Memo: Decommissioning Real-Time Water Quality Monitoring Stations GZM and GZB

Michelle Nelson and Vivian Klotz

Estuarine Monitoring Research and Reporting Branch

Division of Integrated Science and Engineering

Department of Water Resources

Final 4/16/2025

Background

The Department of Water Resources conducts real-time, continuous (15-minute) water quality monitoring throughout the Sacramento-San Joaquin Delta and Suisun Marsh to comply with a variety of mandates, including Water Rights Decision 1641 (D1641), and the State Water Project Incidental Take Permit and Biological Opinion. The 2020 Incidental Take Permit (ITP) for the State Water Project mandated the installation of three additional real-time water quality monitoring stations in Grizzly Bay to improve measurement of salinity and assess the effect of the summer-fall Suisun Marsh Salinity Control Gate (SMSCG) action on habitat conditions in Grizzly Bay (COA 9.1.3.3). The three installed stations were Grizzly Bay Mouth (GZM), Grizzly Bay Buoy (GZB) and Tule Red Breach (TRB).

Prior to the 2020 ITP, the existing monitoring network included several stations in and around Grizzly Bay. Two of the new ITP stations were near two existing stations. GZM was placed 1.8 km away from Hunter Cut (HUN), which supports the Delta Smelt Summer-Fall Habitat Action as required by the State Water Project ITP and Biological Opinion. GZB was placed 2.7 km away from Grizzly Bay Pile (GZL), which is mandated by D1641 (Figure 1).

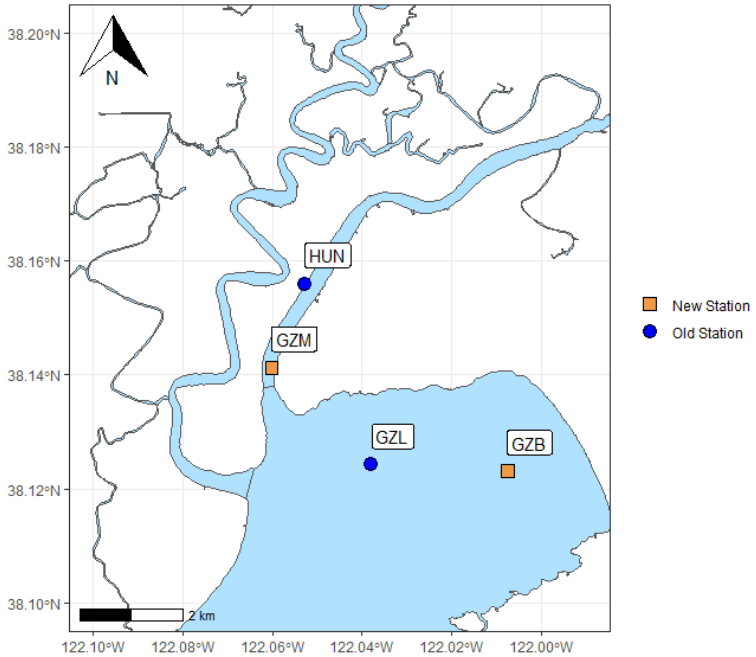


Figure 1. Locations of stations in Grizzly Bay.

Maintenance Challenges

HUN and GZL are constructed as permanent, fixed infrastructure: the water quality instruments, and associated telemetry equipment are affixed to piles driven into the earth. Acquiring the proper permits to drive new piles into a public waterway is extremely costly and time-consuming, so DWR opted to install GZM and GZB as telemetered buoys. Buoy stations are more challenging to maintain than pile sites, which leads to safety and data-quality challenges. Table 1 shows that buoy stations have a larger proportion of poor quality data than pile stations.

With the constant movement of both the water quality instrument and the associated telemetry equipment, there is a higher incidence of wires loosening and moisture intruding into the buoy, which can compromise data. Servicing the buoys when telemetry problems arise is nearly impossible when the buoys are still in the water, so the buoys need to be retrieved to work on the delicate electronics inside the buoy wells. Due to the weight and the size of these buoys, a large vessel is required, but their location in shallow bays only allows vessels with shallow draft depths. Tethering the boat to the buoy while servicing the station created safety concerns, as these independently moving, heavy objects moved in unpredictable ways.

