, the main drivers of change in the Delta are identified as "subsidence, sea-level rise, seismicity, regional climate change, alien species, and urbanization" (Culberson, Bottorff, Roberson, Soderstrom, 2008, p. 48). Concerns over the Delta system are not new, however, and attempts have been made before to address them, most notably the Peripheral Canal, which was defeated by California voters in 1982 (Gwynn, Thompson, L'Ecluse, 1983, p. 22). The Peripheral Canal proposal was for the construction of a canal that would divert water from "northern California Rivers around the Sacramento-San Joaquin Delta into the California State Water Project feeding southern California" (Gwynn et al, 1983, p. 22).

The Peripheral Canal, like the tunnels, had mixed amounts of support and opposition from various interest groups. Many farmers and southern California communities were interested in the prospect of increased water deliveries into the area (Gwynn et al, 1983, p. 22). Many Delta farmers were concerned that the decrease in freshwater in the Delta system would reduce the ability to flush out saltwater and increase salinity. Other northern California farmers were opposed to having their water taken away to be used in other parts of the State (Gwynn et al, 1983, p. 22). Additional entities that provided input on the ballot measure were "conservationists, recreationists, urban-based industries, industries engaged in the extraction of natural resources, government bureaucracies,

and labor unions" (Gwynn et al, 1983, p. 23). Most of the division between interest groups was split between north and south and federal or state agency. The contention of the issue was settled on June 8, 1982 when the voters of the State of California rejected the proposal, and the canal was never built. The California WaterFix project was proposed and designed to achieve the same goals, just through different means.

The State of California Department of Water Resources and the Conveyance Project Coordination Agency proposed the California WaterFix project (Alternative 3) to update the water delivery system to the State (2015, p. 3). The proposal calls for two tunnels, with three intakes along the Sacramento River, that will divert water around the Delta to a pumping plant at the Clifton Court Forebay (CCF) where freshwater will be pumped into the existing Central Valley Project (CVP) and State Water Project (SWP) canal systems (DWR "Agreement Regarding Construction," 2015, p. 3). Figure One, on page 6, provides an illustration of the proposed system. The Sacramento River contributes the largest amount of water into the Delta, at an average of 17,220 Acre Feet per Year (AFY) and the diversions will reduce the amount of freshwater that is flowing into the Delta (DWR "Delta Flows Components," 1995, p. 19).

The concerns raised by the Editorial Board stem from the objectives in the *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary.* This plan, along with the *Substitute Environmental Document*, were prepared in preparation for the implementation of the California WaterFix project. The *Substitute Environmental Document* provides data, projections, and analysis of the various project alternatives to meet the goals

outlined in the *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary.*

The first phase of the *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* (2018) was recently approved by the State Water Resources Control Board on December 12, 2018 through resolution 2018-0059. Chapter Three of the Plan establishes a series of water quality objectives for "Municipal and Industrial Beneficial Use," "Agricultural Beneficial Use," and "Fish and Wildlife Beneficial Use" (State Water Resources Control Board [SWRCB], 2018, p. 9-10). For each objective there are a series of implementation measures and objectives for delta outflow, Sacramento River flows, Lower San Joaquin River flows, export limits, Delta cross channel gate operation, and salinity control (SWRCB, 2018).

The specific objective that will have the most direct impact on the City of Modesto, is the "Fish and Wildlife Beneficial Use." In order to maintain water levels sufficient to maintain ecological viability in the Delta, the State Water Resources Control Board, through this specific objective, has proposed a 40 percent unimpaired flow rate, from the Stanislaus, Tuolumne, and Merced Rivers from February through June (SWRCB, 2018, p. 15). This objective requires a base flow of 1000 cubic feet per second (cfs) in the San Joaquin River at the USGS gage at Vernalis at all times. When that base flow cannot be maintained, the plan requires that the Stanislaus River contribute 29 percent, the Tuolumne River 47 percent, and the Merced river 24 percent of the total outflow needed to meet that goal (SWRCB, 2018, p. 25).

Assessment of Impacts

The WaterFix project and associated plans and documents have been referred to as a “water grab” by the State by many entities (e.g. Mercury News “Delta hearings,” Kasler & Sabalow, 2018, Horton, 2019). For Modesto, this characterization is used to describe the provision of water within the *Water Quality Control Plan for the San Francisco Bay /San Joaquin Delta Estuary*, through the unimpaired flow rate requirements.

The purpose of this project is to assess the impacts the California Water-Fix project implementation would have on the City of Modesto, through the lens of the issues raised by the Modesto Bee Editorial Board. However, the amount of water that the State would require from the Tuolumne River is a major underlying consideration for many of the points raised by the Board. For this reason, a discussion and analysis of data on existing flow rates and the proposed flow rate requirements, is warranted. The unimpaired flow rate analysis will be referenced in the specific analysis of the issues raised by the Editorial Board.

Unimpaired Flow Rate Requirement Analysis

The plan sets minimum flow requirements as part of an implementation measure for fish and wildlife beneficial use. For the Tuolumne River, the plan mandates that the river contribute 40 percent of its unimpaired flow, from February through June, into the San Joaquin River, with a compliance point at the USGS gauge in Modesto. The use of unimpaired flow as a management basis is one of the most contentious aspects of the project (Austin, 2015). Alternative 3 is the project alternative from the *Substitute Environmental Document* that sets the requirement for 40 percent unimpaired flow rates in the Tributaries (SWRCB, 2018, 3-18).

According to the plan, an unimpaired flow is the "the natural water production of a river basin, unaltered by upstream diversions, storage, or by export or import of water to or from other watersheds" (SWRCB, 2018, p. 17). In order for the Tuolumne River to be in compliance with this implementation measure, the flow rate at the gauge at Modesto must have a flowrate that is greater or equal to the calculated unimpaired flow rate for the Tuolumne River. Intakes for the Modesto Irrigation District happen well upstream of this compliance point, at the La Grange Dam where water is diverted out of the river and pumped by canal into the Modesto Reservoir or other water systems.

The unimpaired flow rate for a river is an estimated value that is defined by the California Department of Water Resources as "a theoretically available water supply assuming existing river channel conditions in the absence of (1) storage regulation for water supply and hydropower purposes and (2) stream

diversions for agricultural and municipal uses. Unimpaired flow estimates are theoretical in that such conditions have not occurred historically" (DWR, 2016, ES-1).

As a part of the *Substitute Environmental Document* for the *Water Quality Control Plan for the San Francisco Bay/San Joaquin Delta Estuary* the State Water Resource Control Board and California Environmental Protection Agency (EPA) provides a technical report in the appendix titled, Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives. The technical report provides background and data on monthly and seasonal trends for the San Joaquin River at Vernalis and the three Lower San Joaquin River (LSJR) tributaries, the Stanislaus, Merced, and Tuolumne Rivers. The technical report explains that existing spring flows in the tributaries have been significantly reduced, while late summer and fall flows increased (SWRCB & CA EPA, 2016, p. 2-26). This change in flow has resulted in less variability across the year and the year-to-year variability in flow, for winter and spring, has been reduced (SWRCB & CA EPA, 2016, p. 2-26). The report also lists that the median currently observed percentage of unimpaired flow for February through June in the Tuolumne River is 21 percent; in comparison to 40 percent in the Stanislaus River and 26 percent in the Merced River. The data provided by the technical report is for the years 1984 to 2009. For the purposes of this paper, the same range of dates was used to be consistent with the impact evaluation provided by the State Water Resources Control Board.

Table 1 provides the data from in the technical report for the unimpaired flow rates for 1984 to 2009 in the Tuolumne River, with considerations for monthly, annual, and February through June flow delineations.

Table 2 provides the data from the technical report for the observed flow rates for 1984 to 2009 in the Tuolumne River, also with considerations for monthly, annual, and February through June flow delineations.

The final piece of flow rate data is the observed flow in the Tuolumne as a percentage of the unimpaired flow. This data is vital in determining the impacts of the *Water Quality Control Plan for the San Francisco Bay/San Joaquin Delta Estuary* and *Substitute Environmental Document*, as it can be used to assess the impacts of the 40 percent unimpaired flow rate. Table 3 illustrates the observed flow as a percentage of the unimpaired flow, meaning how observed flow compares in magnitude to the corresponding unimpaired floor rate. Any month with a percentage that is greater than or equal to 40 percent would be in compliance with the proposed components of the *Water Quality Control Plan for the San Francisco Bay/San Joaquin Delta Estuary*. On Table 3 the cells that are in compliance are highlighted in green.

Because the 40 percent unimpaired flow rate requirement is only applied to February through June, there is a separate column that considers in which years the overall February through June flowrate was in compliance.
Further analysis also considers the frequency of months that are in compliance for the various water year types. Table 4 outlines the percentage of months that are in compliance for each water year index type. This indicates the frequency with which the Tuolumne River was out of compliance and which water year types were more likely to be in compliance than others. The data outlined in Table 4 was calculated from the observed flow and unimpaired flow rates for the Tuolumne River, from the State Water Resources Control Board and California

Table 1: Monthly, Annual, and February through June Unimpaired Flow in the Tuolumne River from 1984 to 2009

Water Year	Oct (TAF)	Nov (TAF)	Dec (TAF)	Jan (TAF)	Feb (TAF)	Mar (TAF)	Apr (TAF)	May (TAF)	Jun (TAF)	Jul (TAF)	Aug (TAF)	Sep (TAF)	Annual (TAF)	Feb-Jun (TAF)	Water Year Type
1984	44	310	402	175	151	200	203	536	330	93	21	7	2,472	1,420	AN
1985	26	85	48	41	69	126	302	341	135	23	15	18	1,229	973	D
1986	31	49	94	129	616	493	320	540	507	144	30	18	2,971	2,476	W
1987	18	8	13	6	37	99	194	203	65	10	8	3	664	598	C
1988	11	26	50	70	57	105	159	213	98	24	6	1	820	632	C
1989	4	21	27	37	61	285	309	321	207	28	2	10	1,312	1,183	C
1990	49	25	22	38	53	130	220	182	100	20	4	1	844	685	C
1991	1	8	5	5	8	168	180	336	295	67	19	7	1,099	987	C
1992	16	25	18	25	93	115	230	189	46	59	14	4	834	673	C
1993	10	14	46	278	161	319	335	631	524	226	54	25	2,623	1,970	W
1994	19	7	18	22	53	108	195	275	119	33	25	10	884	750	C
1995	10	64	58	348	160	579	385	659	811	652	162	35	3,923	2,594	W
1996	12	7	72	129	348	290	323	576	389	133	26	11	2,316	1,926	W
1997	8	112	387	1,033	170	232	277	542	336	57	49	21	3,224	1,557	W
1998	10	18	35	202	358	354	351	477	855	559	84	35	3,338	2,395	W
1999	21	48	68	136	252	171	262	569	436	109	35	20	2,127	1,690	AN
2000	11	17	10	132	277	253	334	539	322	70	35	18	2,018	1,725	AN
2001	17	17	22	32	60	179	227	408	55	12	2	2	1,033	929	D
2002	4	40	93	109	79	141	301	372	223	24	8	6	1,400	1,116	D
2003	1	69	69	89	65	124	218	520	372	55	30	15	1,627	1,299	BN
2004	5	13	82	70	110	257	264	318	148	33	13	7	1,321	1,097	D
2005	54	55	71	260	192	325	305	837	589	258	40	21	3,006	2,248	W
2006	15	16	248	248	154	296	610	816	649	208	37	15	3,313	2,526	W
2007	11	19	29	28	94	147	175	251	61	15	10	8	849	729	C
2008	7	7	18	78	101	124	189	360	204	32	5	4	1,129	977	C
2009	4	62	27	105	118	228	260	563	225	57	9	7	1,665	1,395	D

