Continuous Water Quality Monitoring Report for Water Year 2023

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Introduction

The Department of Water Resources (DWR) and the US Bureau of Reclamation (USBR) are required by Water Right Decision 1641 (D-1641) to collect continuous water chemistry data to monitor the water quality at select sites in the upper San Francisco Estuary (Estuary). This report describes the results of these monitoring efforts for water year 2023 (October 1st 2022 through September 30th 2023) which was classified as a wet year in the Sacramento and San Joaquin Valleys (source). Results are compared to the previous water year, which was classified as critically dry in both valleys.

Methods

Discrete water quality samples were collected monthly at 24 monitoring sites throughout the Upper Estuary and were grouped into regions based on their geographic location . These sites represent a variety of aquatic habitats, from narrow, freshwater channels to broad, estuarine bays.

Water quality data was continuously monitored at 15 sites throughout the Upper Estuary and were grouped into regions based on their geographic location (Figure 1; Table 1). These sites represent a variety of aquatic habitats, from narrow, freshwater channels to broad, estuarine bays. **Note**: CEMP's Sherman Island station (SSI), which was called D11A in previous reports, has been renamed D22A to better reflect it's location in relation to historical station D22.

Data were collected for six water quality parameters. All water samples were collected 1-meter below the water surface using a float-mounted YSI EXO2 multi-parameter water quality sonde. These parameters are:

- Water Temperature (°C)
- Specific Conductance (S/cm)
- Dissolved Oxygen (mg/L)
- pH
- Turbidity (FNU)
- Fluorescence (g/L)

Regional facet graphs were created for each parameter. The average, minimum, and maximum values were determined for parameter, both overall and per region. Average summary statistics are reported as the mean ( ) ± the standard deviation.

For more in-depth methodology, see here.

Results

Water Temperature

The average water temperature value was 15.90 ± 5.19 °C; for comparison, the previous year average was 18.00 ± 5.11 °C. Values ranged from 7.32 °C to 26.90 °C. Per region average, minimum, and maximum values are shown in Table 2; time series plots are shown in Figure 2.

Specific Conductance

The average specific conductance value was 3070 ± 6140 µS/cm; for comparison, the previous year average was 5470 ± 7800 µS/cm. Values ranged from 68 µS/cm to 31600 µS/cm. Per region average, minimum, and maximum values are shown in Table 3; time series plots are shown in Figure 3.

Dissolved Oxygen

The average dissolved oxygen value was 9.16 ± 1.04 mg/L; for comparison, the previous year average was 8.97 ± 1.14 mg/L. Values ranged from 5.86 mg/L to 12.00 mg/L. Per region average, minimum, and maximum values are shown in Table 4; time series plots are shown in Figure 4.

Stockton Station DO Values

C-EMP monitors DO at the Stockton Ship channel to determine if/when it fall below limits established by the CVRWQCB (1998). For the months that coincide with the passage of fall-run Chinook salmon (October, November, and September), values fell below the 6 mg/L limit in October. For all other months, values did not fall below the 5 mg/L limit. A boxplot of the DO values is shown in Figure 5.

pH

The average pH value was 7.64 ± 0.26; for comparison, the previous year average was 7.87 ± 0.32. Values ranged from 6.90 to 9.38. Per region average, minimum, and maximum values are shown in Table 5; time series plots are shown in Figure 6.

Turbidity

The average turbidity value was 19.90 ± 22.30 FNU; for comparison, the previous year average was 14.70 ± 16.50 FNU. Values ranged from 0.20 FNU to

201.00 FNU. Per region average, minimum, and maximum values are shown in Table 6; time series plots are shown in Figure 7.

Chlorophyll *a* Fluorescence

The average fluorescence value was 3.48 ± 2.96 µg/L; for comparison, the previous year average was 2.86 ± 1.76 µg/L. Values ranged from 0.34 µg/L to 34.50 µg/L. Per region average, minimum, and maximum values are shown in Table 7; time series plots are shown in Figure 8.