Each of the stations has their own acute issues, too. On one occasion, the strong winds and currents at GZM snapped the wire tethering the buoy to the anchor, leaving the station adrift. GZB, which is in the shallows of Grizzly Bay, can only be serviced on high tides of non-windy days. On many instances, runs were cancelled when, upon reaching the field site, staff found that the winds were much stronger than the forecast predicted, leading to an inability to safely service the station and thus more unreliable data when sonde exchanges could not be performed.

Table 1. Percentage of 2022 specific conductance data marked with a "good" QA/QC flag, out of a possible 35,040 specific conductance readings per station.

Station Name	GZM	HUN	GZB	GZL
Station Type	Buoy	Pile	Buoy	Pile
Percent Good Data	95.6%	97.3%	91.2%	99.9%

Analysis

To assess the difference between data provided by the new stations (GZM, GZB) and existing stations (HUN, GZL), during Summer-Fall Habitat Actions, we extracted and conducted quality control procedures on all specific conductance data from 2018-2024 for all four stations. Station GZB was temporarily established in 2018 to test the effectiveness of the 2018 SMSCG action before being permanently installed in 2021. Station GZM was installed in 2021. We focused our analysis on specific conductance since the ITP requirement was put in place to improve our understanding of salinity dynamics during operation of the SMSCGs. Based on visual inspection of the time series of specific conductance (Figure 2), we hypothesized that there would be no significant difference in information collected by the individual sondes in each pair.