Water Type: W, AN, BN, D, C; Wet, Above Normal, Below Normal, Dry, Critically Dry respectively

Source: California State Water Resources Control Board and California EPA. (2016). *Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives.*

Table 2: Monthly, Annual, and February through June Observed Flow in the Tuolumne River from 1984 to 2009

Water Year	Oct (TAF)	Nov (TAF)	Dec (TAF)	Jan (TAF)	Feb (TAF)	Mar (TAF)	Apr (TAF)	May (TAF)	Jun (TAF)	Jul (TAF)	Aug (TAF)	Sep (TAF)	Annual (TAF)	Feb-Jun (TAF)	Water Year Type
1984	293	124	263	367	268	188	56	39	19	18	19	23	1,677	569	AN
1985	62	69	131	96	76	46	23	21	19	17	16	15	593	186	D
1986	29	33	38	37	140	380	305	170	103	22	21	56	1,334	1,098	W
1987	78	72	127	56	26	46	45	27	12	11	12	11	522	156	C
1988	17	18	19	18	13	15	22	9	7	6	6	7	156	65	C
1989	8	10	11	11	9	16	21	10	8	8	9	10	134	65	C
1990	15	18	16	15	15	16	16	14	7	7	8	9	157	68	C
1991	12	12	11	9	9	23	23	26	6	6	7	7	152	88	C
1992	10	12	11	12	27	16	19	22	7	6	6	7	153	90	C
1993	10	12	13	46	25	18	49	45	29	20	30	59	357	166	W
1994	46	23	27	38	23	20	31	27	9	7	8	7	266	110	C
1995	11	14	15	98	236	348	426	483	326	202	88	141	2,389	1,820	W
1996	110	26	26	41	316	328	180	252	47	21	27	31	1,406	1,123	W
1997	38	30	307	953	488	182	96	70	27	30	28	28	2,275	862	W
1998	45	29	28	167	417	348	343	224	266	184	74	97	2,223	1,599	W
1999	71	31	80	83	288	230	129	113	28	29	27	29	1,138	788	AN
2000	36	28	26	28	149	294	109	87	35	37	60	54	942	674	AN
2001	44	29	28	33	76	61	43	56	15	16	17	17	435	251	D
2002	21	16	25	28	15	19	43	38	14	15	16	14	264	129	D
2003	21	17	20	18	15	18	48	38	20	21	23	23	284	140	BN
2004	25	19	20	21	27	79	76	36	15	15	15	14	362	233	D
2005	23	15	15	53	126	275	294	299	235	133	62	32	1,560	1,229	W
2006	35	27	78	295	160	291	492	490	281	73	49	38	2,309	1,714	W
2007	39	28	29	28	29	33	38	34	15	15	15	13	316	149	C
2008	15	14	15	31	24	18	36	52	12	12	12	11	251	142	C
2009	15	13	14	14	15	18	26	49	15	14	11	12	213	122	D

Water Type: W, AN, BN, D, C; Wet, Above Normal, Below Normal, Dry, Critically Dry respectively

Source: California State Water Resources Control Board and California EPA. (2016). *Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives.*

Table 3: Monthly, Annual, and February through June Observed Flow as a Percentage of Unimpaired Flow in the Tuolumne River from 1984 to 2009

Water Year	Oct (%)	Nov (%)	Dec (%)	Jan (%)	Feb (%)	Mar (%)	Apr (%)	May (%)	Jun (%)	Jul (%)	Aug (%)	Sep (%)	Annual (%)	Feb-Jun (%)	Water Year Type
1984	665	40	65	210	177	94	28	7	6	20	90	330	68	40	AN
1985	240	82	273	235	111	37	8	6	14	73	105	85	48	19	D
1986	92	68	40	29	23	77	95	32	20	15	71	310	45	44	W
1987	431	901	979	940	71	46	23	13	19	107	151	361	79	26	C
1988	150	70	37	26	23	14	14	4	7	25	107	660	19	10	C
1989	208	46	42	31	15	6	7	3	4	30	443	102	10	6	C
1990	31	71	74	39	28	12	7	8	7	36	209	881	19	10	C
1991	1,211	147	216	189	115	14	13	8	2	10	38	101	14	9	C
1992	60	48	62	48	29	14	8	12	14	10	43	176	18	13	C
1993	99	89	27	17	16	6	15	7	5	9	56	238	14	8	W
1994	240	335	150	174	44	18	16	10	7	21	31	74	30	15	C
1995	106	22	27	28	148	60	111	73	40	31	55	402	61	70	W
1996	919	373	35	32	91	113	56	44	12	16	105	281	61	58	W
1997	470	27	79	92	287	78	34	13	8	52	57	132	71	55	W
1998	445	162	81	83	117	98	98	47	31	33	89	278	67	67	W
1999	338	64	118	61	114	135	49	20	6	27	77	147	54	47	AN
2000	326	162	259	22	54	116	33	16	11	52	172	298	47	39	AN
2001	260	172	126	104	127	34	19	14	27	130	849	851	42	27	D
2002	513	41	27	26	18	13	14	10	6	61	203	235	19	12	D
2003	2,084	25	29	21	23	15	22	7	6	38	76	156	17	11	BN
2004	474	140	24	30	24	31	29	11	10	46	111	188	27	21	D
2005	42	27	21	20	66	85	96	36	40	51	155	153	52	55	W
2006	241	166	31	119	104	98	81	60	43	35	133	246	70	68	W
2007	356	150	97	101	31	23	21	14	25	103	143	166	37	21	C
2008	217	195	83	40	24	14	19	14	6	36	233	245	22	15	C
2009	351	21	49	13	12	8	10	9	7	24	133	178	13	9	D

Water Type: W, AN, BN, D, C; Wet, Above Normal, Below Normal, Dry, Critically Dry respectively

Source: California State Water Resources Control Board and California EPA. (2016). *Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives.*

Table 4: Water Year Type and Unimpaired Flow Rate Compliance

Water Year Type	Months above 40% (Feb-Jun)	Percent of Total
W	26	20%
AN	7	5%
BN	0	0
D	2	2%
C	4	3%
Total	39	30%

Water Year Type	Months below 40% (Feb-Jun)	Percent of Total
W	13	10%
AN	9	7%
BN	5	4%
D	23	18%
C	41	32%
Total	91	70%

[W=Wet, AN=Above Normal, BN=Below Normal, D=Dry, C=Critically Dry]
Source: SWRCB & Cal EPA. (2016). *Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives.* p. 2-33--2-34

EPA (2016).

Water year type determination in the San Joaquin Valley, is a very complex process. The classifications are Wet, Above Normal, Below Normal, Dry, and Critically Dry. The determination is made by calculating the water year index. The index is calculated using the formula from the State Water Resources

$$INDEX = 0.6 * X + 0.2 * Y + 0.2 * Z$$

Where X = Current year's April – July San Joaquin Valley unimpaired runoff

Y = Current October – March San Joaquin Valley unimpaired runoff

Z = Previous years index (p. 19).

Control Board (2018): The classifications are based on the result of the calculation, which is presented in Millions of Acre-Feet. The index calculation utilizes the runoff data to provide a series of classifications for the water year. Figure 4 provides the index ranges for each water year type.

From 1984 to 2009, the majority (70 percent, or 91 months) of the months in February through June did not meet the 40 percent unimpaired flow rate as required under the implementation of Alternative 3. This means that, in those months, more water would need to be provided to the Tuolumne River from

diversion points upstream of the Modesto compliance gage. In addition, 64 months (70 percent) of those noncompliant months occurred in “dry” or “critically dry” years. In that same time period, 39 months (30 percent) from February through June, were in compliance with the 40 percent unimpaired flow rate. Of those 39 months, 33 (85 percent) occurred in “wet” and “above normal” water years.

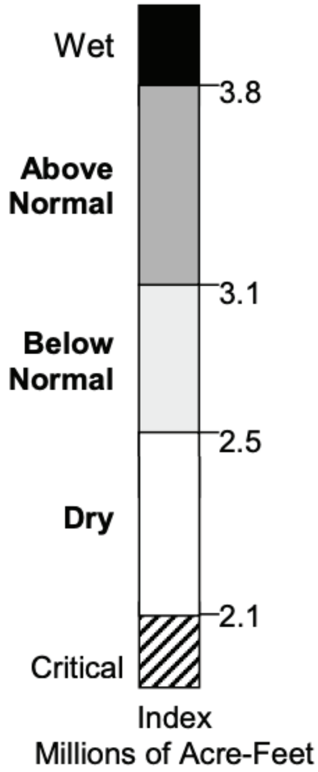


Figure 4: Water Year Type
Source: (SWRCB, 2018, p. 19)

California experienced record drought from 2011 to 2015 (Hanak, Mount, & Chappelle, 2016). The reason the drought years are not considered in this report is because there is no data provided for any year after 2009 in the technical report or *Substitute Environmental Document*. In order to consider how extreme drought would affect these numbers, the water year index and type can be considered. The index and water year type for the years 2011 to 2015 are provided in Table 5 In the San Joaquin Valley, the mean index for 1901 to

Table 5: California Drought Years Index Value and Water Year Type

Year	Index	Water Year Type
2011	5.58	W
2012	2.18	D
2013	1.71	C
2014	1.16	C
2015	0.81	C

[Source: CA DWR, (2019) "Water Year"]

2018 was 3.24, the minimum being 0.81 (2015) and the maximum being 7.22. In previous analysis it was shown that only four out of 45 months that are classified as "critically dry" were in compliance with the 40 percent unimpaired flow rate. This indicates that under extreme drought conditions, the impact to stream flows in the Tuolumne River would be even more significant than the data provided in the *Substitute Environmental Document* technical report.

The final piece of data analysis that is required to thoroughly assess the concerns of the Modesto Bee Editorial Board is a calculation of the flow rate deficit for years where the Tuolumne River flow is out of compliance. The values provide the necessary flow to get to 40 percent under that specific scenario. While it is not a precise indicator of the future needs of the river, it can provide the historic context needed to assess the potential impacts.

This analysis was conducted by calculating 40 percent of the unimpaired flow rate in the Tuolumne River from the data for 1984 to 2009. That number was then subtracted from the observed flow for the corresponding annual and monthly data. The resulting value is either the surplus or deficit in the flow rate. This data and calculated values are provided in Table 6.

The average deficit for 1984 to 2009 in the Tuolumne River was calculated to be 64.43 Thousand Acre Feet (TAF) per month. The average deficit for months in "Wet" water years was 83.81 TAF; the average deficit for months in

"Above Normal" water years was 102.7 TAF; the average deficit for months in "Below Normal" water years was 76.12 TAF; the average deficit for months in "Dry" water years was 60 TAF; and the average deficit for months in "Critically Dry" water years was 48.2 TAF. While it is reasonable to expect that wet years would have smaller deficits than critically dry years, unimpaired flow rates in years with more precipitation can be significantly inflated, while observed flow-rates appear smaller due to water management and controlled releases at various dams along the system.