Interpretations

Water Year 2023 began as a continuation of the preceding three years of drought conditions, but a deluge of atmospheric rivers beginning in late December and continuing through March brought high amounts of precipitation and a massive snowpack, which resulted in WY 2023 ultimately being classified as Wet.

The extreme precipitation events and snowpack runoff led to a considerable drop in specific conductivity in the Delta. The low values persisted through WY 2023 in the Interior Delta regions, with the western regions of Grizzly/Suisun and the Confluence beginning to show a marine influence in July. Cooler than average air temperatures at the start of the water year and runoff from the record snowpack resulted in much cooler water average temperatures. The Water Year 2023 average was 2.1 ^{o}C cooler than the critically dry Water Year 2022. High flows created by the winter storms resulted in high turbidity in January with maximum values in all regions exceeding 100 FNU. A smaller spike in turbidity occurred in March also due to storm runoff.

References

[CVRWQCB] Central Valley Regional Water Quality Control Board. (1998). Water Quality Control Plan for the California Regional Water Quality Control Board Central Valley Region, the Sacramento River Basin, and San Joaquin River Basin [Basin Plan] (4th ed.).

[SWRCB] State Water Resources Control Board. (1995). Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Estuary [Bay-Delta Plan] (Adopted May 22, 1995, pursuant to Water Right Order 95-1). Sacramento, CA.

[SWRCB] State Water Resources Control Board. (1999). Water Rights Decision 1641 for the Sacramento-San Joaquin Delta and Suisun Marsh (Adopted December 29, 1999, Revised in Accordance with order WR2000-02 March 15, 2000). Sacramento, CA.

Archived Reports

Old EMP continuous water quality reports can be found here.

