Morro Bay Estuary Bacteria and Dissolved Oxygen Analysis
Water Year 2019

Date Range: Water Year 2019 (October 1, 2018 to September 30, 2019)
Analytes: Dissolved Oxygen, *Enterococcus spp.*

Background

The Morro Bay National Estuary Program's Monitoring Program conducts monitoring in the Morro Bay estuary and watershed to track ambient water quality trends and to assess the impacts of specific implementation projects.

Monitoring data is collected by Estuary Program staff and volunteers, under the guidance of a Quality Assurance Project Plan (QAPP) which is reviewed and approved by the EPA and the State Water Resources Control Board. This quality control document contains the monitoring locations, protocols, equipment specifications, and other details that allow users to assess the quality of the collected data. The full QAPP is available upon request.

Bay Bacteria

The Estuary Program's goal for bay bacteria monitoring is to assess the safety of the bay shoreline waters for recreational contact. Since 2005, program volunteers have sampled monthly at eight bay shoreline sites and analyzed the samples for the indicator bacteria enterococcus. The samples are collected using sterile technique and analyzed by volunteers at the Morro Bay-Cayucos Wastewater Treatment Plant lab using the IDEXX method.

Enterococcus Monitoring Specifications

Specification	Value
Method	IDEXX Enterolert
Detection Range	10 to 24,190 MPN/100 mL
Hold Time	24 hours
Sample storage conditions	4°C in the dark

To ensure data quality, volunteers analyze blanks to check for sterility, split samples to check for precision, and certified reference materials to check for accuracy.

For this analysis, a random value between 0.1 and 10 was assigned for all samples that had a result of <10 MPN/100mL, which is the detection limit for this method. This approach affects the calculated geomeans for past years and thus, graphs will not match previous reports. This method of handling non-detect data is utilized by the Central Coast Regional Water Quality Control Board (CCRWQCB) in their own analysis.

Monitoring Locations: The eight bay shoreline monitoring sites were selected because they represent the areas with the most recreational contact. The sites are (from north to south) Coleman Beach (site code COL), Tidelands Park (TID), Windy Cove (WIN), State Park Marina (SPM), Pasadena Point (PAS), Baywood Pier (BAY), Cuesta Inlet (CIN), and Sharks Inlet (SIN).

The following map indicates the monitoring locations.

