Long-Term Operation – Final Environmental Impact Statement

Chapter 4 – Water Quality

November 2024

This page intentionally left blank.

Contents

Page

Chapter 4 Water Quality

This chapter is based on the background information and technical analysis documented in Appendix G, *Water Quality Technical Appendix*, which includes additional information on water quality conditions and technical analysis of the effects of each alternative.

4.1 Affected Environment

Changes in water quality due to changes in the Central Valley Project (CVP) and State Water Project (SWP) operation may occur in the Trinity River, Sacramento River, Clear Creek, American, Stanislaus, and San Joaquin rivers, San Francisco Bay/Sacramento–San Joaquin Delta (Bay-Delta), and the CVP/SWP service area (south to Diamond Valley).

The "Bay-Delta" region includes the legal Delta, Suisun Marsh, Suisun Bay, and San Francisco Bay. Primary factors affecting water quality in the Delta, Suisun Marsh, and Suisun Bay include patterns of land use in the upstream watersheds; inter-annual hydrologic variations; operations of the SWP, CVP, and flow control gates within the Delta and marsh; and activities and sources of pollutants within and upstream of these water bodies. Point and nonpoint pollutant sources include drainage from inactive and abandoned mines and related debris/sediment from headwaters, industrial and municipal wastewater treatment plant discharges, agricultural return flows, urban storm water runoff, atmospheric deposition, recreational uses, and metabolic waste from wildlife and livestock. Natural erosion, in-stream sediments, and atmospheric deposition also affect water quality. The magnitude of each source's effect correlates with the relative contribution from each source at a given location and can differ by constituent or with hydrologic and climatic conditions during different times of year, and from year to year.

The San Francisco Bay water quality is similarly affected by upstream land uses; hydrologic variations; pollutant source input from municipal wastewater discharges, agricultural return flows, urban runoff, and mining activities; and recreational uses. The northern and central portions of San Francisco Bay are strongly influenced by freshwater Delta inputs, whereas the southern portion of the bay is often dominated by ocean water and is generally isolated from the northern portion.

4.2 Effects of the Alternatives

The impact analysis considers changes in water quality conditions related to changes in CVP and SWP operation under the alternatives as compared with the No Action Alternative.

The No Action Alternative is based on 2040 conditions. Changes that would occur over that time frame without implementation of the action alternatives are not analyzed in this chapter. However, the changes to water quality that are assumed to occur by 2040 under the No Action Alternative are summarized in this section.

Conditions in 2040 would be different than existing conditions because of the following factors:

- Climate change and sea-level rise
- General plan development throughout California, including increased water demands in portions of the Sacramento Valley

In the long term, it is anticipated that climate change, and development throughout California, could affect water supply deliveries.

Under the No Action Alternative, Reclamation would continue with the current operation of the CVP, as described in the 2020 Record of Decision and subject to the 2019 Biological Opinions. The 2020 Record of Decision for the CVP and the 2020 Incidental Take Permit for the SWP represent current management direction or intensity pursuant to 43 CFR Section 46.30.

Although the No Action Alternative included habitat restoration projects at a programmatic level, the 2020 ROD did not provide environmental coverage for these projects, and all of the habitat projects considered under the No Action required or will require additional environmental documentation. Thus, ground disturbance for habitat restoration projects did not materialize as a result of implementing the No Action Alternative. For the purpose of the analysis, these habitat restoration projects are considered independent projects that will be considered under cumulative effects.

Under the No Action Alternative, land uses in 2040 would occur in accordance with adopted general plans, which could also result in impacts on water quality. In terms of CVP operations, under the No Action Alternative, by the end of September, the surface water elevations at CVP reservoirs generally decline. It is anticipated that climate change would result in more short-duration high-rainfall events and less snowpack in the winter and early spring months. As water is released in the spring, there would be less snowpack to refill the reservoirs. This condition would reduce flow within streams, potentially resulting in less dilution of constituents of concern. Since this water is delivered to reservoirs for storage in CVP and SWP reservoirs, concentrations of constituents of concerns in reservoirs may increase.

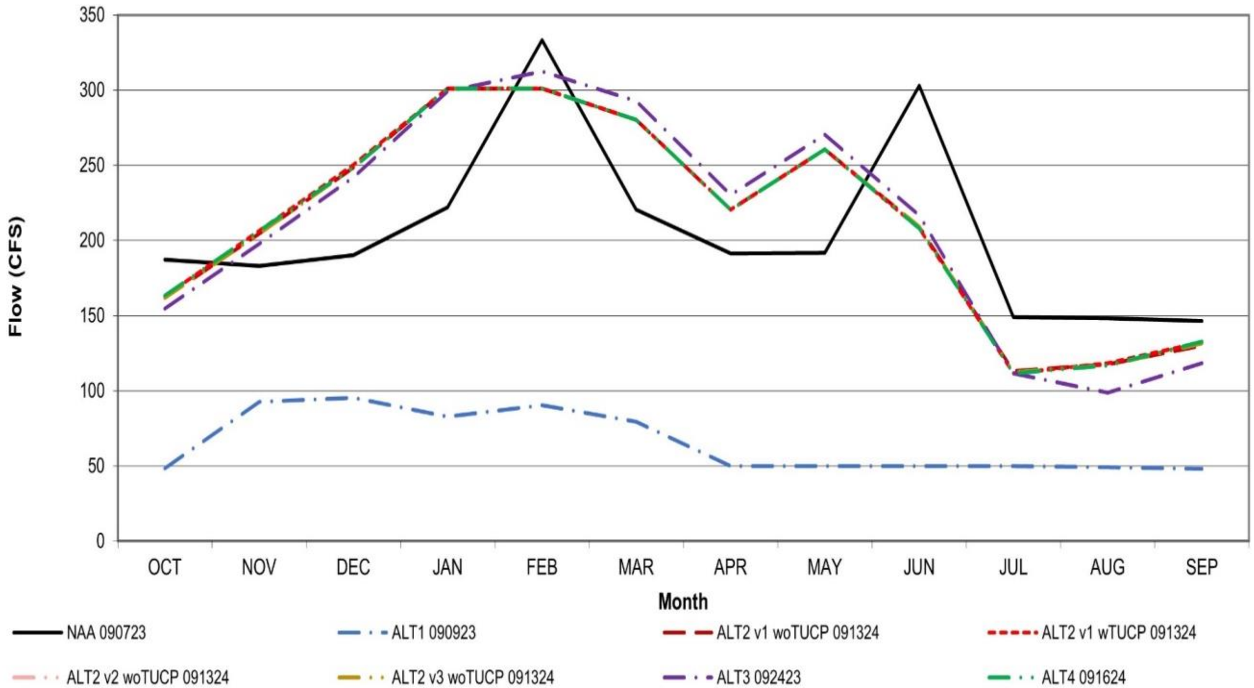
The No Action Alternative is expected to result in potential changes water quality at reservoirs that store CVP water, tributaries, and agricultural land. These changes were described and considered in the 2020 Long-Term Operation Record of Decision and associated documents.

4.2.1 Trinity, Sacramento, and American Rivers and Clear Creek

As documented in Appendix E, *Draft Alternatives*, Alternatives 1 through 4 would have limited changes in flows on the Trinity River compared with the No Action Alternative; therefore, changes in flows would have limited potential to affect water quality.

Under Alternative 1, long-term average flow changes on the Sacramento River are not expected to deviate substantially from the No Action Alternative. While Alternative 1 would create flow changes, including decreases of up to 20%, in the Sacramento River, the flow changes would largely occur during wet and above normal water years when base flow is adequate and decreases in flow are not expected to cause violations of water quality standards. Changes in flow in the Sacramento River under Alternatives 2, 3, and 4 generally increase in winter and early spring and decrease during the summer months. As flow increases are beneficial to water quality because it dilutes constituents of concern, flow decreases are not expected to be large enough to negatively impact water quality and increase the frequency of exceedances of water quality thresholds in the Sacramento River.