Figures

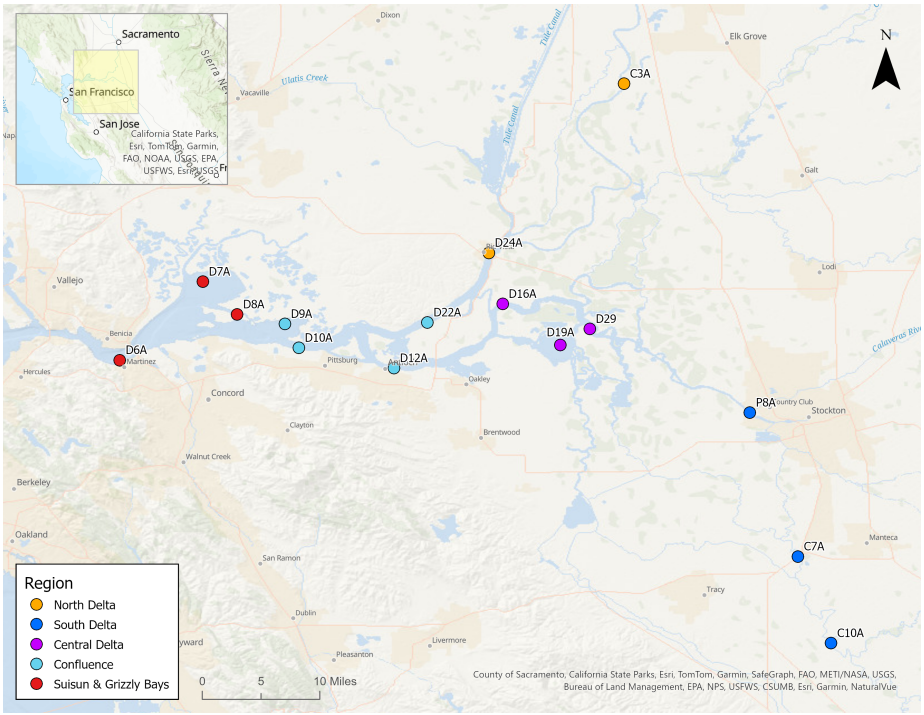

Figure 1: Map of EMP's continuous WQ field sites

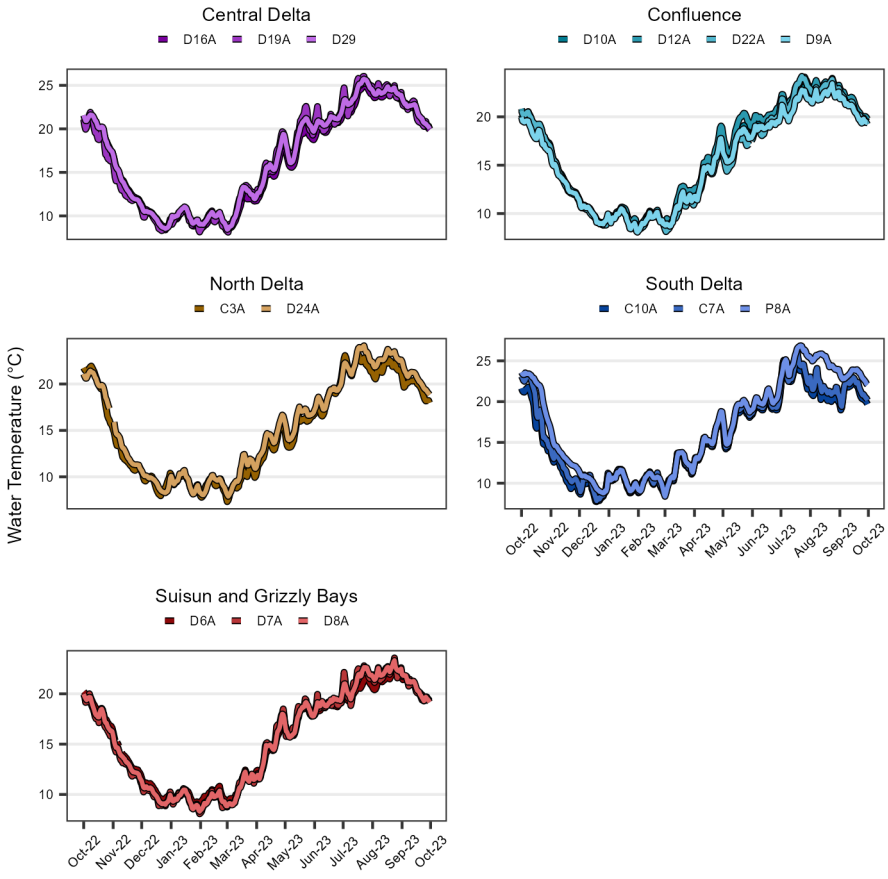

Figure 2: Water temperature by region in the San Francisco Bay-Delta estuary.