The overall data indicates that the Modesto Bee Editorial Board was correct in assessing that the implementation of the 40 percent unimpaired flow rate on the Tuolumne River would have an impact on the water supply of the City of Modesto and the other customers of the Modesto Irrigation District. Because the majority of the months from February through June were below the 40 percent unimpaired flow rate, there will be a great need to decrease surface water diversions upstream of the Modesto compliance gage to allow for greater flows. Discussion on the reduction in water availability to address this need is discussed under "Issue Six: Decrease in Water Availability."

Table 6: February through June Observed Flow Compared to 40 Percent of the Unimpaired Flow in the Tuolumne River from 1984-2009

Water Year	Oct (TAF)	Nov (TAF)	Dec (TAF)	Jan (TAF)	Feb (TAF)	Mar (TAF)	Apr (TAF)	May (TAF)	Jun (TAF)	Jul (TAF)	Aug (TAF)	Sep (TAF)	Water Year Type	Feb-Jun (TAF)
1984	275.4	0	102.2	297	207.6	108	-25.2	-175.4	-113	-19.2	10.6	20.2	AN	1
1985	51.6	35	111.8	79.6	48.4	-4.4	-97.8	-115.4	-35	7.8	10	7.8	D	-203
1986	16.6	13.4	0.4	-14.6	-106.4	182.8	177	-46	-99.8	-35.6	9	48.8	W	108
1987	70.8	68.8	121.8	53.6	11.2	6.4	-32.6	-54.2	-14	7	8.8	9.8	C	-83
1988	12.6	7.6	-1	-10	-9.8	-27	-41.6	-76.2	-32.2	-3.6	3.6	6.6	C	-188
1989	6.4	1.6	0.2	-3.8	-15.4	-98	-102.6	-118.4	-74.8	-3.2	8.2	6	C	-408
1990	-4.6	8	7.2	-0.2	-6.2	-36	-72	-58.8	-33	-1	6.4	8.6	C	-206
1991	11.6	8.8	9	7	5.8	-44.2	-49	-108.4	-112	-20.8	-0.6	4.2	C	-307
1992	3.6	2	3.8	2	-10.2	-30	-73	-53.6	-11.4	-17.6	0.4	5.4	C	-179
1993	6	6.4	-5.4	-65.2	-39.4	-109.6	-85	-207.4	-180.6	-70.4	8.4	49	W	-622
1994	38.4	20.2	19.8	29.2	1.8	-23.2	-47	-83	-38.6	-6.2	-2	3	C	-190
1995	7	-11.6	-8.2	-41.2	172	116.4	272	219.4	1.6	-58.8	23.2	127	W	782
1996	105.2	23.2	-2.8	-10.6	176.8	212	50.8	21.6	-108.6	-32.2	16.6	26.6	W	353
1997	34.8	-14.8	152.2	539.8	420	89.2	-14.8	-146.8	-107.4	7.2	8.4	19.6	W	239
1998	41	21.8	14	86.2	273.8	206.4	202.6	33.2	-76	-39.6	40.4	83	W	641
1999	62.6	11.8	52.8	28.6	187.2	161.6	24.2	-114.6	-146.4	-14.6	13	21	AN	112
2000	31.6	21.2	22	-24.8	38.2	192.8	-24.6	-128.6	-93.8	9	46	46.8	AN	-16
2001	37.2	22.2	19.2	20.2	52	-10.6	-47.8	-107.2	-7	11.2	16.2	16.2	D	-121
2002	19.4	0	-12.2	-15.6	-16.6	-37.4	-77.4	-110.8	-75.2	5.4	12.8	11.6	D	-317
2003	20.6	-10.6	-7.6	-17.6	-11	-31.6	-39.2	-170	-128.8	-1	11	17	BN	-380
2004	23	13.8	-12.8	-7	-17	-23.8	-29.6	-91.2	-44.2	1.8	9.8	11.2	D	-206
2005	1.4	-7	-13.4	-51	49.2	145	172	-35.8	-0.6	29.8	46	23.6	W	330
2006	29	20.6	-21.2	195.8	98.4	172.6	248	163.6	21.4	-10.2	34.2	32	W	704
2007	34.6	20.4	17.4	16.8	-8.6	-25.8	-32	-66.4	-9.4	9	11	9.8	C	-143
2008	12.2	11.2	7.8	-0.2	-16.4	-31.6	-39.6	-92	-69.6	-0.8	10	9.4	C	-249
2009	13.4	-11.8	3.2	-28	-32.2	-73.2	-78	-176.2	-75	-8.8	7.4	9.2	D	-436

Water Type: W, AN, BN, D, C; Wet, Above Normal, Below Normal, Dry, Critically Dry respectively

Source: California State Water Resources Control Board and California EPA. (2016). *Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives.*

Issues Raised by the Editorial Board

In order to assess the impacts the implementation of the California WaterFix project would have on the City of Modesto, through the lens of the Modesto Bee Editorial Board's article, the proposed impacts will be assessed for validity based on the claims made and data referenced. With the 40 percent unimpaired flow rate analysis in consideration, each point is given a designated section below.

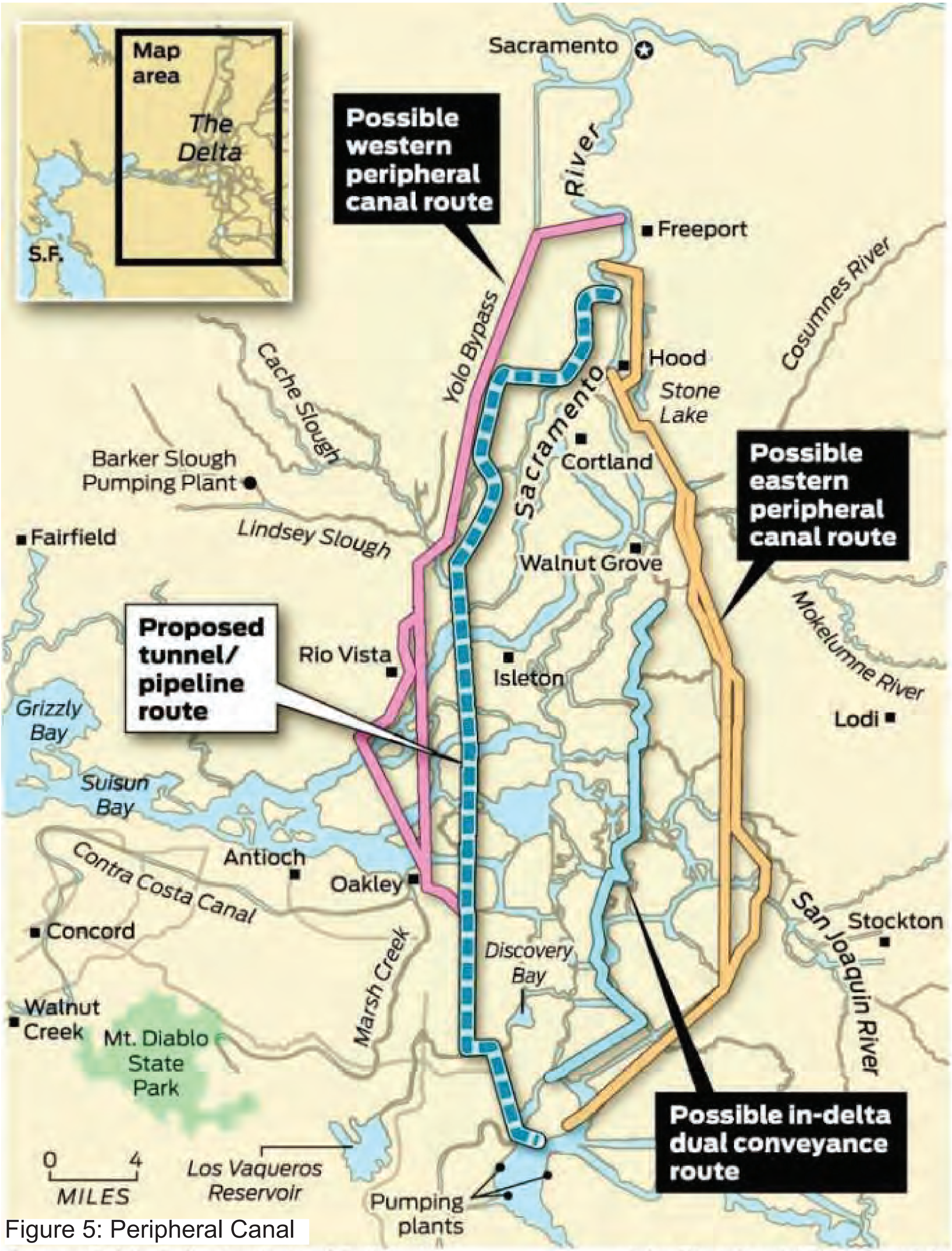


Figure 5: Peripheral Canal

Source: Public Policy Institute of California John Blanchard / The Chronicle

Issue One: Similarity to the Peripheral Canal

The first point raised by the Modesto Bee Editorial Board was that the project mimics the intentions of the Peripheral Canal through Proposition 9 in 1982. Figure 5 depicts the proposed Peripheral Canal pathway as compared to proposed tunnel routes. The Editorial Board bolsters their claim by pointing out that the Modesto Bee is joined in its opposition of the Delta tunnels by the San Francisco Chronicle, San Jose Mercury News, Stockton Record, and The Fresno Bee (Modesto Bee, 2018). The Board also points out that, while opposed in 1982, the Sacramento Bee now favorably views the tunnels (Modesto Bee, 2018). Proposition 9 was defeated on the ballot with 62.7 percent of voters saying "no" and 37.3 percent saying yes (Ballotpedia, n.d.). When looking at results aggregated by county, only eight counties in California voted with more than 50 percent of voters in favor: Kern, San Bernardino, Ventura, Los Angeles, Orange, Riverside, San Diego, and Imperial (Public Policy Institute of California [PPIC], n.d.). Only three counties had more than 60 percent of voters in favor: Los Angeles, Orange, and San Diego (PPIC, n.d.). Stanislaus County, where Modesto is the county seat, voted with 91.4 percent of voters in opposition to the project (PPIC, n.d.).

This point is beneficial in addressing that, historically, voters in Modesto were highly opposed to the project. However, this historical context does not indicate anything beyond voter opinion in 1982 and has no bearing in the assessment of the impacts on the City of Modesto.

Issue Two: Saltwater Intrusion

The second point raised by the Modesto Bee Editorial Board is the potential for saltwater intrusion into the Valley. The Board asserts that the Sacramento River, under existing conditions, provides 80 to 85 percent of the freshwater flowing into the Delta and that when that flow is interrupted by the California WaterFix project tunnels, the San Joaquin River would need to provide more water to prevent saltwater from "rushing deep into our Valley" (Modesto Bee, 2018).