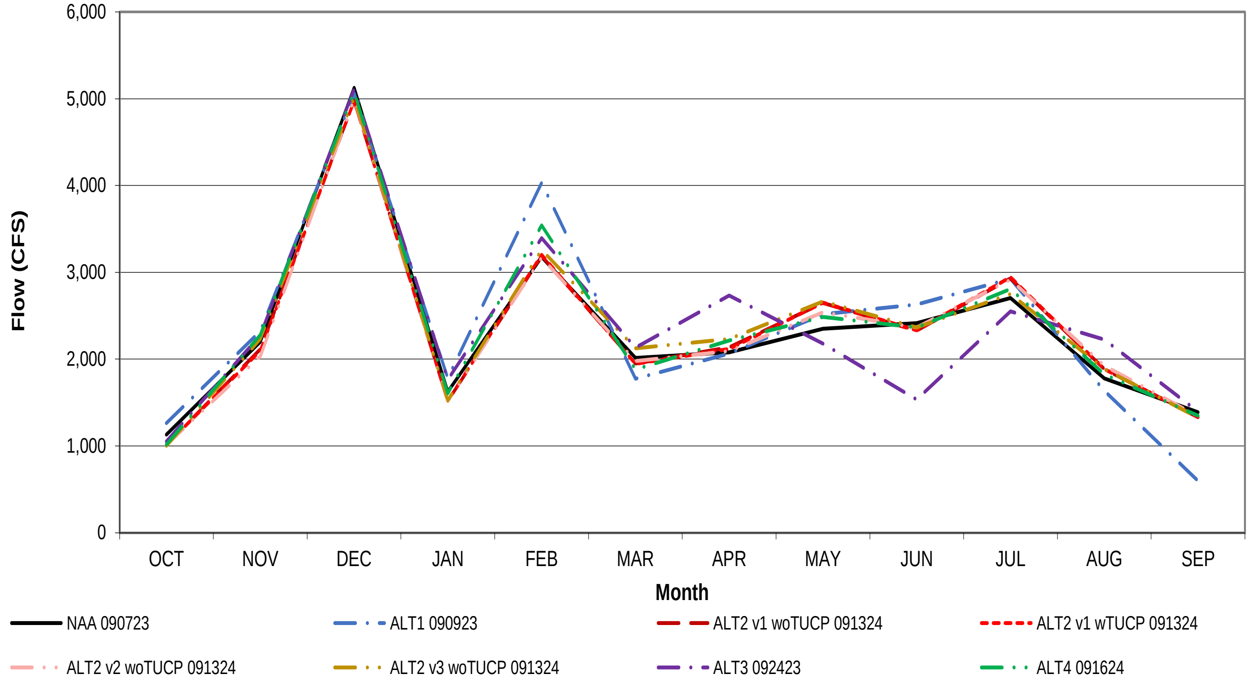
Flows in Clear Creek under Alternative 1 would decrease compared with the No Action Alternative because Alternative 1 does not include specific winter or spring pulse flows. It is expected that flows in Clear Creek would decrease in all months of all water year types, with a maximum average decrease of approximately 84% in June. Figure 4-1 illustrates changes in flow under all alternatives. Reductions in flow due to changes in the operations of CVP/SWP under Alternative 1 could result in less dilution causing increased concentrations of mercury within Clear Creek compared with the No Action Alternative. Changes in flow in Clear Creek under Alternatives 2, 3, and 4 would generally increase in the winter and spring months and decrease during the summer and fall months as compared with the No Action Alternative. Reductions in flow due to changes in the operations of CVP/SWP under Alternatives 2, 3, and 4 could result in less dilution causing increased concentrations of mercury within Clear Creek in certain months and year types compared with the No Action Alternative.



cfs = cubic feet per second;
NAA 090723 = No Action Alternative;
ALT1 090923 = Alternative 1 (Water Quality Control Plan);
ALT2 v1 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus without Temporary Urgency Change Petition);
ALT2 v1 wTUCP 091324 = Alternative 2 (Multi-Agency Consensus with Temporary Urgency Change Petition);
ALT2 v2 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = Early Implementation Voluntary Agreements);
ALT2 v3 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = All Voluntary Agreements);
ALT3 092423 = Alternative 3 (Modified Natural Hydrograph);
ALT4 091624 = Alternative 4 (Risk Informed Operations).
As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (State Water Resources Control Board 2000). These results are displayed with water year–year type sorting. These are draft results and meant for qualitative analysis are subject to revision.

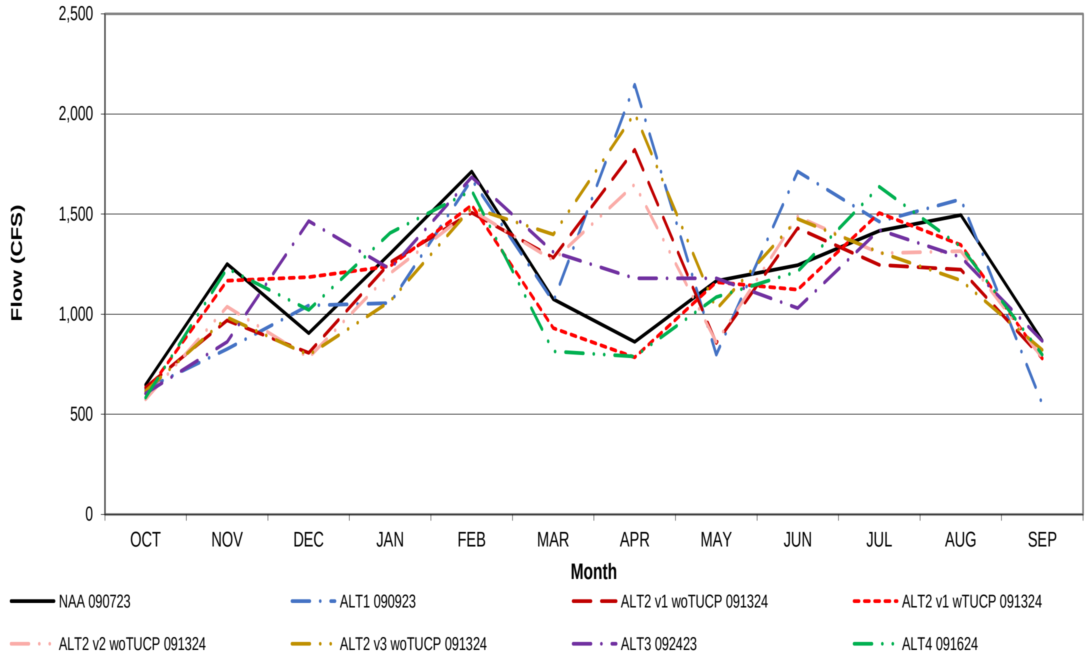
Figure 4-1. Clear Creek Flow below Whiskeytown, Long-Term Average Flow

Flows on the American River would differ from those under the No Action Alternative, with the largest flow increases and decreases under Alternatives 1, 2, and 4 in dry and critical years. Based on modeling, the maximum average increase in flows on the American River at H Street would be during critical water years under Alternative 2, when flows would be expected to increase by up to 132% in some months. The maximum average decrease in flows would be during September of dry water years under Alternative 1, when flows are expected to decrease by 57%. Alternative 3 would bypass 55% of unimpaired inflows to Folsom Reservoir from December through May, which may shift the timing of releases from Folsom Reservoir. The largest flow decreases would be in June of above normal water years and the largest flow increases would be in December of critical water years. Figures 4-2 and 4-3 illustrate flow changes on the American River at H Street under dry and critical years, respectively.



*As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (State Water Resources Control Board 2000)
*These results are displayed with water year – year type sorting.
*These are draft results and meant for qualitative analysis are subject to revision.
* cfs- cubic feet per second;
NAA 090723 = No Action Alternative;
ALT1 090923 = Alternative 1 (Water Quality Control Plan);
ALT2 v1 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus without Temporary Urgency Change Petition);
ALT2 v1 wTUCP 091324 = Alternative 2 (Multi-Agency Consensus with Temporary Urgency Change Petition);
ALT2 v2 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = Early Implementation Voluntary Agreements);
ALT2 v3 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = All Voluntary Agreements);
ALT3 092423 = Alternative 3 (Modified Natural Hydrograph);
ALT4 091624 = Alternative 4 (Risk Informed Operations).