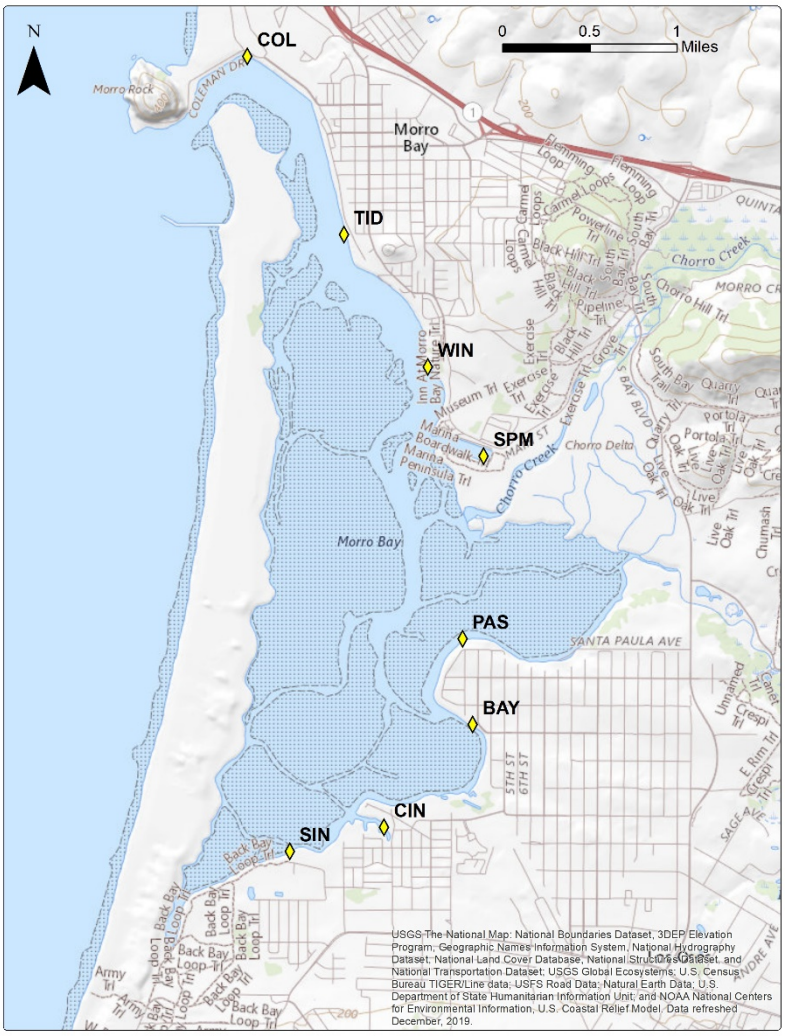

Figure 1: Locations of shoreline bacteria monitoring sites in the Morro Bay estuary.

Results:

Indicator bacteria data shows how often the waters in specific locations along the bay shoreline have levels greater than those safe for recreational contact.

The following graph (Figure 2) shows the percent of samples from Water Year 2019 (WY2019) that exceeded the Statistical Threshold Value (STV) criteria. Ideally, no more than 10% of samples exceed this value of 110MPN/100mL. This guiding value is from the State Water Resources Control Board's Bacterial Objectives and is lower than the previous EPA guiding value of 130MPN/100mL.

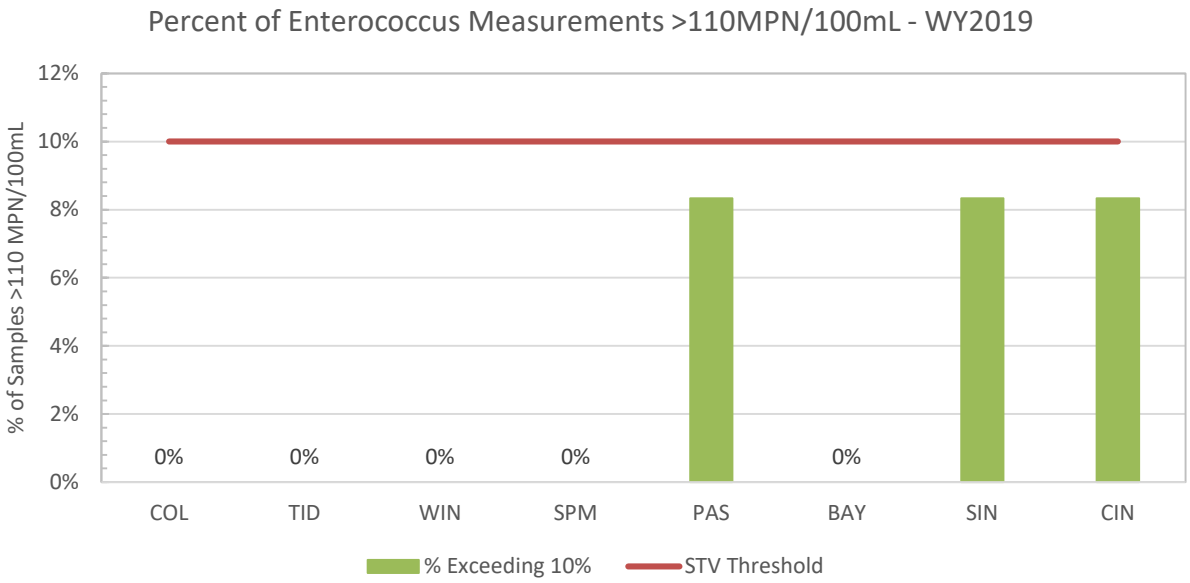

Figure 2: Percent of Enterococcus measurements greater than 110 MPN/100 mL for WY2019.

The following graph (Figure 3) shows the geomean of all WY2019 data for each site. Ideally the sample geomean remains below the guideline of 30 MPN/100mL. This guideline is from the State Water Resources Control Board's Bacterial Objectives. This is lower than the previous guideline of 35 MPN/100mL.