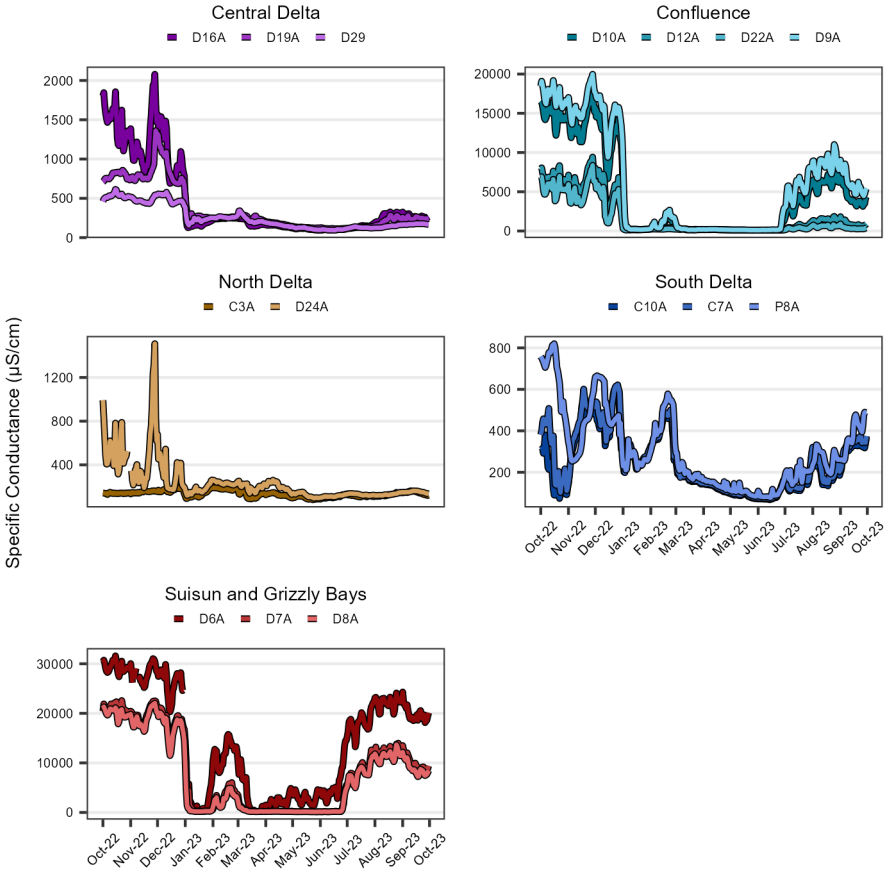

Figure 3: Specific conductance by region in the San Francisco Bay-Delta estuary.

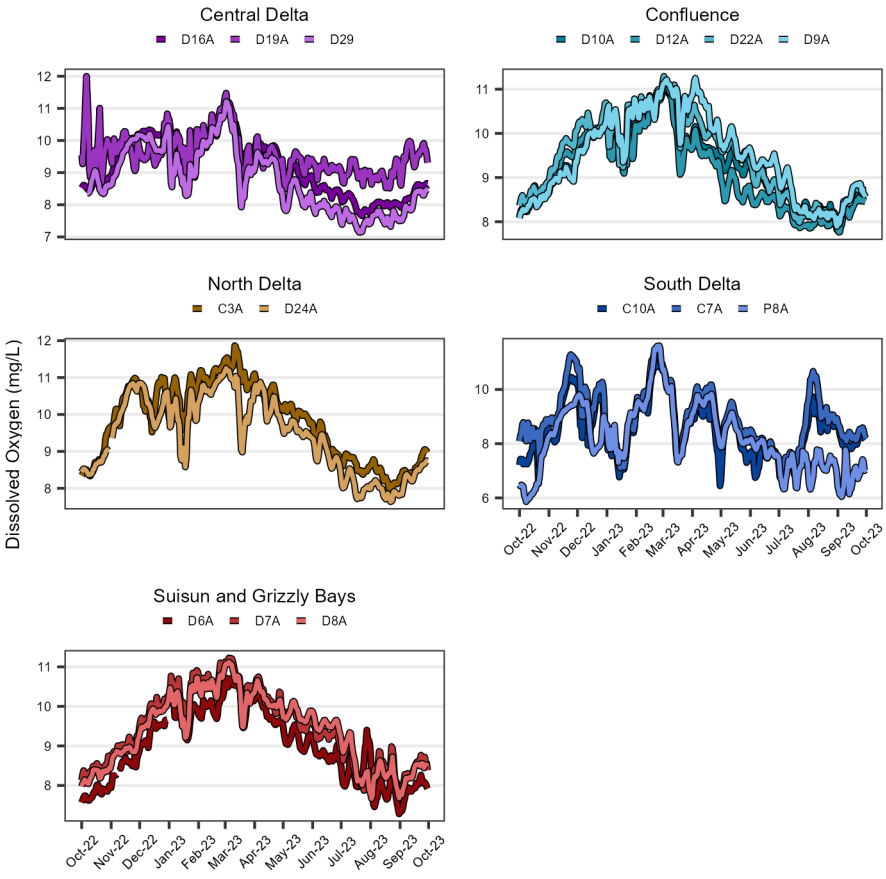

Figure 4: Dissolved oxygen by region in the San Francisco Bay-Delta estuary.