Figure 4-2. American River at H Street, Dry Year Average Flow



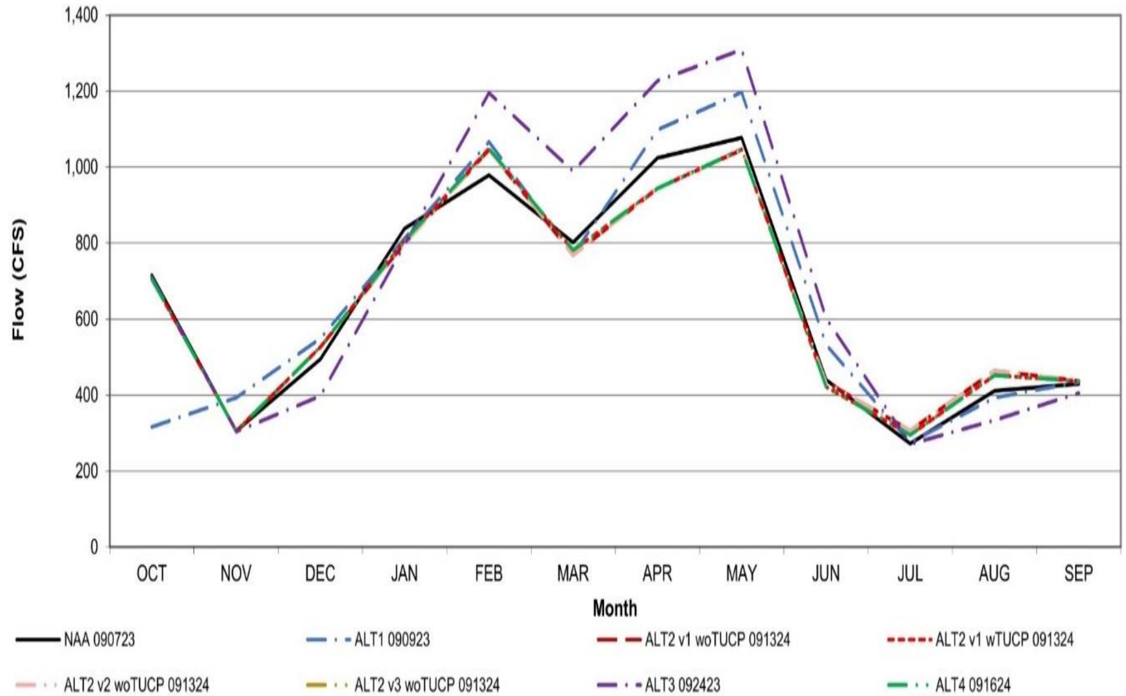
*As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (State Water Resources Control Board 2000)
*These results are displayed with water year – year type sorting.
*These are draft results and meant for qualitative analysis are subject to revision.
*cfs- cubic feet per second; NAA 090723 = No Action Alternative;
ALT1 090923 = Alternative 1 (Water Quality Control Plan);
ALT2 v1 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus without Temporary Urgency Change Petition);
ALT2 v1 wTUCP 091324 = Alternative 2 (Multi-Agency Consensus with Temporary Urgency Change Petition);
ALT2 v2 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = Early Implementation Voluntary Agreements);
ALT2 v3 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = All Voluntary Agreements);
ALT3 092423 = Alternative 3 (Modified Natural Hydrograph);
ALT4 091624 = Alternative 4 (Risk Informed Operations).

Figure 4-3. American River at H Street, Critical Year Average Flow

4.2.2 Stanislaus and San Joaquin Rivers

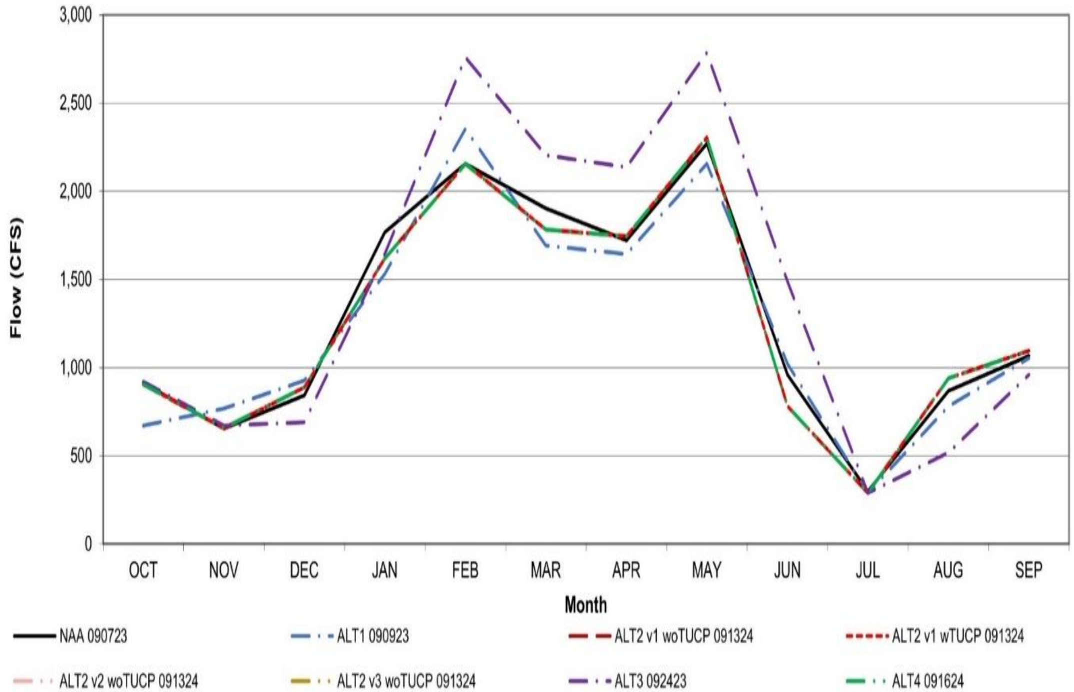
Alternatives 1 through 4 would cause changes in flow in some water year types on the Stanislaus River relative to the No Action Alternative. Figures 4-4 through 4-9 show changes in flow below Goodwin Dam across all water year types for all alternatives. Changes in flow at the mouth of Stanislaus River follow a similar trend but are generally smaller. Alternative 1 would change flows on the Stanislaus River, with the largest flow decrease (approximately 77%) in October of critical water years and the largest flow increase (approximately 74%) in November of below normal water years. Across all four phases of Alternative 2, changes in flow in the Stanislaus River below Goodwin Dam would generally decrease in October, January, and March through June, with flows increasing in all other months when compared with the No Action Alternative. Under Alternative 3, the largest flow decrease (approximately 37%) would be in December of below normal water years, and the largest flow increase (approximately 62%) would be in February of dry water years. Changes in flow under Alternative 4 would be similar to those under Alternative 2 because Alternative 4 includes the same minimum instream flow requirements, winter instability flows, and fall pulse flows.

As mentioned in Section G.1.7, *Stanislaus River*, there are several constituents of concern within the Stanislaus River, resulting in contamination in all reaches of the river. At times when flow increases, water quality could improve as more water is available to dilute pesticide runoff. Reductions in flow due to changes in the operations of CVP/SWP could result in less dilution causing increased concentrations of constituents of concern compared with the No Action Alternative.