Salt water intrusion is one of the largest challenges facing the Delta, as the result of sea-level rise (CA DWR "The Delta," n.d.). Increased salt water intrusion poses a significant risk to the water supply for 27 million California residents. The Delta has always existed as an interaction point between fresh water and saltwater from the ocean (Water Education "Sacramento-San Joaquin", n.d.). Prior to the human intervention in the Delta, saltwater from the Pacific Ocean flooded marsh land in the summer, and mountain runoff in the winter pushed back the saltwater from the ocean (Water Education, "Sacramento-San Joaquin", n.d.).

Saltwater from the Pacific Ocean has the capability of seeping through Delta levees and into land because most of the islands in the Delta are below sea level (Water Education, "Sacramento-San Joaquin", n.d.). Farmers in the Delta pump that water off of the land and add fresh water to allow for agricultural production (Water Education, "Sacramento-San Joaquin", n.d.). The South Delta relies primarily on irrigation water from the San Joaquin River, and irriga-

tion processes concentrate salt in agricultural drainage water, which is subsequently pumped into delta channels (Water Education, "Sacramento-San Joaquin", n.d.). This process brings saltwater into the San Joaquin Valley through both Federal and State Water Projects. An estimate provided by the Water Education Foundation is that nearly forty railroad cars of salt are brought in to the West San Joaquin Valley every day (Water Education, "Sacramento-San Joaquin", n.d.)

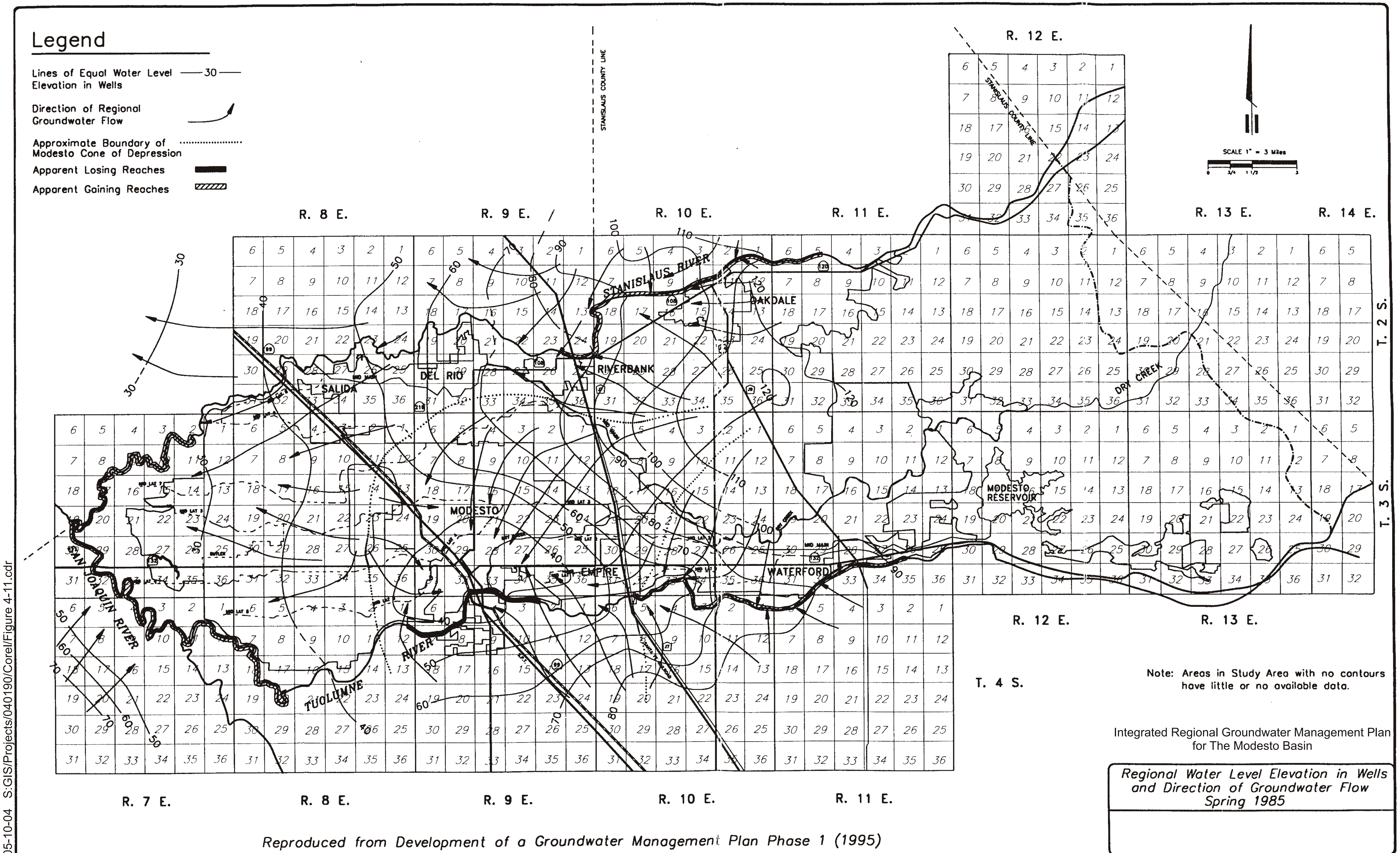
The soil in the western San Joaquin Valley is defined by the Corcoran Clay that is present throughout the groundwater system (Flay, n.d.). The Corcoran clay has an extremely low permeability and boundaries ranging from 20 to 120 feet in thickness (Flay, n.d.). These dense clay layers prevent the saline water from being able to permeate into deeper water tables and the salts accumulates in soils (Water Education "Salinity," 2009). Consequently, as fields are irrigated, the salts accumulate into shallower groundwater tables (Water Education "Salinity," 2009). Drainage of the salt in the area is provided by the San Joaquin River, which flows to the North, where it is subsequently transported to the Delta. This process has dramatically affected the crop production viability in the South Valley, as salt is not able to be drained naturally leaving thousands of acres unfarmable (Water Education "Salinity," 2009).

According to the Integrated Regional Groundwater Management Plan (Stanislaus and Tuolumne Rivers Groundwater Basin Association [STRGBA], 2005) there is little documentation of a history of saline (salt water) intrusion from the San Joaquin River or the west side of the San Joaquin Valley into the Modesto Groundwater Basin (p. 109). The Integrated Regional Groundwater

Management Plan attributes the lack of saltwater intrusion from the Western San Joaquin Valley to high groundwater elevations present in the basin, as demonstrated in Figure Six (STRGBA, 2005, p. 109). The positive groundwater gradient is vital in restricting the flow of saltwater into the basin and its maintenance is recognized as the strongest preventative measure to prohibit flows into the basin from the San Joaquin River and the West San Joaquin Valley (STRGBA, 2005, p. 109).

The Integrated Regional Groundwater Management Plan proposes three measures to maintain the gradient:

- Continue collecting groundwater quality data along the San Joaquin River, and track the progression, if any, of saline water moving east from the San Joaquin River. This action will include communicating with DWR's District Office on a biennial basis to check for significant changes to [Total Dissolved Solids] TDS concentrations in wells. DWR has a regular program of sampling water quality in selected domestic, agricultural and monitoring wells throughout the basin. These wells will be augmented by additional monitoring wells to develop an early warning system able to detect saline water intrusion from the river.
- The program of monitoring for intrusion of saline water will be supplemented by the Groundwater Monitoring Program described in this [The Integrated Regional Groundwater Management Plan] plan. The program includes provisions for monitoring groundwater levels and quality.



05-10-04 S:GIS/Projects/040190/Corel/Figure 4-11.cdr

Figure 6: Groundwater Elevations
Source: STRGBA, 2005

- Observe TDS concentrations in public supply wells that are routinely sampled under the DHS Title 22 Program. (STRGBA, 2005, p. 109).

The Plan also provides data and information about the salinity of deep-water basin levels, their potential to impact the overhead freshwater, and measurements of Total Dissolved Solids, a measure of the amounts of salts in water. According to the plan, “Salts are a concern for both potable and agricultural users. Salt-tolerance thresholds for permanent and vegetable crops may be as low as 600 milligrams per liter (mg/L). Drinking water standards provide recommended maximum contaminant levels (MCLs) of 500 mg/L. An upper limit of 1,000 mg/L is allowed if it is not reasonable or feasible to supply water with levels less than 500 mg/L. TDS concentrations in most wells in the sub basin are low and suitable for potable or agricultural use” (STRGBA, 2005, p. 60). The Modesto sub basin is underlain with salt water and the deep-water aquifer is identified as the potential source of salt water in the basin (STRQBA, 2005, p. 63). The plan acknowledges that the existing downward gradient prevents the saltwater from rising, but that deep water aquifer pumping could result in an upward gradient that brings saltwater into the aquifer above (STRQBA, 2005, p. 63).

Saltwater intrusion in the Delta has been a progressively increasing issue. In a paper published in the Review of Geophysics, Cloern and Jassby (2012) analyzed Delta inflow, outflow, exports, and depletions and assessed the impacts on saltwater intrusion based on varying conditions (p. 6). Cloern and Jassby define Delta outflow as “what remains of Delta inflow after exports to various water projects and depletions within the Delta” (2012, p. 6). This means

that water that is sent to the Bay that serves to push back salt water from the Pacific Ocean. Salinity in the Delta is often discussed and quantified using the unit “X2” which is the “distance in kilometers from the Golden Gate Bridge to the point where the salinity on the bottom is about 2 parts per thousand (ppt) and is the basis for standards to protect aquatic life (seawater salinity is about 35 ppt)” (Water Education “Sacramento-San Joaquin”, n.d.).

In their analysis of inflow and outflow, Cloern and Jassby noticed a decrease in upstream supply, which did not compensate for exports and thus lead to a decline in the outflow from the Delta to the Bay (2012, p. 7). The September through December flow trends resulted in salinity moving further inward in that part of the year. In order to quantify the increase by decade, they looked at the X2 for each decade and compared it to a proposed X2 based on an unimpaired flow condition (Cloern et al, 2012, p.8). When comparing the difference

Table 7: Salinity Conditions in the Delta Expressed through X2 Measurement

Decade	X2	X2*	ΔX2
1950-1959		73.7	
1956-1959	73.2	75.9	-2.7
1960-1969	71.3	73.3	-2.0
1970-1979	73.3	73.7	0.5
1980-1989	75.1	72.5	2.6
1990-1999	78.6	75.9	2.7
2000-2003	79.9	74.2	5.6
2000-2010	80.5		

a X2 measured in kilometers. X2, estimated from outflow; X2*, estimated from unimpaired outflow; ΔX2, difference between them
Source: Cloern and Jassby, (2012), p. 8

between the two (ΔX2), a negative number indicates that the X2 condition in that decade is smaller than was estimated in an unimpaired flow condition, while a positive number indicates that the X2 condition exceeds the estimated

unimpaired flow condition. Therefore a positive number indicates that, for that decade, the salinity condition worsened. Table 7 provides the data for September through December for the decades of 1950 to 2010.

This increased saltwater intrusion in the Delta does have the potential to impact Modesto and Modesto Water supplies if left unchecked. As Delta water becomes saltier and exports continue, the problems currently facing the western San Joaquin Valley will continue to exist or be exacerbated. This is due to the fact that water deliveries from the federal and state water projects deliver more salt than is able to be discharged (Water Education “Salinity”, 2009). As was previously mentioned in this section, the Modesto Groundwater Basin has been able to limit saltwater limit into the basin from the western San Joaquin due to the positive gradient that is maintained through high groundwater elevations.