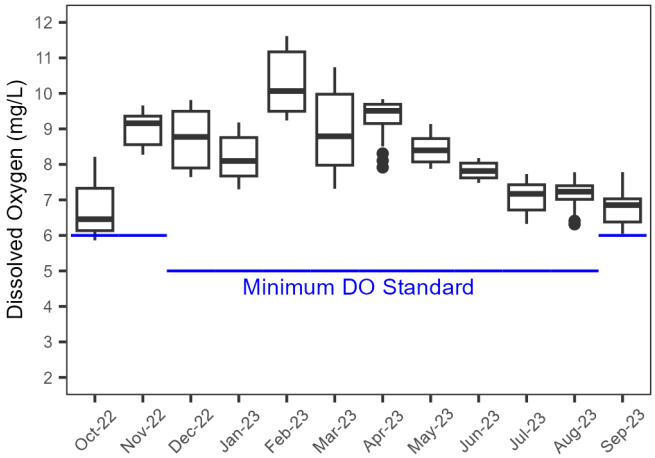

Figure 5: Range of daily dissolved oxygen values at the Stockton Ship Channel (P8).

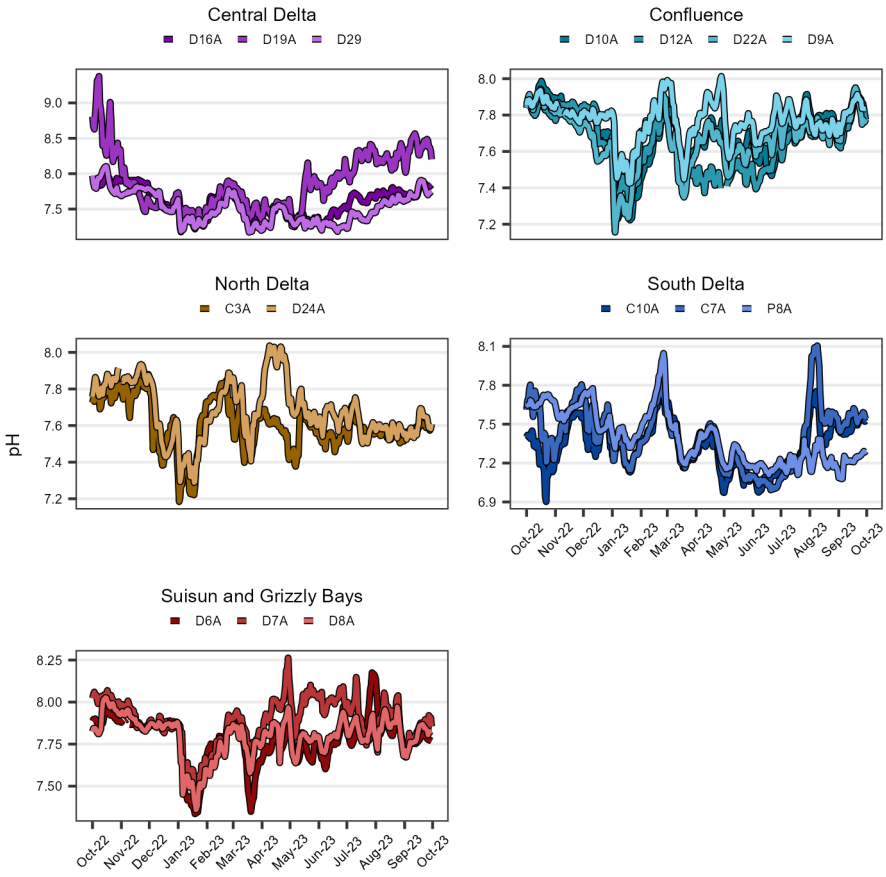

Figure 6: pH by region in the San Francisco Bay-Delta estuary.