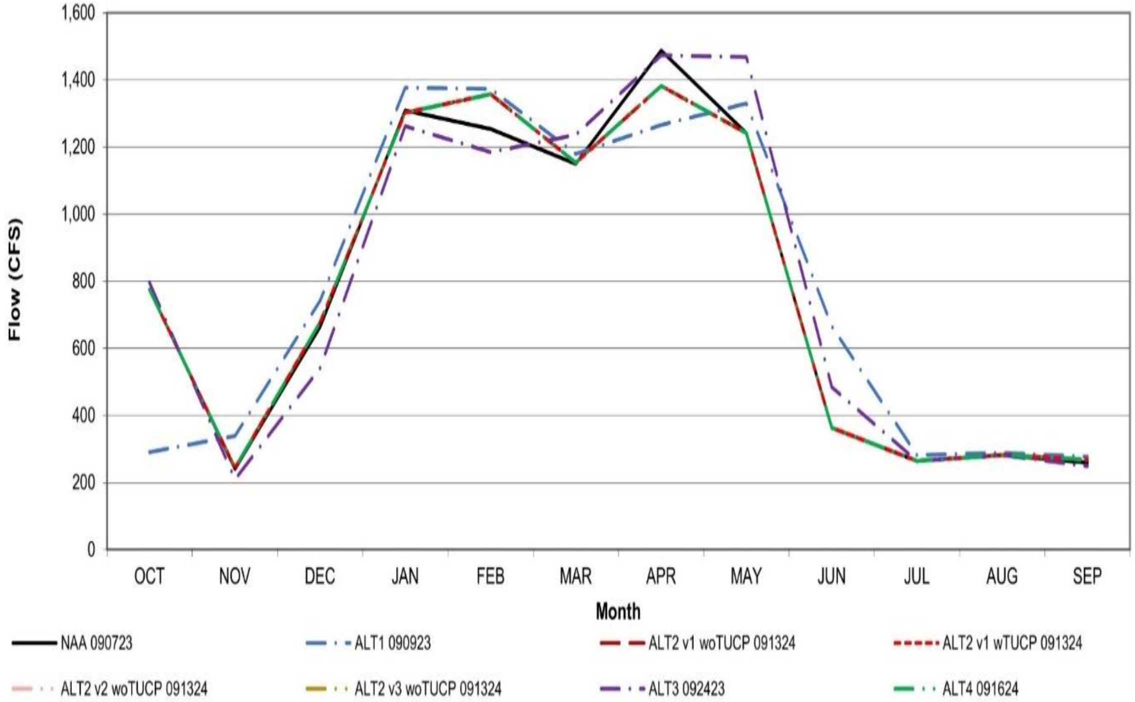
*As defined by the San Joaquin Valley 60-20-20 Index Water Year Hydrologic Classification (State Water Resources Control Board 2000)
*These results are displayed with water year – year type sorting.
*These are draft results and meant for qualitative analysis are subject to revision.
*cfs- cubic feet per second; NAA 090723 = No Action Alternative;
ALT1 090923 = Alternative 1 (Water Quality Control Plan);
ALT2 v1 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus without Temporary Urgency Change Petition);
ALT2 v1 wTUCP 091324 = Alternative 2 (Multi-Agency Consensus with Temporary Urgency Change Petition);
ALT2 v2 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = Early Implementation Voluntary Agreements);
ALT2 v3 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = All Voluntary Agreements);
ALT3 092423 = Alternative 3 (Modified Natural Hydrograph);
ALT4 091624 = Alternative 4 (Risk Informed Operations).

Figure 4-4. Stanislaus River Flow below Goodwin, Long-Term Average Flow



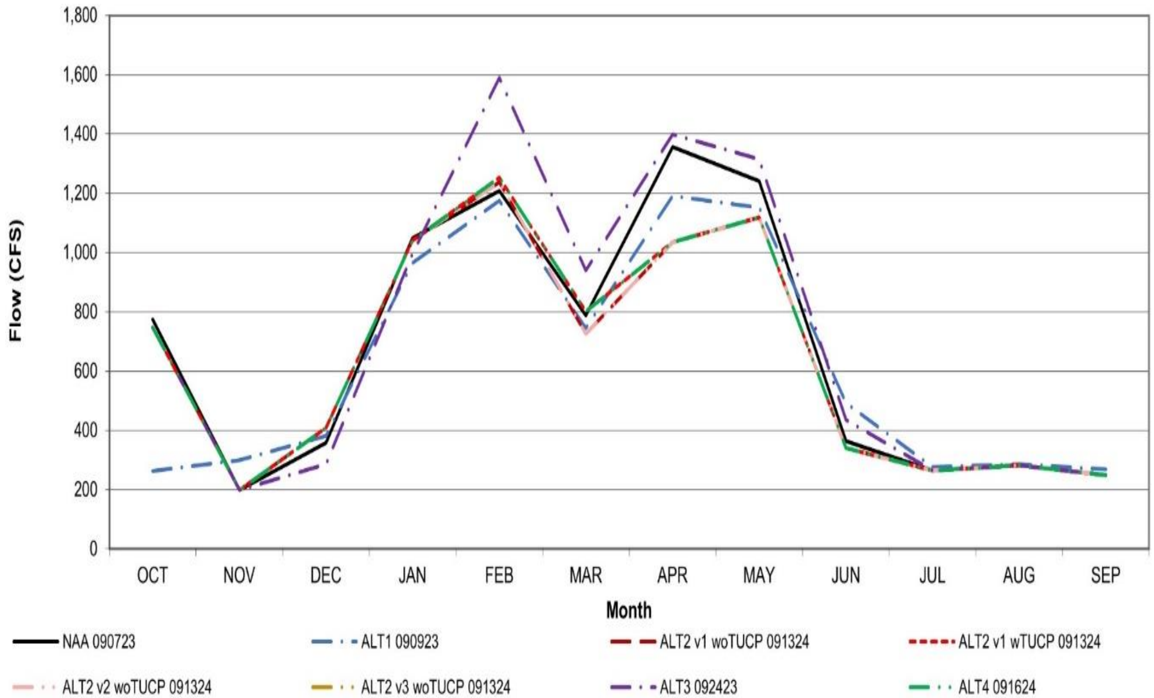
*As defined by the San Joaquin Valley 60-20-20 Index Water Year Hydrologic Classification (State Water Resources Control Board 2000)
*These results are displayed with water year – year type sorting.
*These are draft results and meant for qualitative analysis are subject to revision.
*cfs- cubic feet per second; NAA 090723 = No Action Alternative;
ALT1 090923 = Alternative 1 (Water Quality Control Plan);
ALT2 v1 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus without Temporary Urgency Change Petition);
ALT2 v1 wTUCP 091324 = Alternative 2 (Multi-Agency Consensus with Temporary Urgency Change Petition);
ALT2 v2 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = Early Implementation Voluntary Agreements);
ALT2 v3 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = All Voluntary Agreements);
ALT3 092423 = Alternative 3 (Modified Natural Hydrograph);
ALT4 091624 = Alternative 4 (Risk Informed Operations).

Figure 4-5. Stanislaus River Flow below Goodwin, Wet Year Average Flow



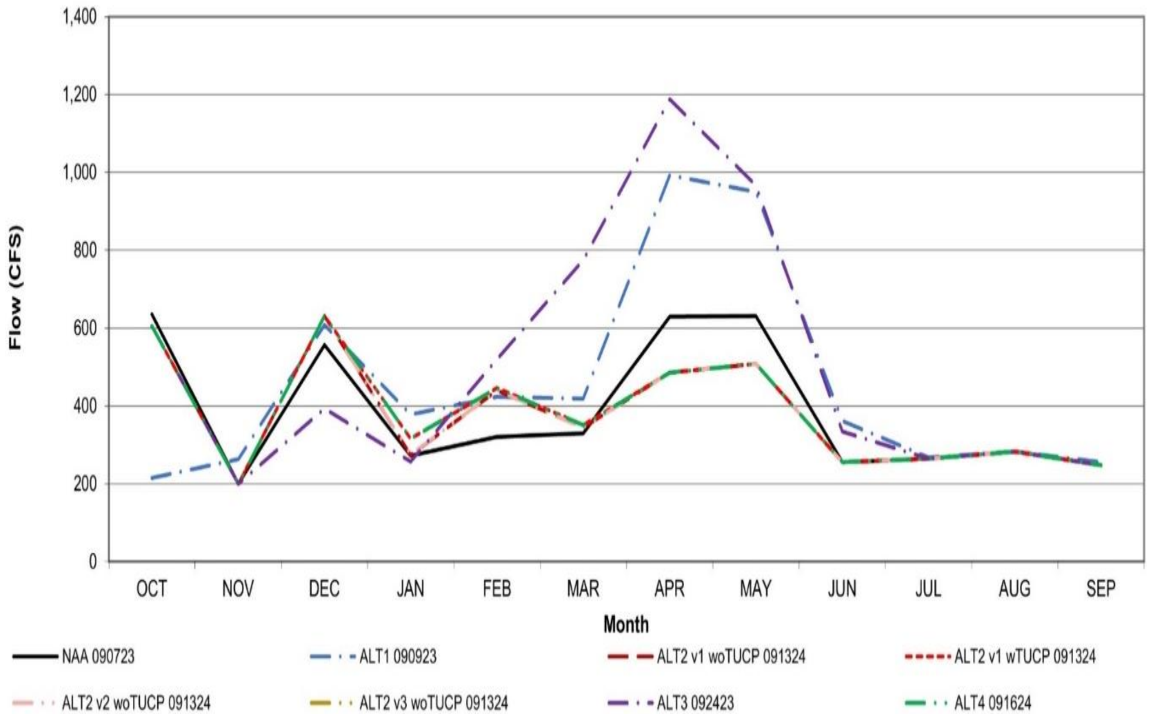
*As defined by the San Joaquin Valley 60-20-20 Index Water Year Hydrologic Classification (State Water Resources Control Board 2000)
*These results are displayed with water year – year type sorting.
*These are draft results and meant for qualitative analysis are subject to revision.
*cfs- cubic feet per second; NAA 090723 = No Action Alternative;
ALT1 090923 = Alternative 1 (Water Quality Control Plan);
ALT2 v1 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus without Temporary Urgency Change Petition);
ALT2 v1 wTUCP 091324 = Alternative 2 (Multi-Agency Consensus with Temporary Urgency Change Petition);
ALT2 v2 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = Early Implementation Voluntary Agreements);
ALT2 v3 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = All Voluntary Agreements);
ALT3 092423 = Alternative 3 (Modified Natural Hydrograph);
ALT4 091624 = Alternative 4 (Risk Informed Operations).