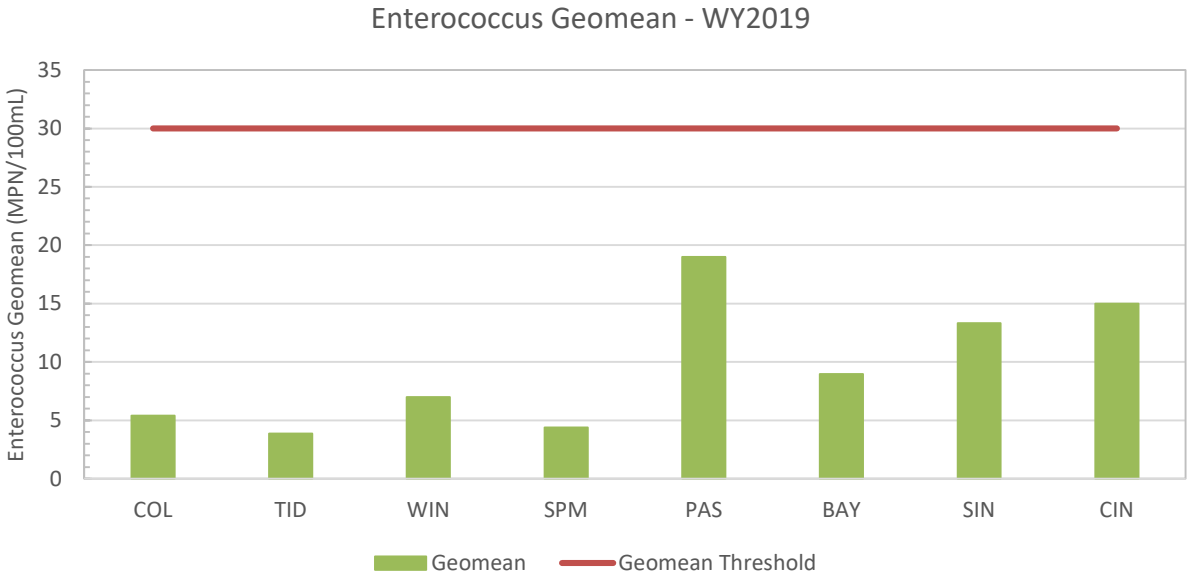

Figure 3: Geomean values from WY2019 collected from Morro Bay estuary shoreline sites.

Discussion:

Of the eight sites monitored, historical trends showed six sites typically had only rare exceedances of recreational contact standards. Two sites, Baywood Pier (BAY) and Pasadena Point (PAS), had frequent exceedances of the standard. These trends did not apply to WY2019 or WY2018. In WY2019, PAS only had one elevated value for the year. BAY had no elevated values.

The following graph (Figure 4) shows the percent of exceedances of the recreational standard for data from the last 13 years. For PAS, nine of the 13 years had percent exceedances greater than 10%. For BAY, ten of the 13 years had percent exceedances greater than 10%.