The issue of water availability is discussed in greater detail under “Issue Six: Decrease in Water Availability” but it is important to note, for this discussion, that the implementation of the 40 percent unimpaired flowrate will reduce the available water supply for both municipal and agricultural supplies. This could potentially lead to increased groundwater pumping in the Modesto Groundwater Basin, which depending on the extent of pumping, has the potential to affect that gradient. The Integrated Regional Groundwater Management Plan outlines a “Groundwater Monitoring Plan” in Appendix D, which is listed as an action item for controlling saltwater intrusion into the Modesto Groundwater Basin (STRGBA, 2005, p. 109).

The reduction of Delta outflows due to the diversion of water from the

Sacramento River under the California WaterFix project could result increased saltwater intrusion in the Delta, as indicated in the research of Cloern and Jassby. Due to the salinity issues in the western San Joaquin Valley and San Joaquin River, and the potential for increased groundwater pumping in the Modesto Groundwater Basin, there is the potential for that salinity to begin to infiltrate the basin. This impact has very legitimate potential, but more specific hydrological studies would be needed to determine the extent to which groundwater pumping would reduce groundwater elevations. In addition, analysis would be needed to determine the extent to which groundwater elevations would need to be depleted to affect the gradient that currently holds back the saline water from the western San Joaquin Valley and San Joaquin River.

The State Water Resources Control Board approved the *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* and *Substitute Environmental Document* on December 12, 2018 in a four-to-one vote. The State administers the Porter-Cologne Water Quality Control Act which seeks "to achieve an effective water quality control program for the state and are responsible for the regulation of activities and factors that may af-fect the quality of the waters of the state" (SWRCB "Water Quality", 2018, p 1). In addition, Water Code §13170 authorizes the State to adopt a Water Quality Control Plan.

According to the resolution adopted in 2018, the State Water Board, in its role as a water quality authority, amended the Water Quality Control Plan for the

Delta. In order to do this, water quality objectives in the plan protect beneficial uses and action items to achieve them (SWRCB “Water Quality,” 2018, p. 3).

In the plan, Water Quality Objective C is for Fish and Wildlife Beneficial Uses. The flow rate requirements on the Lower San Joaquin River, which will impact Modesto, are the result of an implementation measure listed under this beneficial use are. The plan identifies the purpose of the implementation measures as necessary to maintain flows into the Delta that are able to maintain the Delta migrating San Joaquin River fish populations (SWRCB “Water Quality”, 2018, p. 15). The implementation measure also clarifies that the flows that are meant to contribute towards maintaining fish populations could include but might not be limited to: “flows that more closely mimic the natural hydrographic conditions to which native fish species are adapted, including the relative magnitude, duration, timing, and spatial extent of flows as they would naturally occur. Indicators of viability include population abundance, spatial extent, distribution, structure, genetic and life history diversity, and productivity” (SWRCB “Water Quality”, 2018, p.15).

The point raised by the Modesto Bee Editorial Board is that the State is presenting the project as being undertaken, “for the sake of salmon” (Modesto Bee, 2018). The Editorial Board also takes issue with the State’s assertion that increased flows are the only method that can save the salmon and calls the claim “laughably inaccurate” (2018). In the editorial piece, there is a link to a peer reviewed study that asserts that salmon are more dependent on “better habitat, more wetlands, less predation, and facilitating natural migration signals only the salmon understand” (Modesto Bee, 2018). They also raise claims that

experts in the field refer to the Delta as a "killing field" for salmon (Modesto Bee, 2018).

The peer reviewed study referenced in the article does have some credence on this issue. The paper was written by Matthew Peterson, Andrea N. Fuller, and Doug Demko and was published in the North American Journal of Fisheries Management in 2017. The study looked at twelve years of data for upstream migration patterns of Chinook Salmon in the Stanislaus River. The study analyzed "environmental factors and two management actions (installation of a rock barrier at a distributary and managed pulse flows)" (p. 78).

By compiling data and analyzing results, the authors were able to write a series of potential management implications. The study found that pulse flows should be an important consideration for management moving forward. However, the authors assert that other factors may by more beneficial and that there are potential thresholds which may represent the upper cap of usefulness in their application. The threshold used for the pulse flows in the study 20 m3/sec, which translates to about 706 cubic feet per second (cfs), which is the unit of measurement for flow rates in the Plan (Peterson, Fuller, & Demko, 2017, p. 88). They also pose that daily proportions with higher discharge levels begin to decline (Peterson, et al, 2017, p. 88).

The proposed mandatory flow rate in the plan is 1000 cfs on the San Joaquin River at the Vernalis compliance point (SWRCB "Water Quality," 2018, p. 15). There is also an adaptive management range of 800 cfs to 1200 cfs at the Vernalis compliance point. These values are all above the recommended flow rate from the paper. The study proposes that considerations for changes should

be made along the Stanislaus River, with relation to flow rate, in order to better align the management practices with the recommendations of the report. However, it should be noted that the study was done specifically for the Stanislaus River, and it may not be appropriate to apply the same proposed standards for the San Joaquin River given the variance in environmental conditions of the River.

The Delta Watermaster, Michael George, when asked about the merits of mimicking natural flow through the unimpaired flow proposal, responded by saying that he believes unimpaired flows alone may not be enough to increase salmon populations (Maven's Notebook, 2018). The quote from the editorial piece about the Delta being a "killing field" for salmon comes out of the Watermaster's response to this question. In context the quote reads (Maven's Notebook, 2018).

> The phase 1 proposed project basically increases flows measured at Vernalis which is the beginning of my domain. I have authority in the Delta. So on the one hand, I know that if you deliver fish and water at that point, you're introducing them to the killing fields and the difficulty of getting them to Chipps Island and getting them out of the system is daunting; there is an argument that doing all that won't make a significant enough difference unless you deal with all the other problems. So this goes back to my point that you have to look at it as a system.

He continues to state that the "system" must consist of methods to improve the ecosystem. Acknowledging that he is not a scientist, he continues

to claim that he has learned from other scientists that doing a better job with the ecosystem will produce more salmon. This opinion has been presented in scientific studies as well. A publication from March 22, 2018 entitled Survival of Juvenile Fall-Run Chinook Salmon through the San Joaquin River Delta, California, 2010–2015, asserts that increased flows are not likely to increase the survival rates of juvenile Chinook Salmon entering the Delta from the San Joaquin River. The authors assert that the highest survival rates are in those salmon who are taken from the State Water Project pumping plant because they avoid the Delta (Buchanan, Patricia, Skalski, 2018, p. 674). The biggest key to improving survival, according to the authors, is habitat quality in the Delta along with efforts to improve conditions throughout the life cycle (Buchanan, et al, 2018, p. 676).

Based on the opinions of scientific papers and the testimony of experts in the field, protection of salmonid species is dependent on both managed flow and improved aquatic habitat. The Editorial Board was correct in their assessment that flow rates will not solve the issue on their own, however there is no indication that they are not necessary or that habitat restoration outweighs the impact of flowrates.

Issue Four: Hydropower

The fourth issue raised by the editorial board is that the Modesto and Turlock Irrigation Districts have multiple canal and dam systems, with the capability of generating power. The argument raised in the Board's concern was that the power houses present at the dams would do very little for power generation if there was no water behind them (Modesto Bee, 2018). The dams and power sources that are either owned by or produce power for the Modesto Irrigation District are as follows: The Don Pedro Powerhouse, Woodland Generation Stations, McClure Generation Station, Ripon Generation Station, Stone Drop Mini-Hydro, and the New Hogan Powerhouse (MID "Electric Facilities," n.d.). The energy production portfolio of the MID is not entirely dependent on hydropower, so in order to assess the proposed impact, a comparison of the potential reduction in hydropower generation to the overall generation of the MID system will indicate the extent to which decreased water supplies could have on power generation.

- The Don Pedro Reservoir and Powerhouse is a joint operation between the Modesto and Turlock Irrigation Districts. In terms of power generation, the MID owns 31.54 percent of the power generated. The dam has three 55 MW turbines and one 34 MW turbine. The share going to MID is about 63 MW (MID "Electric Facilities," n.d.).
- The Woodland Generation Stations are natural gas generator system (CA Energy Commission, 2001). It consists of three units built from 1993 to 2011 (MID "Electric Facilities," n.d.). The first unit has

an output of 49.4 MW, the second unit has an output of 83 MW, and the third unit has an output of 49.6 MW (MID "Electric Facilities," n.d.).

- The McClure Generation Station is a series of two units completed in 1980 and 1981, with an output of 56 MW each (MID "Electric Facilities," n.d.). They serve as a peak power generator and the electricity generated is used locally when there is a peak need, such as on hot days, and sold to the California electricity market when the power is not needed locally (Moran, 2000).
- The Ripon Generation Station is another peaking power source with a single turbine completed in 2006 with a 95 MW output (MID). This plant also serves to provide energy on high load days and seasonal needs (CA Energy Commission "Ripon", 2004, p. 2).
- The Stone Drop Mini-Hydro is a small hydropower unit that generates energy from canal flow during irrigation season (MID "Electric Facilities," n.d.). Being a small unit, it only generates 230 kW.
- New Hogan Powerhouse is another smaller scale hydropower unit which generates energy from the water stored in New Hogan Reservoir. This unit generates 3.15 MW (MID "Electric Facilities," n.d.).

With regards to MIDs energy portfolio, three out of the six facilities are dependent on water storage for operation. Of the 455.38 MW that are generated and owned by the MID, 66.38 MW are generated through hydroelectric power, or about 15 percent.

The Don Pedro Reservoir is located upstream of the intake for the

Modesto Regional Water Treatment Plant as well as the Modesto compliance gage. This means the compliance point for the *Water Quality Objective for Fish and Wildlife Beneficial Use, as outlined in the Water Quality Control Plan for the San Francisco Bay/San Joaquin Delta Estuary* (SWRCB, 2018), is below the powerhouse.

The Editorial Board presents their point on this issue with regards to the hydropower systems in place. The argument they present is that an increased demand for water in the Delta will lead to less water in the Tuolumne River, and ultimately will lead to less water being stored in the Don Pedro Reservoir because more water will need to be released to meet the flow rate at the compliance point. The Editorial Board claims that, in the situation of reduced water storage in Don Pedro Reservoir, the power generation for the Modesto Irrigation District would be decreased.

This point is difficult to quantify as the potential impacts would vary from year to year and is dependent on many factors. As was previously mentioned, hydropower only accounts for 15 percent of the power generation output that is owned by the MID. Because the Don Pedro Reservoir is the only hydropower station on the Tuolumne River system that provides power to the MID network, the potential impacts on flow and reservoir would only affect the power generation at that particular station. The Don Pedro Dam only contributes 63 MW of electricity to the overall Modesto Irrigation District production, or around 14 percent.