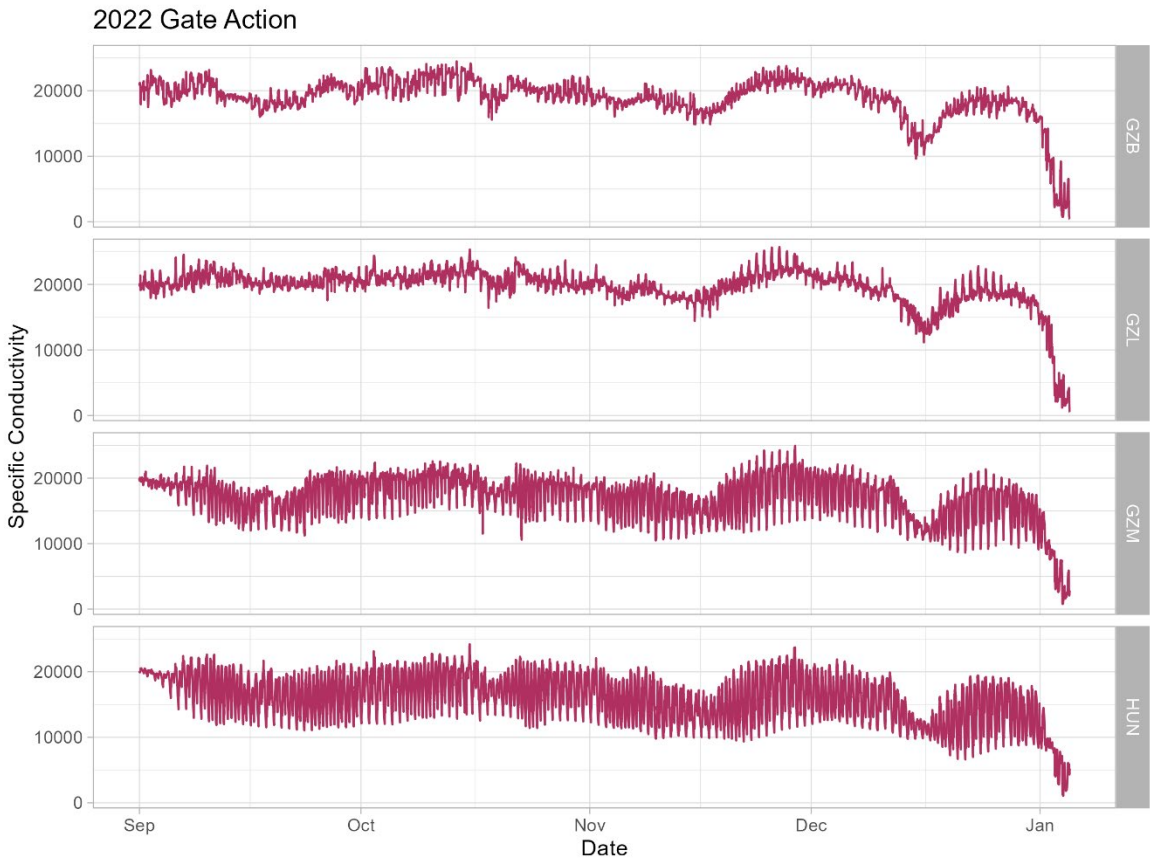


Figure 2. Comparison of the specific conductance data from all four sites during the 2022 Gate Action.

We calculated the daily mean specific conductance, then subsetted the data to July 1-October 31, the period of the summer SMSCG action. We only included data from days when both sondes in the pair were operational (sondes on buoy stations experienced several interruptions in service due to logistical constraints). This left us with 439 days of data from GZB/GZL and 530 days from GZM/HUN.

For each pair of stations, we conducted a linear model using the formula: SPC_t = Station + SPC_{t-1} , where SPC is the specific conductance on day *t* and SPC_{t-1} is the specific conductance on the previous day. The previous day's conductance was included to account for the temporal autocorrelation. Models were checked for residual autocorrelation, normality of residuals, homogeneity of variance, and outliers. There was minor deviation from normality of residuals, but all other assumptions were met, so deviation from normality should not unduly bias the results. All analyses were conducted using R 4.4.2.

The model comparing specific conductance between GZB and GZL found that, on average, SPC at GZL was slightly higher than at GZB, but only by 37.5 uS/cm, and not significantly so ($P > 0.05$, Table 1). The overall model had an adjusted R-squared of 0.938, f-statistic of 6577 on 2 and 867 degrees of freedom, $P < 0.0001$.

The model comparing specific conductance between GZM and HUN found that, on average, SPC at GZB was slightly higher than at HUN, but only by 25.2 uS/cm, and not significantly so ($P > 0.05$,

Table 1). The overall model had an adjusted R-squared of 0.964, f-statistic of 14040 on 2 and 1050 degrees of freedom, P < 0.0001.

Table 12. Results of two linear models, the first one comparing mean daily specific conductance at GZB versus GZL with station and the previous day's specific conductance as predictors. The second model performs the same analysis on GZM and HUN.

Pair	Term	Estimate	Std. Error	t value	Pr(>|t|)	Sig
GZB/GZL	Intercept - GZB	556.6	143.50	3.879	0.000113	***
	GZL	37.5	108.50	0.346	0.72972	
	SPC(t-1)	1.0	0.01	114.488	<0.0001	***
GZM/HUN	Intercept - GZM	411.25	101.12	4.067	<0.0001	***
	HUN	-25.24	74.55	-0.339	0.735	
	SPC(t-1)	0.98	0.01	167.307	<0.0001	***

Recommendations

Due to the similarity between the data collected at the buoy sites in relation to each corresponding nearby pile site, the difficulty of maintaining the buoy stations, and the greater percentage of good data at the pile sites than at the buoy sites, we recommend that all instrumentation: YSI EXO2 sondes, telemetry equipment, buoys, anchors, etc. from GZM and GZB be removed from Grizzly Bay. The Water Quality Assessment (WQA) Unit will collaborate with Continuous Environmental Program (CEMP) staff to use the *R/V Sentinel*, plus an additional support vessel if needed, to remove the aforementioned instrumentation. WQA staff will QA/QC the data, and the cleaned data will be made available to any interested parties or regulatory authorities. The analysis detailed above was presented at the 2025 IEP Workshop.