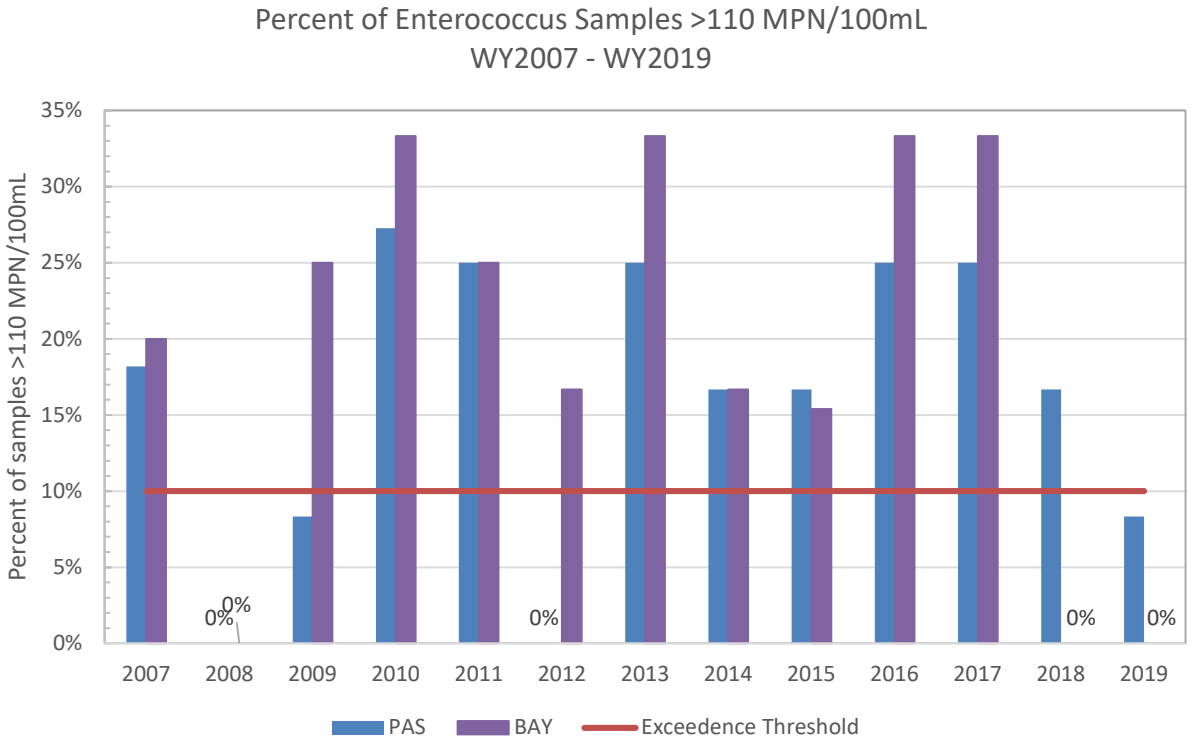

Figure 4: Percent of enterococcus samples greater than the Statistical Threshold Value of 110MPN/100ml over the last 13 years. Note – the absence of a bar indicates that 0% of samples exceeded the threshold for the year.

The following graph (Figure 5) shows the geomean of results by water year. For PAS, four of 13 years exceeded the criteria. For BAY, seven of 13 years exceeded the Recreational Contact Criteria.

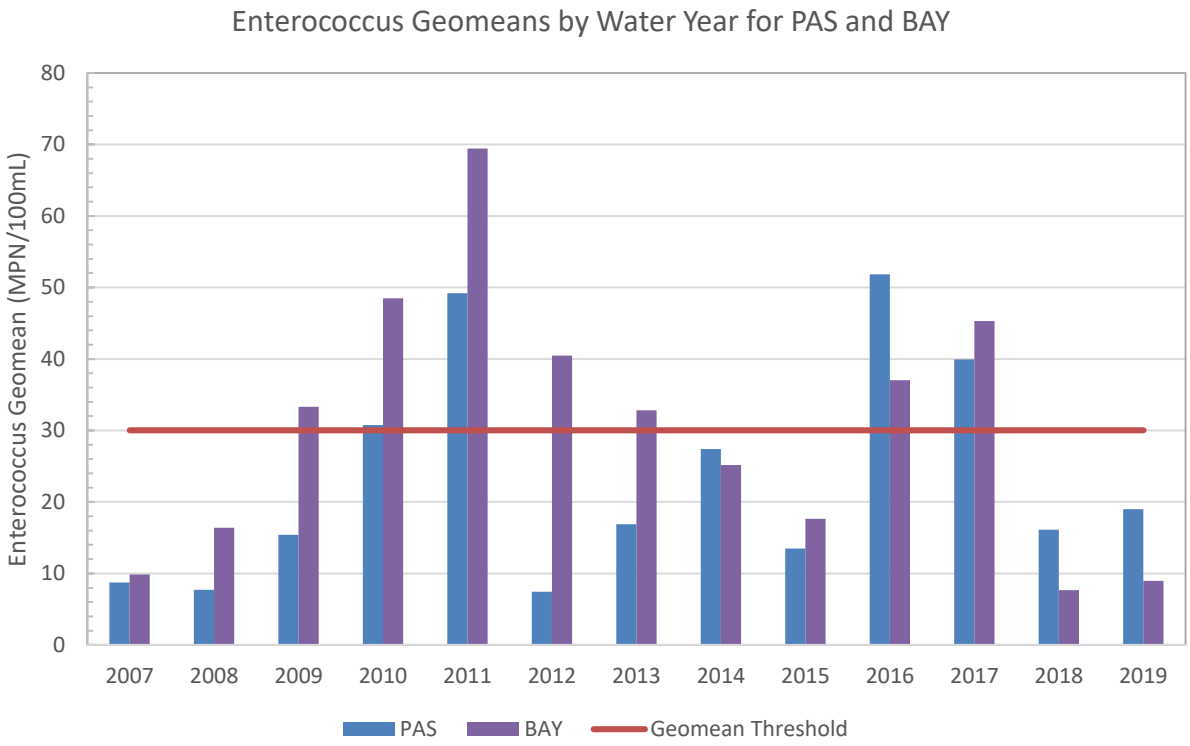

Figure 5: Enterococcus geomean by year for PAS and BAY. Ideally the geomean values remain below 30 MPN/100 mL.