The State Water Resources Control Board and California Environmental Protection Agency, in Appendix J of the *Substitute Environmental Document*,

analyzed the impacts of the various California WaterFix project alternatives and how they will impact the hydropower capacity for the New Melones Dam, the Don Pedro Dam, and the New Exchequer Dam for July and August, as they are high capacity years (SWRCB “Appendix J,” 2018, p. J-1). The alternative that includes the 40 percent flow rate requirements is Alternative 3. In the Figures 7 and 8 the combined power generation for the three dams previously identified are quantified for the various alternatives and the baseline. Their analysis indicates that Alternatives 3 and 4 would result in a decrease in power generation capacity, relative to the baseline, at times when the baseline reservoir levels and generation were higher. They also found that when baseline reservoir level and hydropower capacity has been low, the capacity for all three alternatives is higher than they baseline, which they attribute to increased storage in dry years (SWRCB “Appendix J,” 2018, p. J-16).

These findings indicate that the 40 percent unimpaired flow rate requirement could have an impact on power generation dependent on the conditions from year to year. The implementation of the 40 percent flow rate requirement has the potential to reduce hydropower generation in summer months, when peak demand is typically highest (SWRCB “Appendix J,” 2018, p. J-18). The requirement would also result in about a four percent reduction in combined capacity for the three dams (New Melones Dam, the Don Pedro Dam, and the New Exchequer Dam). The State Water Resources Control Board determined that the overall reduction in power generation from the three facilities, would have a less-than-significant impact on the power grid (SWRCB “Appendix J,” 2018, p. J-23).

The Editorial Board was correct in assessing that the California WaterFix project would have an impact on the hydropower generation capabilities of the MID system, however modeling and assessment of the demands of the power grid indicate that these impacts would not have a significant impact on the California power grid's reliability.

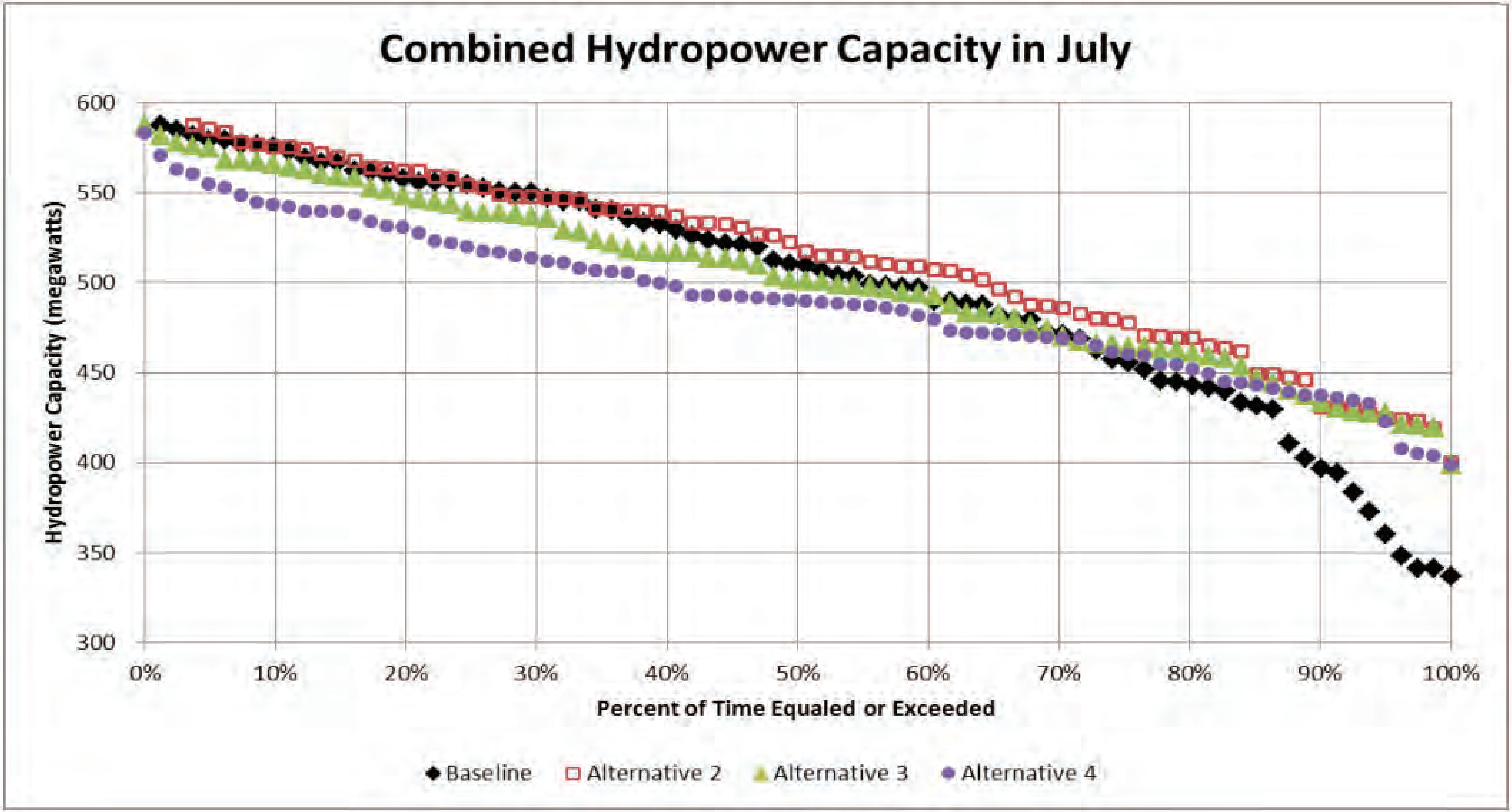


Figure 7: Exceedance Plot of Total Generating Capacity (megawatts) in July, Across 82 Years of Simulation, from the Three Major Tributary Hydropower Facilities, Comparing LSJR Alternatives 2–4 and Baseline.
Source: SWRCB “Appendix J,” 2018, p. J-17

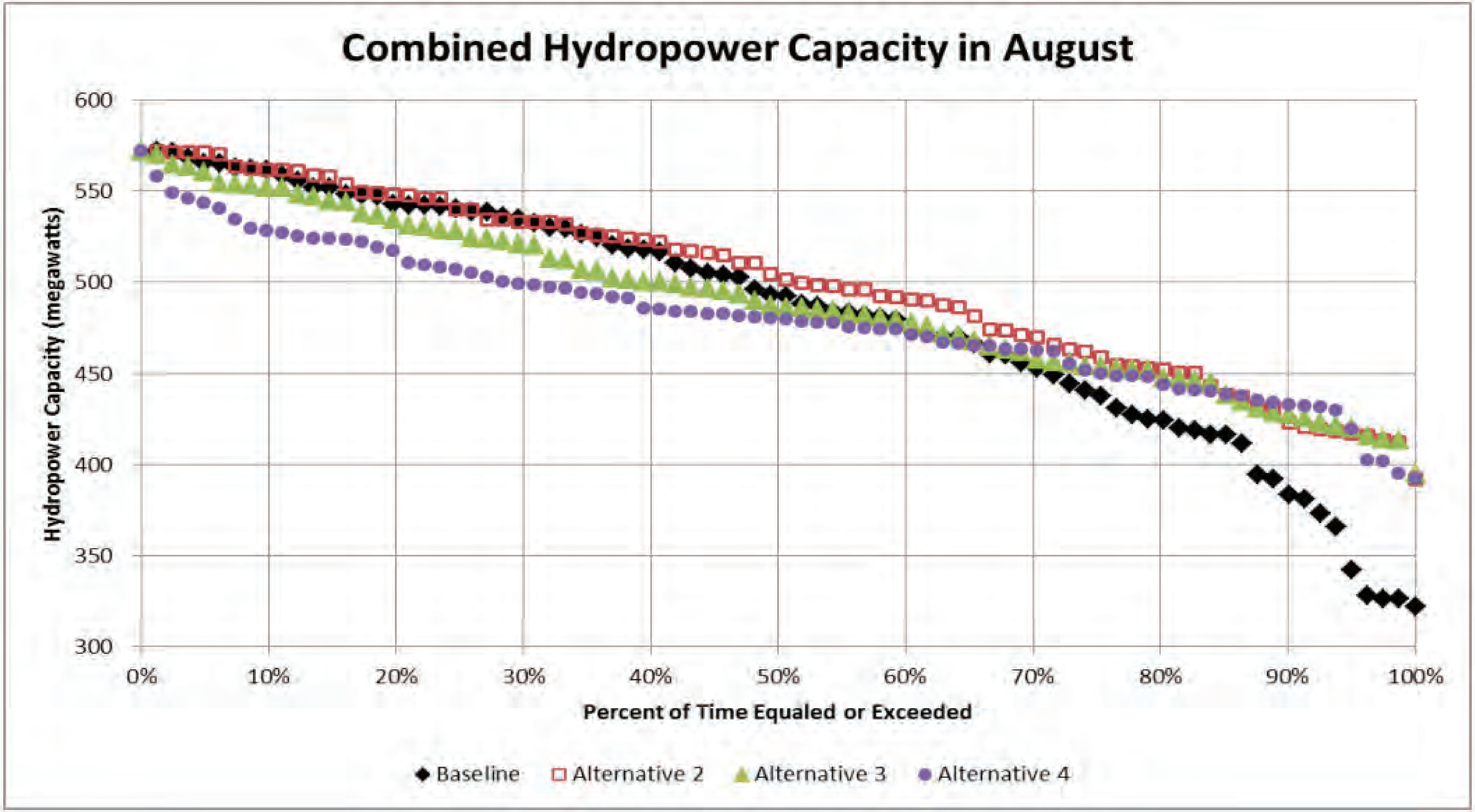


Figure 7: Exceedance Plot of Total Generating Capacity (megawatts) in August, Across 82 Years of Simulation, from the Three Major Tributary Hydropower Facilities, Comparing LSJR Alternatives 2–4 and Baseline.
Source: SWRCB "Appendix J," 2018, p. J-17

Issue Five: Habitat Restoration

The fifth issue raised by the Editorial Board is the reduction in size of proposed habitat restoration being done by the State of California. They take issue with the fact that the proposal under WaterFix is for 30,000 acres of restored wetland in the Delta, which was reduced from 67,000 acres, which was also reduced from the 100,000 acres that were originally planned (Modesto Bee, 2018). The Board expresses hope that if the tunnels are not built, there may be an added incentive for the State to divert more resources into Delta habitat restoration.

There is no verifiable evidence to support this point as there is no way to predict how State budget will be allocated.

The sixth point raised by the Editorial Board relates to the amount of water that the Tuolumne River supplies to the Modesto region, and the impacts that the decrease in available water would have on municipal uses and the agricultural production in the region. The editorial board asserts that the residents of Modesto get "half of their drinking water from the Tuolumne River" and that "8,400 farmers use it [Tuolumne River] to generate $3 billion in food products" (Modesto Bee, 2018). The City of Modesto and the Modesto Irrigation District produced the Joint Urban Water Management Plan which was last updated and adopted in 2010. The plan anticipates water demand up to the year 2035 and accounts for both planned increases in groundwater pumping and wholesale purchase of water from the MID.

Table 8: City of Modesto Current and Planned Water Supplies, AFY

Supply	2010	2015	2020	2025	2030	2035
Wholesale Water Providers (MID)	30,647	67,200	67,200	67,200	67,200	67,200
Supplier Produced Groundwater	33,816	15,700	13,300	20,700	28,800	37,600
Total	64,464	82,900	80,500	87,900	96,000	104,800

[AFY: Acre Feet per Year]
Source: City of Modesto & Modesto Irrigation District [Mod & MID]. (2011). p. ES-4

The wholesale water provider supply caps out at 67,200 AFY in 2015 because of the second phase of the Modesto Regional Water Treatment Plant. The new capacity provided by the second phase allowed for a substantial decrease in groundwater pumping up until 2025, when pumping will be required to keep up with projected population growth (Mod & MID, 2011, p. ES-4).