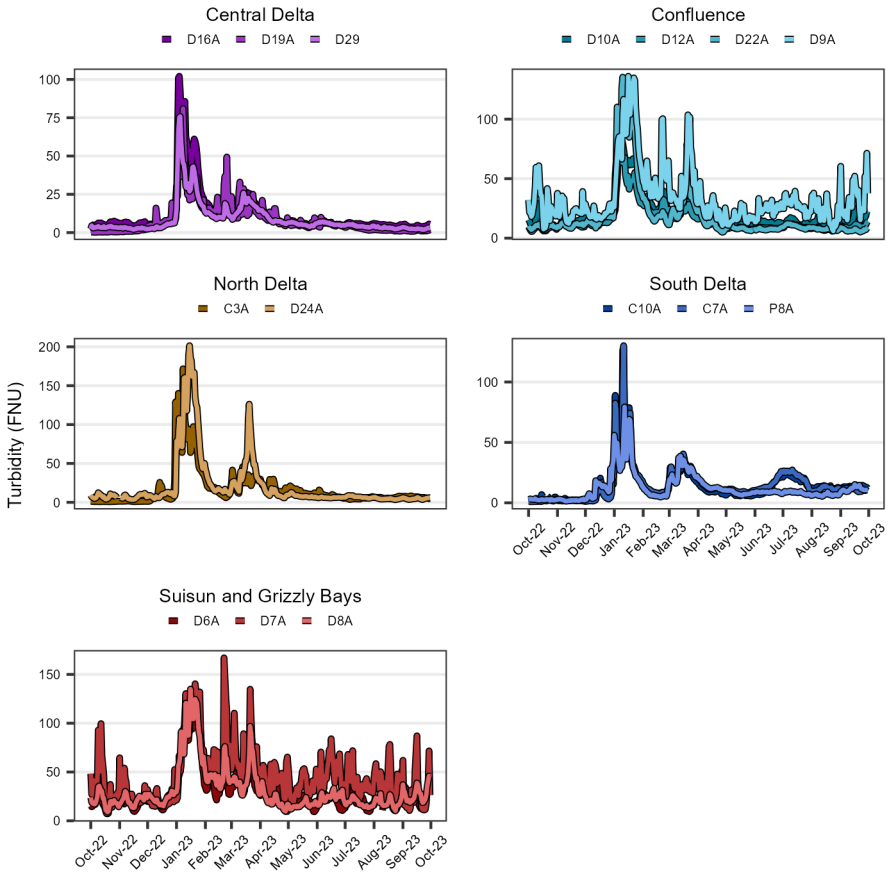

Figure 7: Turbidity by region in the San Francisco Bay-Delta estuary.