The four sites toward the mouth of the bay (COL, TID, WIN, and SPM) are along the well-mixed channel and are thought to be primarily influenced by ocean water entering the bay with the incoming tide. These sites have very few elevated bacteria results.

The two sites further back in the bay, Cuesta Inlet (CIN) and Sharks Inlet (SIN), have minimal exceedances of recreational standards. These sites may experience some water circulation issues, as the back bay is shallow and experiences minimal mixing with the incoming tides during certain times of year. In WY2019, there was only one reading that exceeded the safe swimming standard at PAS. BAY had zero samples exceed the safe swimming standard for both WY2018 and WY2019. Prior to WY2018, this had not occurred since WY2008 for BAY and since WY2009 for PAS.

Potential sources of the bacteria could include runoff from land, contaminated groundwater, and wildlife. The California Department of Public Health (CDPH) monitoring of the freshwater seeps along the back bay indicated elevated levels of the fecal coliform indicator bacteria. Additional information on this seeps data set is available on the Estuary Program website.

Bay Dissolved Oxygen

The Estuary Program wanted to assess the dissolved oxygen (DO) concentrations at the lowest levels in the diurnal cycle. Since 2002, program volunteers monitor monthly at seven bay sites and collect surface measurements for DO concentration, temperature, and salinity. The monitoring occurs in the early morning hours within two hours of sunrise on an adequate tide for safe access.

Equipment Specification: The Estuary Program uses a YSI Pro 2030 meter, which measures DO concentration, DO % saturation, temperature, specific conductance, and salinity. The equipment specifications for DO are as follows:

Dissolved Oxygen (DO) Concentration

Specification	Value
Sensor Type	Polarographic
Measurement Range	0 to 50 mg/L
Calibrated Range	0 to 20 mg/L; 0 to 35°C
Accuracy	±2% of reading for 0 to 20 mg/L; ±6% of reading for 20 to 50 mg/L
Resolution	0.01 mg/L

To ensure data quality, the Estuary Program calibrates the meters weekly for DO using an internal calibration. They are tested against a Winkler titration twice a month.

Monitoring Locations: The seven bay monitoring sites were selected to represent different regions of the bay. The sites are (from north to south) Tidelands (site code ATP), State Park Marina (SPO), Los Osos Channel (LO2), Pasadena Point (PSP), Cuesta Channel (CHI), Cuesta Inlet (CSI), and Sharks Inlet (SHI).

The following map shows the seven monitoring locations.