Agricultural uses in the Modesto area utilize significantly more water than

municipal uses. The Modesto Irrigation District joined the Agricultural Water Management Council (AWMC) in the 1990's and submitted their first ever Agricultural Water Management Plan (AWMP) in 1999 (MID, n.d.). After the passing of Senate Bill 7 in 2009, the AWMC program became mandatory and it was mandated that the plan be updated in 2012, then again in 2015, and every five years after that. The most recent plan available is the 2015 plan. The AWMP provides data on surface water diversions through the MID and agricultural water demand in the MID customer base.

Water that leaves the Don Pedro Reservoir is diverted at the La Grange Dam into the Modesto Irrigation District's Upper Main Canal (MID "AWMP" 2015, p. 41). Some of that water is diverted to customers from the canal, on its way to delivery into Modesto Reservoir (MID, AWMP, 2015, p. 41). Water is then diverted into the downstream irrigation canals and agricultural customers (MID "AWMP" 2015, p. 41). Water from the reservoir is also diverted into the Modesto Regional Water Quality Treatment Plant (MID "AWMP" 2015, p. 41).

The 2015 Agricultural Water Management Plan outlines the amount of water that was diverted from the Tuolumne River for 2010 through 2014. The values fluctuate because diversion is dependent on the flowrate behind the Dam.

Table 9: Surface Water Supplies – Agricultural and Municipal Diversions by MID

Source	2010	2011	2012	2013	2014
MID Water Diverted from the Tuolumne River at La Grange	261,728 AF	282,640 AF	311,500 AF	316,571 AF	176,087 AF

[Source: MID, AWMP, 2015, p. 41. AF = Acre Feet]

Groundwater pumping is meant to supplement the surface water supply, with 93 MID owned wells providing a capacity of about 250 cfs (MID "AWMP" 2015, p. 41). The MID acknowledges that through their own experiences, that continued pumping at the maximum rate, over prolonged periods of time, are not sustainable (MID "AWMP." 2015, p. 41). The MID is voluntarily associated with the Stanislaus and Tuolumne River Groundwater Basin Association (STRGBA) which manages groundwater. Through the involvement with the STRGBA, the USGS was contracted to complete a study of the groundwater basin in 2004, with an update to the study being completed in 2015 (MID "AWMP", 2015, p. 42). The AWMP also indicates that they and STRGBA will take on the lead role in the implementation of SGMA (MID "AWMP", 2015, p. 42).

The MID views the ability to use groundwater to supplement surface water supplies as being one of the most substantial benefits of the conjunctive use program that the District utilizes (MID, 2015, p. 45). The AWMP provides data on groundwater supplies in 2012 which are listed in the Table 10.

Table 10: Groundwater Supplies in 2012

Groundwater Basin	2012 Total (AF)
MID Direct Pumping	17,300
City of Modesto Pumping	28,500
City of Waterford	200
Total	46,000

[Source: MID "AWMP," 2015, p. 45. AF = Acre Feet]

The City of Waterford is included in the data because they were added into considerations with the STRGBA through an MOU. The AWMP also asserts that "total agency groundwater pumping decreased by almost 20% from 2009

to 2012" (MID "AWMP," 2015, p.45). The AWMP also indicates that the implementation of SGMA and the new data available for the newly updated DWR study will allow for methods to calculate groundwater pumping by private citizens.

The concern of the Modesto Bee Editorial Board is that the implementation of the *Water Quality Control Plan for the San Francisco Bay/San Joaquin Delta Estuary* and its *Substitute Environmental Document* (SED) will have negative impacts on the municipal and agricultural water supplies. The AWMP has a section entitled "Future Water Supply" which accounts for some impacts that the SED will have on the agricultural water supply.

The AWMP claims that aside from environmental and Federal Energy Regulatory Commission (FERC) relicensing "future surface water supplies are also threatened by loss of Tuolumne River diversions to assist fisheries and Delta water quality" (MID "AWMP," 2015, p. 57). They claim that the SED calls for up to a 33 percent reduction in MID diversions, an estimated 100,000 AF out of 300,000 AF (MID, "AWMP," 2015, p. 57). This would cause major alterations to water use in water shortage years and could potentially impact both municipal and agricultural water use, and by extension, could have significant impacts on the sustainability of the Modesto Sub-basin (MID, "AWMP," 2015, p. 57). Currently the Modesto Sub-basin is one of few groundwater basins that is not in critical overdraft (DWR, 2015).

This data and analysis indicate that the concerns of the Modesto Bee Editorial Board, related to the issue of water availability, are valid. Because the surface water supply of the MID is entirely dependent on the Tuolumne River,

any reduction in flow would have an impact on the supply for both municipal and agricultural water use.

In order to measure the impact of the 40 percent unimpaired flow rate, the average February through June deficit can be compared to the demand for water. Table 11 shows the analysis of the stream diversions for the MID and the average February through June deficit for the corresponding water year type.

Table 11: Comparison of Surface Water Diversion and 14 Percent Diversion Reduction

	2010	2011	2012	2013	2014
Total Surface Water Diversions from Tuolumne River (AF)	261728	282640	311500	316571	176087
Water Year Type	AN	W	D	C	C
14 Percent of Diversion	36,642	39,570	43,610	44,320	24,652
Remaining Surface Water (AF)	225086	243070	267890	272251	151435

[W=Wet, AN=Above Normal, BN=Below Normal, D=Dry, C=Critically Dry; AF=Acre Feet]
Sources: MID, AWMP, 2015, p. 41.

The remaining available surface water can be compared to the amount of surface water that is used for urban and agricultural water uses. Table 12 compares the remaining surface water to the base urban and agricultural demand that was provided by the MID.

Table 12: Available Surface Water Diversions After Reduction Compared to Demand

	2010	2011	2012	2013	2014
Remaining Surface Water After 14 Percent Diversion Reduction (AF)	225086.08	243070.4	267890	272251.06	151434.82
MID Base Urban Water Supply (AF)	30647	29400	25300	21100	17000
Water for Agricultural Use (AF)	231081	253240	286200	295471	159087
Percent of Remaining Surface Water for Urban Use	14%	12%	9%	8%	11%
Percent of Remaining Surface Water for Agricultural Use	103%	104%	107%	109%	105%

[AF=Acre Feet]
Source: MID, AWMP, 2015, p. 41.

The percentage of remaining surface water for urban use indicates how much of the remaining surface water would be needed to meet the same de-

mand from that year, for municipal uses. The percentage of remaining surface water for agricultural use indicates the amount of the remaining surface water that would be needed to meet the demand without the reduction in diversions. The percentages for agricultural demand being above 100 percent indicates that the existing agricultural demand would not be able to be met after reduced surface water diversion.

This data indicates that the implementation of the 40 percent flow rate requirement would have a substantial impact on the water supply and water management practices for the MID and City of Modesto. Because the existing demand for agricultural use exceeds the remaining supply after surface water diversion reductions, there would be an increased demand for groundwater pumping, which may run contrary to goals for the Modesto Sub-basin and cause alterations to current management practices. Municipal water supply would also be greatly affected because the agricultural demand already exceeds the available remaining surface water. With their demands in tandem, the unimpaired flowrate requirement will result in significant impacts on the water supply for the City of Modesto and the MID.

Issue Seven: Decreased Value of Agricultural Land

The Modesto Bee Editorial Board claims that agricultural land in the Modesto area, and surrounding counties, sells for 10 to 20 times more than agricultural land in water poor areas. They claim that this heightened value is the result of years of investment in water infrastructure (Modesto Bee, 2018). The assumption they make is that the implementation about this project will reduce the values of these properties and, as a result, will lower property tax revenue. This, the Board asserts, will ruin public services like law enforcement and education (Modesto Bee, 2018).

There is truth in the fact that a reduction in property tax revenue will have impacts on public services. According to the California Legislative Analyst's Office, property tax revenues in California remain in the county where they are

collected (LAO, 2012). This money can be spent as the locality sees fit, but most of the money is allocated to K-14 schools and counties (LAO, 2012).

In the "Agricultural Resources" section of the *Substitute Environmental Document* (SED) the State acknowledges that the 40 percent unimpaired flow-rate would cause "significant and unavoidable" impacts to agricultural resources in the Lower San Joaquin River area (SWRCB, 2018, p. 11-5). According to analysis by the State, the implementation of the 40 percent unimpaired flow rate requirement would cause significant impacts to the amount of existing farmland as well. The reduction in irrigated acreage for the MID is on the highest end of the spectrum, at 9.3 percent as reported in the SED (SWRCB, 2018, p. 11-5).

With SGMA, there will be limitations to the extent to which groundwater will be available in coming years. SGMA requires that "governments and water agencies of high and medium priority basins to halt overdraft and bring groundwater basins into balanced levels of pumping and recharge "(DWR "SGMA", n.d.). Under 2019 SGMA basin prioritization, the Modesto basin is listed as high-priority (DWR "Basin Prioritization", 2019, p. A-8). Due to its classification, the Modesto basin must reach sustainability within 20 years of implementing a sustainability plan (DWR "SGMA", n.d.). The requirements could provide restrictions on new well development and reductions in groundwater extraction as the basin will need to be brought into compliance.

Water availability is also linked to agricultural land values. In their publication of the 2016 Trends in Agricultural Land and Lease Values: California and Nevada, the California Chapter of the American Society of Farm Managers and

Rural Appraisers (ASFMRA) presented an assessment of the trends noticed in 2015, particularly in the almond industry. In this article, Janie Gatzman ARA (Accredited Rural Appraiser), the co-chair of the publication, pointed out that, "land with the least expensive water sources, coupled with favorable growing conditions for the most desirable nut crops showed the highest value" (Gatzman 2016, p. 7). It is anecdotally reported that Paramount Farming (now Wonderful Orchards) had paid around $1,120 per acre-foot of water, while farmers in Eastern Stanislaus County paid as little as $6 per acre-foot (Gatzman, 2016, p. 6).

This aligns with the argument maid by the Editorial Board that water infrastructure investments over the years contributed to land values in the area. Gatzman (2016, p. 7) also asserts that there were "virtually no sales of rangeland intended for permanent planting development" in the Northern San Joaquin Valley, because counties were implementing strict groundwater controls that limited the drilling of new wells.

Another influence that water resources have on land values is irrigation potential. According to a United States Department of Agriculture Economic Research Service report, the number one factor in determining farmland value is the profitability associated with the land (Burns, Key, Tulman, Borchers, & Weber. 2018, p. 7). They describe this phenomenon as the "cash return per acre" principal, indicating that land with more productive with a certain amount of input will drive up cash returns per acre (Burns et al., 2018, p. 7). "Cash returns per acre drive both farmland values and cash rental rates" (Burns et al., 2018, p. 7). Janie Gatzman ARA contextualizes this concept in her analysis of

the ebbs and flows of crop values leading up and in to 2015. Gatzman states that land prices throughout the state saw increases in 2015, but major commodity crops began to dip in value in 2016. This, she says, could cause the "the historic rise in land prices" to "slow or even falter" (Gatzman, 2016, p. 8). This assessment adds to the case that crop values influence land values, however benefiting from crop values depends on the interaction between yield and demand.