Figure 4-6. Stanislaus River Flow below Goodwin, Above Normal Year Average Flow



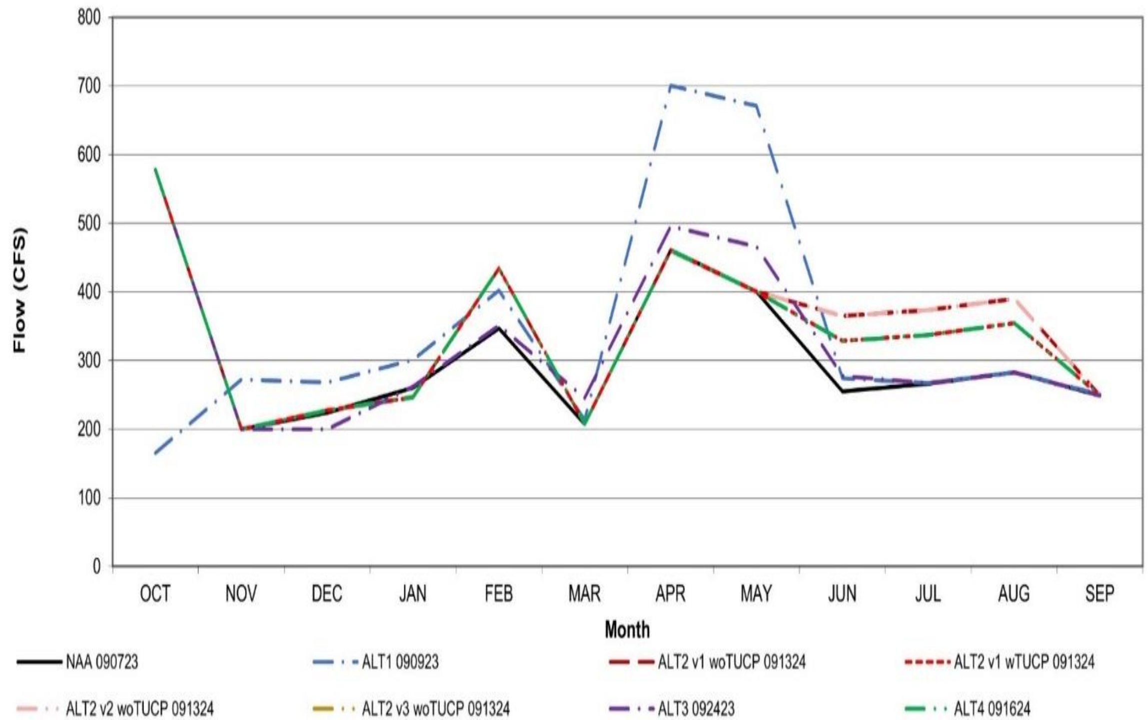
*As defined by the San Joaquin Valley 60-20-20 Index Water Year Hydrologic Classification (State Water Resources Control Board 2000)
*These results are displayed with water year – year type sorting.
*These are draft results and meant for qualitative analysis are subject to revision.
*cfs- cubic feet per second; NAA 090723 = No Action Alternative;
ALT1 090923 = Alternative 1 (Water Quality Control Plan);
ALT2 v1 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus without Temporary Urgency Change Petition);
ALT2 v1 wTUCP 091324 = Alternative 2 (Multi-Agency Consensus with Temporary Urgency Change Petition);
ALT2 v2 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = Early Implementation Voluntary Agreements);
ALT2 v3 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = All Voluntary Agreements);
ALT3 092423 = Alternative 3 (Modified Natural Hydrograph);
ALT4 091624 = Alternative 4 (Risk Informed Operations).

Figure 4-7. Stanislaus River Flow below Goodwin, Below Normal Year Average Flow



*As defined by the San Joaquin Valley 60-20-20 Index Water Year Hydrologic Classification (State Water Resources Control Board 2000)
*These results are displayed with water year – year type sorting.
*These are draft results and meant for qualitative analysis are subject to revision.
*cfs- cubic feet per second; NAA 090723 = No Action Alternative;
ALT1 090923 = Alternative 1 (Water Quality Control Plan);
ALT2 v1 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus without Temporary Urgency Change Petition);
ALT2 v1 wTUCP 091324 = Alternative 2 (Multi-Agency Consensus with Temporary Urgency Change Petition);
ALT2 v2 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = Early Implementation Voluntary Agreements);
ALT2 v3 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = All Voluntary Agreements);
ALT3 092423 = Alternative 3 (Modified Natural Hydrograph);
ALT4 091624 = Alternative 4 (Risk Informed Operations).

Figure 4-8. Stanislaus River Flow below Goodwin, Dry Year Average Flow



*As defined by the San Joaquin Valley 60-20-20 Index Water Year Hydrologic Classification (State Water Resources Control Board 2000)
*These results are displayed with water year – year type sorting.
*These are draft results and meant for qualitative analysis are subject to revision.
*cfs- cubic feet per second; NAA 090723 = No Action Alternative;
ALT1 090923 = Alternative 1 (Water Quality Control Plan);
ALT2 v1 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus without Temporary Urgency Change Petition);
ALT2 v1 wTUCP 091324 = Alternative 2 (Multi-Agency Consensus with Temporary Urgency Change Petition);
ALT2 v2 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = Early Implementation Voluntary Agreements);
ALT2 v3 woTUCP 091324 = Alternative 2 (Multi-Agency Consensus = All Voluntary Agreements);
ALT3 092423 = Alternative 3 (Modified Natural Hydrograph);
ALT4 091624 = Alternative 4 (Risk Informed Operations).

Figure 4-9. Stanislaus River Flow below Goodwin, Critical Year Average Flow

Flows in the San Joaquin River at Vernalis would remain similar between the No Action Alternative and Alternatives 1, 2, and 4. The small changes in flows under these alternatives would have minimal effect on the concentrations of constituents of concern. The greatest flow change in the San Joaquin River would be at Vernalis under Alternative 3, where flows would decrease by a maximum of 20%. This change in flow under Alternative 3 would not likely result in adverse effects on water quality nor an increase in the frequency of exceedances of water quality thresholds in the San Joaquin River.