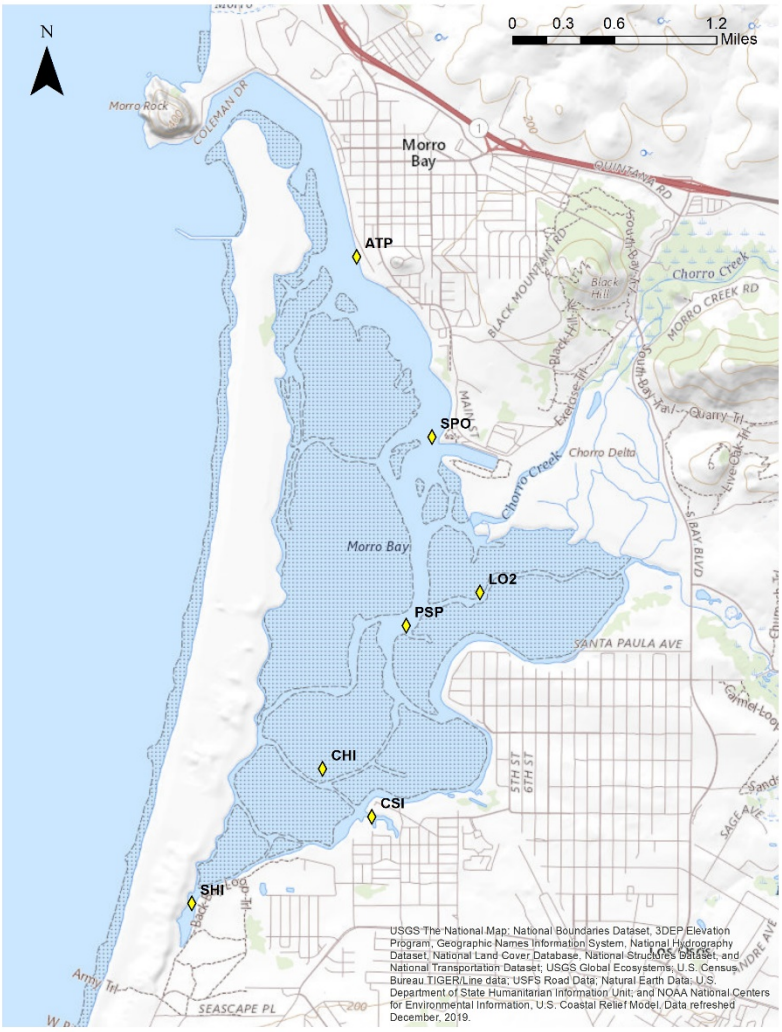

Figure 6: Map of bay dissolved oxygen monitoring locations.

Results: Analysis gives an indication of DO levels relative to standards protective of aquatic life. The CCRWQCB designated the estuary as "Marine Habitat" and lists an objective that DO concentrations must not fall below 7 mg/L to be protective of aquatic life.

The following graphs show the DO concentration data for WY2019 at each of the seven sites. The first graph (Figure 7) shows the percent of DO concentration readings in WY2019 that were less than 7mg/L, which means they violated the numeric objective set by the CCRWQCB for marine waters. Ideally, only 10% or less of results would fall below the standard.

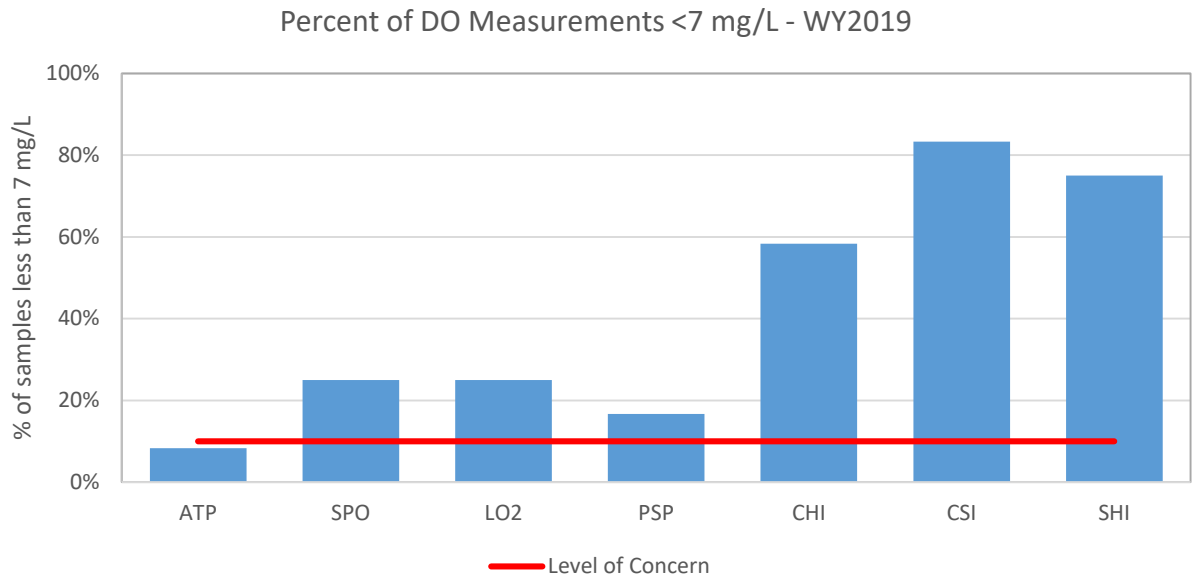

Figure 7: Percent of DO measurements less than 7 mg/L during the WY 2019. Only ATP has less than 10% of samples falling below 7 mg/L.