Given the existing demand for agricultural water in the region, and the significant impacts from the unimpaired flow rate requirements, the reduction in available surface water, from the Tuolumne River, for irrigation, could reasonably impact land values in Modesto and Stanislaus County.

Issue Eight: Groundwater Supply and Tree Crops

The final point brought up by the Modesto Bee Editorial Board fits in conjunction with the previous issue addressed, however, due to its focus being solely on groundwater, it is given its own unique consideration with regards to impact.

In the previous issue, the Board asserted that the farmers will not be able to make up for lost surface water by pumping groundwater, and that the State is aware of this issue (Modesto Bee, 2018). In addition to this point, the Board also claims that the State knows that reduced irrigation water leads to farmers switching from highly profitable tree crops to other annual crops that can easily be lost in drought situations (Modesto Bee, 2018).

Removal of tree crops in water poor regions is not an unprecedented action for farmers to take, as stated in 2016 Trends in Agricultural Land and Lease Values: California and Nevada, “Wonderful Orchards (formerly known as Paramount Farming) removed 10,000 acres of almonds in western Kern County, citing limited water resources and market factors” (Gatzman, 2016, p. 6).

According to the “Ground Water Resources” section of the *Substitute Environmental Document*, the 40 percent unimpaired flow rate would have significant and unavoidable impacts on groundwater resources in the Lower San Joaquin River area. The section specifically states that “the average annual groundwater balance could potentially be reduced by more than the equivalent of one inch in each of three sub basins (Modesto, Turlock, and Extended Merced)” (SWRCB, 2018, p. 9-4).

The “Agricultural Resources” section of the *Substitute Environmental Document* (SWRCB, 2018) provides context for yield reduction in almond production, as it relates to soil salinity and precipitation. It is anticipated that almond yields will decrease three percent with a 15 percent soil leaching factor and minimal precipitation, and one percent with median precipitation (p. 11-30).

The report does not provide any considerations for how tree crops would be affected by the general reduction in surface water availability or whether or not groundwater would be able to recuperate lost access to irrigation water. However, the general reduction in agricultural water and historic actions of farmers, could indicate that the reduced availability of water could lead to a reduction in tree crop acreage and production.

Summary of Impacts

The points raised by the Modesto Bee Editorial Board support their strong opposition to the California WaterFix project. In their editorial piece If Delta 'tunnels' are built, we're the biggest losers the board raised a series of concerns, many of which are substantiated or partially substantiated.

- The California WaterFix project does resemble the peripheral canal proposal of the 1980's. While the resemblance has no bearing on the impact of the project, it is worth noting that the canal was overwhelmingly not supported by Modesto voters.
- The issue of saltwater intrusion is raised with regards to reduced flows from the Sacramento River. The Editorial Board points out that increased flows from the San Joaquin River will be utilized to hold back brackish water from the bay. Delta history has indicated that reduced Delta outflows lead to increased saltwater intrusion into the Delta. Due to existing conditions in soil salinity and San Joaquin River salinity, that saltwater is transported into the western San Joaquin Valley. Current groundwater elevations in the Modesto Basin have stopped the salinity from the western San Joaquin and San Joaquin River from entering the basin, but increased groundwater pumping could reduce that gradient or pull up underlying saline water. While increased flows are helpful, reducing saltwater intrusion will also be dependent on water management practices and groundwater management.
- The issue of salmonid species protection is extremely complex and

difficult to assess. Scientific studies referenced in the editorial put less focus on the need for increased flows and instead point out that habitat restoration is more beneficial. While habitat is an important aspect of restoration, the studies do not necessarily deny flow rates as being an important aspect of salmonid species protection. The scientific paper referenced in the editorial indicates that pulse flows are a useful tool, but their benefit caps out at about 700 cfs, which is lower than the required 1000 cfs flow rate in the San Joaquin River at Vernalis. They indicate that populations do begin to decline over 700 cfs. Another study indicated that habitat restoration in the Delta and efforts to improve conditions throughout the salmon's lifecycle are integral to species survival.

- The impact with regards to hydropower was one of the most exaggerated points in the editorial piece. The Editorial Board asserts that power production will be heavily impacted if the dams don't have water behind them. While that may seem true on the surface, research into Modesto Irrigation District power generation sources show that only 14 percent of all of the power is generated by Don Pedro Dam, which is the only source that would be heavily impacted by the increased flow requirements. Assessment in the *Substitute Environmental Document* indicates that the 40 percent flow rate requirement will have a less-than-significant impact on the state grid.
- The issue of habitat restoration initiatives has no real measure of impact. The point raised by the Editorial Board is that, by not building the tunnels, the State could focus more on habitat restoration proj-

ects. Because there is no way to assess where State resources would be allocated in the absence of a project, there is no way to assess the validity of this statement.

- One of the most contentious issues raised in the *Water Quality Control Plan for the San Francisco Bay/San Joaquin Delta Estuary* and *Substitute Environmental Document* is the decrease in water availability. The SED estimates that surface water diversions will be reduced by 14 percent on the Tuolumne River. This reduction in surface water diversions would have a significant impact on both municipal and agricultural water supplies.
- Reduction in agricultural land value is also a reasonable possibility. The Editorial Board asserted that agricultural land in the area had higher rates than the rest of the state because of a history of water infrastructure investments. While that information had no data to corroborate it, it is true that agricultural land value is highly dependent on access to reliable water sources, and that a reduction in surface water diversions had the potential to decrease agricultural land values for properties associated with the MID system.
- The final point brought up by the editorial board is that groundwater supplies will not be sufficient in supporting the highly profitable tree crops in the region. Some recent incidents in the south Central Valley have indicated that farmers are feeling the strain of the lack of groundwater and began to remove tree crops. Increased groundwater pumping will be a result of the reduction in surface water diversion, and it is a possibility that tree crops will be less economically viable.


WATER WEALTH

Impacts on Modesto

The issues specific to the City of Modesto relate to water accessibility and the decrease in available water supply as the result of the implementation of the 40 percent unimpaired flow rate. Drawing from the previous discussion on the Editorial Board's comments, this section will specifically address the issues that would impact the municipality and community of Modesto.

The first major impact would be the reduction in available surface water diversions. As estimated in the *Substitute Environmental Document*, surface water diversions would be reduced by around 14 percent.

In the analysis of the 14 percent reduction in surface water availability, two different percentages were calculated to quantify the amount of the remaining surface water that would be needed to fulfill existing demand for both municipal and agricultural uses. The analysis found that the reduction in municipal water supply would not be too great, if it were not coupled with agricultural uses. For every year from 2010 to 2014, the percentage needed to address the agricultural water disparity was more than was present in the remaining water (i.e. above 100 percent) while the municipal water supply was well within the remaining values. This indicates that current demand could not be met with surface water supplies and other sources will be necessary (i.e. groundwater).

Should the 40 percent unimpaired flow rate go in to affect, there will be impacts on both municipal and agricultural water users. Because the reduction will not allow for the continuation of existing water use levels, water management, reduction, and sources outside of the Tuolumne River will need to be explored. These solutions each bring about their own considerations.

This is also of concern because of the investments that Modesto and the MID have made in reducing their reliance on groundwater. After the construction of the Modesto Regional Water Treatment Plant (MRWTP), groundwater pumping for municipal uses was significantly decreased. The Modesto Basin is also one of few basins in the Central Valley that is not currently in critical overdraft. Groundwater management has also been able to restrict saltwater intrusion into the Modesto Basin, due to the high groundwater elevations and positive gradient.

Increased groundwater pumping has many potential drawbacks. The MID itself has acknowledged that prolonged groundwater pumping is not a sustainable practice. Increased groundwater pumping also has the capability of increasing salinity in the Modesto Basin through many avenues. Saline water from the western San Joaquin Valley and San Joaquin River that is currently repelled by the positive gradient could be allowed to penetrate the Modesto Basin if increased pumping lowers elevations enough to diminish the gradient. Increased pumping could also cause the saline water underlying the Modesto Basin to be pulled upwards.

Reduced access to surface water could also have an impact on agricultural land values, as access to water is one of the driving factors behind land value. Increased reliance on groundwater could also lead to a decrease in tree crop production. According to the 2016 Stanislaus County Agricultural Report, fruit and nut crops were a 1.25 billion dollar industry in the County (2017, p. 10), and a reduction in tree crop acreage could greatly diminish that economic contribution to the County.

Conclusion

The Modesto Bee Editorial Board was correct in assessing that the California WaterFix Project and the corresponding *Water Quality Control Plan for the San Francisco Bay/San Joaquin Delta Estuary* and *Substitute Environmental Document* would have impacts on the City of Modesto and the surrounding agricultural land. The basis of these impacts is the implementation of the 40 percent unimpaired flow rate requirement on the Tuolumne River. The anticipation of a 14 percent reduction in surface water diversions on the Tuolumne River will definitely bring impacts to Modesto and the surrounding agricultural communities.

While the Editorial Board was correct about the impacts to water supply, decreases in agricultural land values, and groundwater supply; there were three issues that were not substantiated or relevant, one that was only partially substantiated, and one that had more implications to Modesto's water supply that the editorial gave it credit for.

The similarity to the peripheral canal and assertion that cancelling the project would lead to habitat restoration in the Delta both do not provide any insight into how the project will affect Modesto. The assertion of habitat restoration is also lacking any factual basis or indication that the Board's proposal was feasible or likely.

The claim of reduction in hydropower capability was not substantiated by data or analysis of the MID power generation system, as the Don Pedro Reservoir is the only power house on the Tuolumne River and analysis into the impacts found that the 40 percent unimpaired flow rate would have no significant

impacts on the power grid.

The methods of protecting salmon species were not fully addressed or appreciated by the Editorial Board. While peer-reviewed studies do indicate that habitat restoration and other actions are beneficial to salmon species survival, they do not negate the fact that flows are also of importance. The Board presented research which indicated that in the Stanislaus River, salmon species survival begins to decline after 700 cubic feet per second (cfs) flow rates (which is above the 1000 cfs requirement in the San Joaquin River as outline in the plan) but this research was conducted and analyzed specific to the Stanislaus River and may not be applicable to the San Joaquin River.

With regard to saltwater intrusion, the Board was correct in assessing that increased flows from the San Joaquin River would be needed to keep saline water from penetrating further into the Delta. However, there was no consideration for how water deliveries and water management practices could pose significant impacts on Modesto's water supply. While the Board posed the issues surrounding saltwater intrusion as being the increased demand from the San Joaquin River, there are many more considerations with relation to this issue that could pose serious impacts on Modesto's water supply, which were not discussed in the editorial.

The implementation of 40 percent unimpaired flow rates on the Tuolumne River would have significant impacts on the City of Modesto and the MID. After analysis of the proposed impacts raised by the Editorial Board, it was indicated that these impacts would pertain to saltwater intrusion, decreased municipal and agricultural water supply, decreased agricultural land values, and the potential for the reduction of tree crops due to groundwater availability.

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