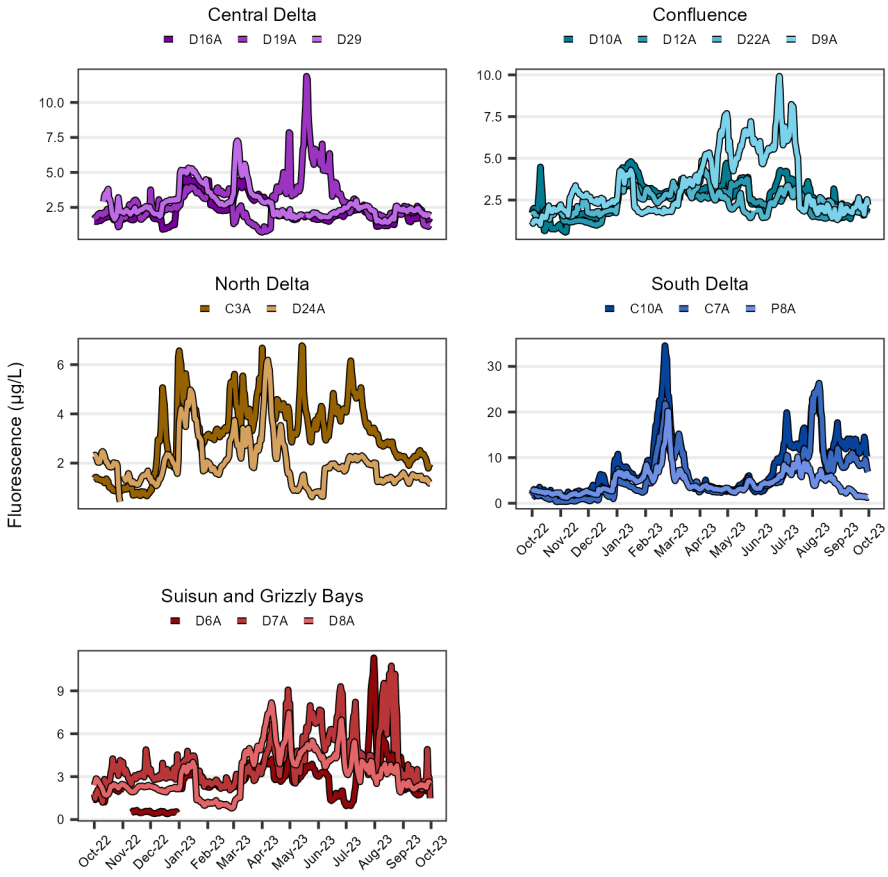

Figure 8: Chlorophyll a fluorescence by region in the San Francisco Bay-Delta estuary.

Table 1: Continuous WQ stations included within each region of the Delta

Region	WY Index	Stations
Central Delta	San Joaquin	D16A, D19A, D29
Confluence	Sacramento	D9A, D10A, D12A, D22A
North Delta	Sacramento	C3A, D24A
South Delta	San Joaquin	C7A , C10A, P8A
Suisun and Grizzly Bays	Sacramento	D6A, D7A, D8A

Table 2: Summary statistics for water temperature by region in the San Francisco Bay-Delta estuary.

Statistic	Central Delta	Confluence	North Delta	South Delta	Suisun and Grizzly Bays
Average	16.50	15.80	15.20	16.30	15.60
Min	8.12	8.06	7.32	7.73	8.07
Max	26.00	24.20	24.10	26.90	23.60

Tables

Table 3: Summary statistics for specific conductance by region in the San Francisco Bay-Delta estuary.

Statistic	Central Delta	Confluence	North Delta	South Delta	Suisun and Grizzly Bays
Average	355	3530	181	266	9930
Min	93	90	81	68	118
Max	2080	20000	1510	820	31600

Table 4: Summary statistics for dissolved oxygen by region in the San Francisco Bay-Delta estuary.

Statistic	Central Delta	Confluence	North Delta	South Delta	Suisun and Grizzly Bays
Average	9.17	9.32	9.62	8.55	9.27
Min	7.14	7.76	7.64	5.86	7.28
Max	12.00	11.30	11.90	11.60	11.20

Table 5: Summary statistics for pH by region in the San Francisco Bay-Delta estuary.

Statistic	Central Delta	Confluence	North Delta	South Delta	Suisun and Grizzly Bays
Average	7.67	7.70	7.64	7.38	7.82
Min	7.17	7.16	7.18	6.90	7.34
Max	9.38	8.01	8.04	8.11	8.26

Table 6: Summary statistics for turbidity by region in the San Francisco Bay-Delta estuary.

Statistic	Central Delta	Confluence	North Delta	South Delta	Suisun and Grizzly Bays
Average	9.66	21.80	18.60	13.70	34.80
Min	0.20	4.93	0.82	0.93	7.12
Max	102.00	136.00	201.00	130.00	167.00

Table 7: Summary statistics for chlorophyll a fluorescence by region in the San Francisco Bay-Delta estuary.

Statistic	Central Delta	Confluence	North Delta	South Delta	Suisun and Grizzly Bays
Average	2.64	2.68	2.62	6.10	3.34
Min	0.72	0.57	0.43	0.34	0.40
Max	11.90	9.92	6.77	34.50	11.30