4.2.3 Bay-Delta

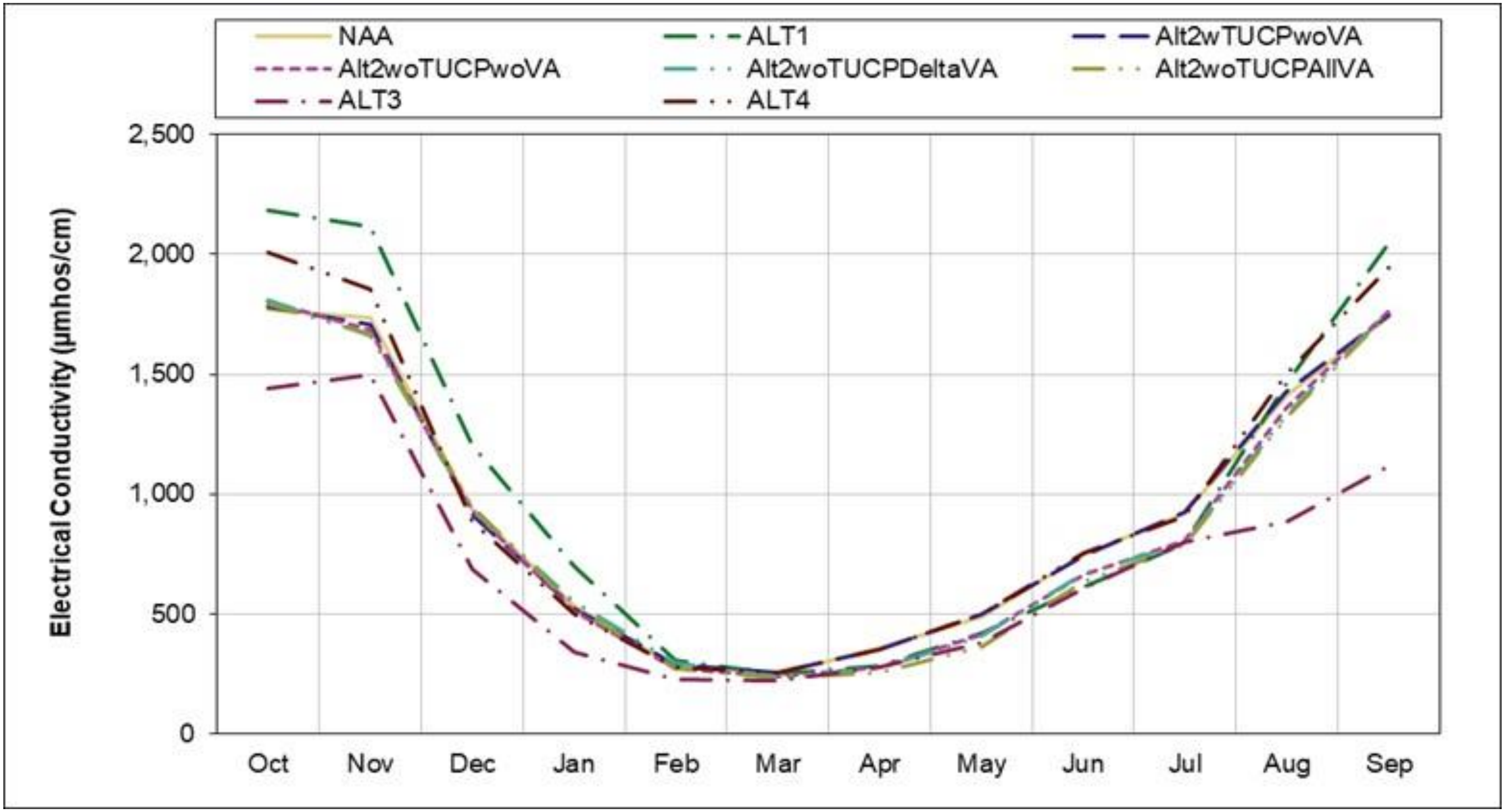
For most constituents and constituent groups of concern, water quality within the Delta, Suisun Marsh, Suisun Bay, and San Francisco Bay under the action alternatives would not differ substantially from the No Action Alternative or differ in a way that would contribute to adverse effects on beneficial uses compared with No Action Alternative conditions. The constituents for which there would be an appreciable difference in water quality under at least one of the action alternatives relative to the No Action Alternative are the salinity-related parameters electrical conductivity (EC), chloride, bromide, methylmercury, and cyanobacteria harmful algal blooms (CHABs).

4.2.3.1 Electrical Conductivity

Under Alternative 1, modeled monthly average EC levels are substantially higher in the San Joaquin River at Jersey Point, Prisoners Point and San Andreas Landing, and the Sacramento River at Emmaton and Threemile Slough are substantially higher in September, October and November compared with the No Action Alternative. Modeled EC levels at other Delta assessment locations are similar to the No Action Alternative. Modeled EC for the Suisun Marsh assessment locations is also higher in these months under Alternative 1. Alternative 2 modeled monthly average EC levels at Delta and Suisun Marsh assessment locations are similar to the No Action Alternative. Alternative 3 modeled EC is lower than No Action Alternative EC levels for western Delta locations and similar to the No Action Alternative for other Delta locations. Alternative 4 modeled EC is substantially higher in the San Joaquin River at Jersey Point and the Sacramento River at Emmaton in August through November compared the No Action Alternative. Modeled EC for the Suisun Marsh assessment locations is also higher in these months. No substantial differences in Suisun Bay or San Francisco Bay are expected with any of the alternatives.

An example of EC levels under the alternatives is shown in Figure 4-10. As shown in Figure 4-10, the modeled average EC levels under Alternative 1 in the Sacramento River at Emmaton for the full simulation period are approximately 100–400 µmhos/cm higher than the No Action Alternative in September through January. Conversely, under Alternative 3, modeled EC levels at Emmaton are approximately 300–600 µmhos/cm lower in September through November, on average, and lower in most months compared with the No Action Alternative. Modeled EC levels for Alternative 2 are similar to the No Action Alternative. Modeled EC levels for Alternative 4 are approximately 100–200 µmhos/cm higher in August through November compared to the No Action Alternative.

For all alternatives, the CVP/SWP would operate in real-time to meet the Bay-Delta Plan EC objectives, which aim to protect beneficial uses. Thus, these alternatives are not expected to contribute to salinity-related impairments.



*NAA- No Action Alternative; ALT1 090923- Alternative 1 (Water Quality Control Plan); ALT2 v1 woTUCP 090723- Alternative 2 (Multi-Agency Consensus without Temporary Urgency Change Petition); ALT2 v1 wTUCP 090723- Alternative 2 (Multi-Agency Consensus with Temporary Urgency Change Petition); ALT2 v2 woTUCP 090723- Alternative 2 (Multi-Agency Consensus- Early Implementation Voluntary Agreements); ALT2 v3 woTUCP 090723- Alternative 2 (Multi-Agency Consensus- All Voluntary Agreements); ALT3 092423- Alternative 3 (Modified Natural Hydrograph); ALT4 090823- Alternative 4 (Risk Informed Operations); µmhos/cm- micromhos per centimeter

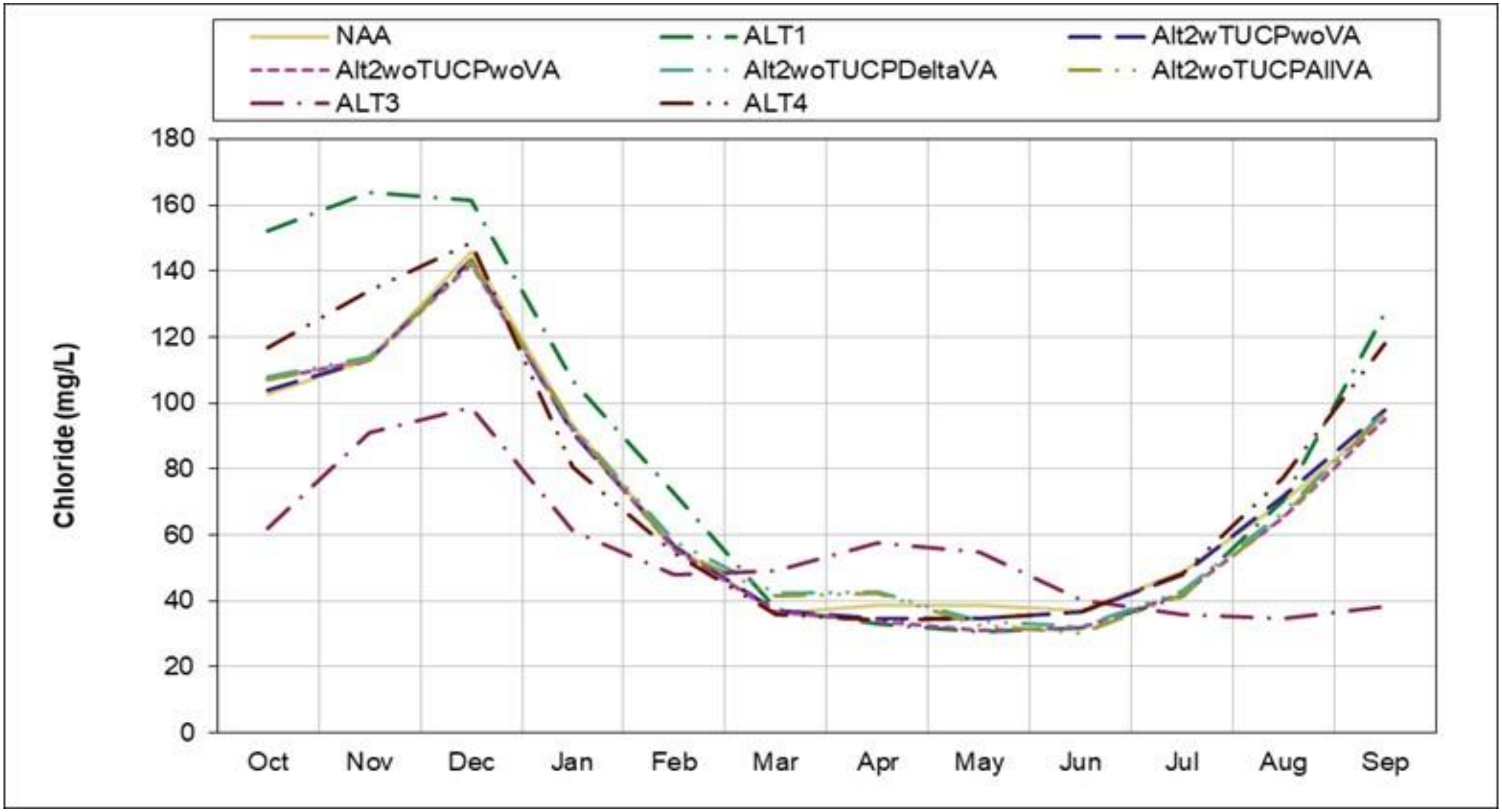
Figure 4-10. Long-Term Monthly Average EC for the Sacramento River at Emmaton for Water Years 1922–2021

4.2.3.2 Chloride

Under Alternative 1, modeled monthly average chloride concentrations at Contra Costa Pumping Plant #1 and San Joaquin River at Antioch are substantially higher in September, October and November compared with the No Action Alternative. Modeled chloride concentrations at other Delta assessment locations—Barker Slough, and Banks and Jones pumping plants—are more similar to the No Action Alternative under Alternative 1. For Alternative 2, modeled monthly average concentrations at the Delta assessment locations are similar to the No Action Alternative. For Alternative 3, modeled monthly average chloride concentrations are substantially lower than the No Action Alternative in the fall months and more similar to the No Action Alternative in other months. For Alternative 4, modeled monthly average concentrations in the San Joaquin River at Antioch are substantially higher in August through November compared to the No Action Alternative, moderately higher at Contra Costa Pumping Plant #1, and similar to the No Action Alternative at the other Delta assessment locations.

An example of chloride concentrations under the alternatives is shown in Figure 4-11. As shown in Figure 4-11, the modeled long-term average concentrations under Alternative 1 at Contra Costa Pumping Plant #1 for the full simulation period are approximately 30–50 mg/L higher than the No Action Alternative in September through November. Modeled chloride concentrations for Alternative 2 are similar to the No Action Alternative. Conversely, Alternative 3 modeled long-term average chloride concentrations are approximately 20–60 mg/L lower in September through November, and lower in most months compared with the No Action Alternative. Modeled chloride concentrations for Alternative 4 are approximately 10–20 mg/L higher in August through November compared to the No Action Alternative.

For all alternatives, the CVP/SWP would operate in real-time to meet the Bay-Delta Plan chloride objectives, which aim to protect beneficial uses. Thus, these alternatives are not expected to contribute to beneficial use impairments related to chloride.



*NAA- No Action Alternative; ALT1 090923- Alternative 1 (Water Quality Control Plan); ALT2 v1 woTUCP 090723- Alternative 2 (Multi-Agency Consensus without Temporary Urgency Change Petition); ALT2 v1 wTUCP 090723- Alternative 2 (Multi-Agency Consensus with Temporary Urgency Change Petition); ALT2 v2 woTUCP 090723- Alternative 2 (Multi-Agency Consensus- Early Implementation Voluntary Agreements); ALT2 v3 woTUCP 090723- Alternative 2 (Multi-Agency Consensus- All Voluntary Agreements); ALT3 092423- Alternative 3 (Modified Natural Hydrograph); ALT4 090823- Alternative 4 (Risk Informed Operations); mg/L- milligrams per liter

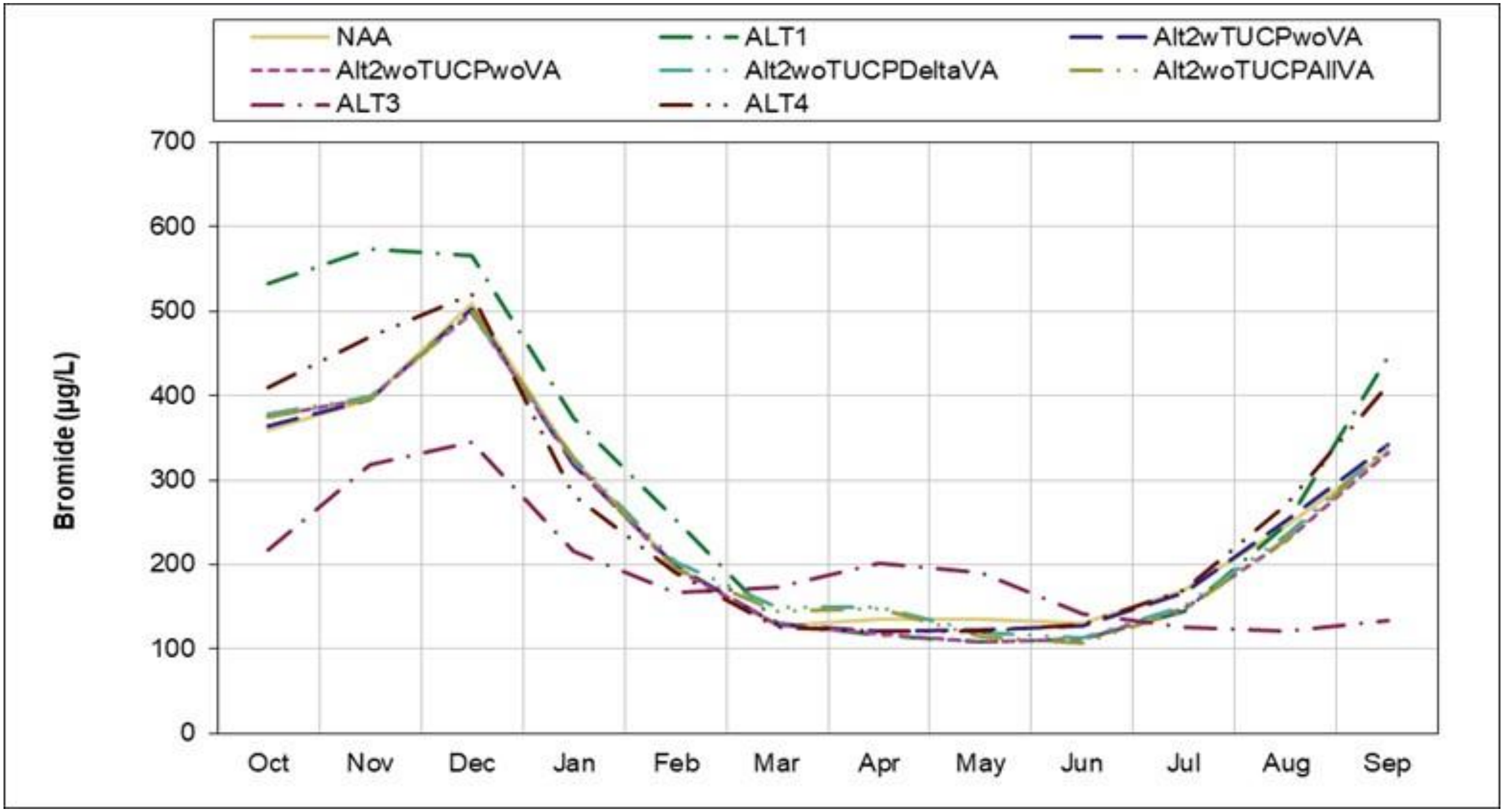
Figure 4-11. Long-Term Monthly Average Chloride for Contra Costa Pumping Plant #1 for Water Years 1922–2021

4.2.3.3 Bromide

Under Alternative 1, modeled monthly average bromide concentrations at Contra Costa Pumping Plant #1 and San Joaquin River at Antioch are substantially higher in September through February compared with the No Action Alternative. Modeled bromide concentrations at other Delta assessment locations—Barker Slough, and Banks and Jones pumping plants—are more similar to the No Action Alternative under Alternative 1. For Alternatives 2 and 4, modeled monthly average concentrations at the Delta assessment locations are similar to the No Action Alternative. For Alternative 3, modeled monthly average bromide concentrations are substantially lower than the No Action Alternative in the fall months and more similar to the No Action Alternative in other months.

An example of bromide concentrations under the alternatives is shown in Figure 4-12. As shown in Figure 4-12, the modeled long-term average concentrations under Alternative 1 at Contra Costa Pumping Plant #1 for the full simulation period are approximately 100–200 µg/L higher than the No Action Alternative in September through November, and 50 µg/L higher in December through February. Modeled bromide concentrations for Alternative 2 are similar to the No Action Alternative. Conversely, Alternative 3 modeled long-term average bromide concentrations are approximately 100–200 µg/L lower in September through January, and lower in most months compared with the No Action Alternative. Modeled bromide concentrations for Alternative 4 are approximately 20–80 µg/L higher in August through November compared to the No Action Alternative.

To meet current drinking water regulations for disinfection byproducts, bromide from 100 to 300 µg/l (and total organic carbon from 4 to 7 mg/l) is acceptable to provide users adequate flexibility in their choice of treatment method (Appendix G, Attachment 3, Section G3.3, *Applicable Water Quality Objectives*). The potentially higher bromide concentrations under Alternatives 1 and 4, relative to the No Action Alternative, could result in greater potential for disinfection byproduct formation in drinking water supplies that use Delta source waters, but the degree to which this would occur is uncertain. Treatment plants that use the Delta as a source for drinking water already experience highly variable bromide concentrations and, thus, must implement appropriate treatment technologies to ensure compliance with drinking water regulations for disinfection byproducts. However, the higher bromide concentrations under the Alternatives 1 and 4, relative to the No Action Alternative, at specific times and locations, are of a magnitude of concern such that they could contribute to drinking water impairments relative to those that would occur under the No Action Alternative.



*NAA- No Action Alternative; ALT1 090923- Alternative 1 (Water Quality Control Plan); ALT2 v1 woTUCP 090723- Alternative 2 (Multi-Agency Consensus without Temporary Urgency Change Petition); ALT2 v1 wTUCP 090723- Alternative 2 (Multi-Agency Consensus with Temporary Urgency Change Petition); ALT2 v2 woTUCP 090723- Alternative 2 (Multi-Agency Consensus- Early Implementation Voluntary Agreements); ALT2 v3 woTUCP 090723- Alternative 2 (Multi-Agency Consensus- All Voluntary Agreements); ALT3 092423- Alternative 3 (Modified Natural Hydrograph); ALT4 090823- Alternative 4 (Risk Informed Operations); µg/L- microgram per liter

Figure 4-12. Long-Term Monthly Average Bromide for Contra Costa Pumping Plant #1 for Water Years 1922–2021

4.2.3.4 Methylmercury

Water column methylmercury concentrations and methylmercury bioaccumulation in biota the Delta, Suisun Marsh, Suisun Bay, and San Francisco Bay would not be substantially affected and existing impairments would not be made worse relative to the No Action Alternative for Alternatives 1, 2, and 4. Modeled total methylmercury concentrations in largemouth bass fillets, presented in Table 4-1, show little difference for these alternatives compared with the No Action Alternative. For Alternative 3, modeled changes in total methylmercury concentrations at all Delta assessment locations indicate this alternative may result in increased Delta, Suisun Bay, and San Francisco Bay water column methylmercury concentrations that could substantially degrade water quality such that methylmercury bioaccumulation in biota the Delta, Suisun Bay, and San Francisco Bay may be affected, and existing impairments could be made worse relative to the No Action Alternative.

Table 4-1. Modeled Total Methylmercury Concentrations in Largemouth Bass Fillets (in milligrams per kilogram wet weight) at Delta Assessment Locations for the Full Simulation Period

Assessment Location	No Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
San Joaquin River at Empire Tract	0.78	0.76	0.78	0.82	0.78
Turner Cut	0.96	0.94	0.96	1.00	0.96
San Joaquin River at San Andreas Landing	0.61	0.60	0.61	0.63	0.61
San Joaquin River at Jersey Point	0.64	0.63	0.63 to 0.64	0.66	0.64
Victoria Canal	0.84	0.82	0.84 to 0.85	0.92	0.84
Sacramento River at Emmaton	0.60	0.60	0.60	0.61	0.60
San Joaquin River at Antioch	0.65	0.65	0.65	0.66	0.65
Montezuma Slough near Beldon Landing	0.73	0.79	0.73	0.74	0.73
Barker Slough at North Bay Aqueduct	0.74	0.75	0.75	0.75	0.75
Contra Costa Water District Pumping Plant #1	0.68	0.67	0.68 to 0.69	0.75	0.68
Banks Pumping Plant	0.83	0.80	0.83	0.90	0.82
Jones Pumping Plant	0.87	0.85	0.87	0.92	0.86

Values for Alternative 2 are a range for the four phases of Alternative 2: Alt2 With TUCP Without VA, Alt2 Without TUCP Without VA, Alt2 Without TUCP Delta VA, Alt2 Without TUCP Systemwide VA.

4.2.3.5 Cyanobacteria Harmful Algal Blooms

Alternatives 1, 2, and 4 would not have substantial increased risk of increased CHABs in the Delta, Suisun Marsh, Suisun Bay, and San Francisco Bay relative to the No Action Alternative. For Alternative 3, there could be increased risk of CHABs in the Delta and Suisun Marsh. This increased risk is associated with lower summer Delta inflows, which may result in lower residence times, making conditions more conducive to CHABs. There is no increased risk of CHABs in Suisun Bay and San Francisco Bay relative to the No Action Alternative for Alternative 3.

4.3 Mitigation Measures

Appendix D includes a detailed description of mitigation measures identified for water quality resources per alternative. These mitigation measures include avoidance and minimization measures that are part of each alternative and, where appropriate, additional mitigation to lessen impacts of the alternatives. An additional mitigation measure for water quality resources is identified: Mitigation Measure WQ-1: Develop a water quality mitigation and monitoring program.

4.3.1 Avoidance and Minimization Measures

4.3.1.1 Alternatives 1-4

For water quality, avoidance and minimization measures generally include measures identified for aquatic resources. These measures include water temperature and storage management, minimum instream flows, pulse flows, turbidity management, increase delta outflow, salinity management.

4.3.2 Additional Mitigation

4.3.2.1 Alternative 1

Alternative 1 could increase concentrations of constituents of concern compared with the No Action Alternative.

- *Mitigation Measure WQ-1: Develop a water quality mitigation and monitoring program* - could be implemented to reduce impacts

4.3.2.2 Alternative 2

Same as Alternative 1.

4.3.2.3 Alternative 3

Same as Alternative 1.

4.3.2.4 Alternative 4

Same as Alternative 1.

4.4 Cumulative Impacts

The No Action Alternative would continue with the current operation of the CVP and may result in potential changes in water quality at reservoirs that store CVP water, tributaries, and agricultural land. The action alternatives will result in changes to water quality at reservoirs that store CVP water, tributaries, and agricultural land. The magnitude of the changes is dependent on alternative and water year type. Therefore, the No Action Alternative and action alternatives may contribute to cumulative changes to water quality as described in Appendix G, *Water Quality* and Appendix Y, *Cumulative Impacts Technical Appendix*.