The following graph, Figure 8, shows the average DO values of WY2019 data. Ideally, all readings are greater than 7mg/L to ensure adequate oxygen to be protective of aquatic life.

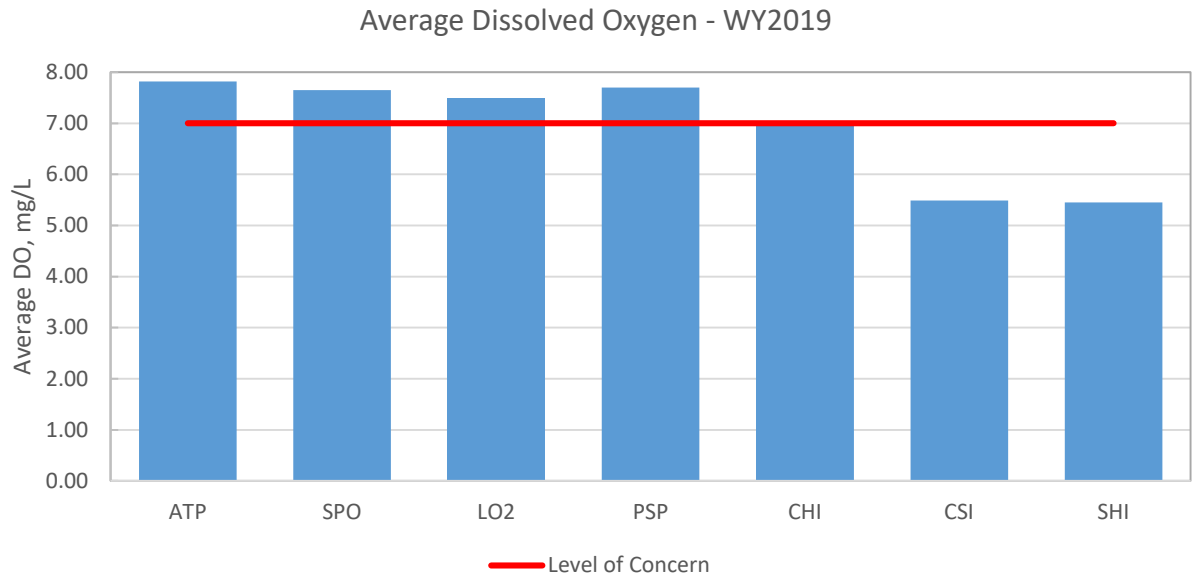

Figure 8: Average of dissolved oxygen levels measured during WY2019.

Discussion:

The estuary waters frequently have DO levels below the 7 mg/L water quality objective protective of the beneficial uses of the estuary. These trends also apply to data prior to WY2019. Sites located closer to

well-mixed channels (ATP, SPO, LO2, and PSP) had fewer readings that fell below 7 mg/L, although all sites frequently violated the Basin Plan standard during WY2019.

The depressed DO levels may be due in part to bay circulation. Waters in the back bay are shallower, meaning they heat up faster in the sun. Warmer water cannot hold onto as much DO as cooler water. Sites toward the back of the bay seem to have lower DO concentrations on average than those located in the channel and towards the front of the bay. Macroalgae, which is typically more prevalent in the back bay than the front bay, could be contributing to the depressed DO levels as well.

Data Availability

The data is available from the California Environmental Data Exchange Network (CEDEN), a State Water Resources Control Board data portal. To retrieve data,

- Visit www.CEDEN.org.
- Click on Find Data.
- For Program, choose Morro Bay National Estuary Program.
- Bay Bacteria: For Stations, choose Morro Bay sites Coleman Beach shoreline, Tidelands Park shoreline, Windy Cove, State Park Marina shoreline, Pasadena Point shoreline, Baywood Pier shoreline, Cuesta Inlet shoreline, and Sharks Inlet shoreline.
- Bay DO: For Stations, choose Tidelands Park, State Park Marina bay, Sharks Inlet bay, Pasadena Point Bay, Near Cuesta Inlet, North of Cuesta Inlet Mouth, and Los Osos Creek Channel.
- Click on Retrieve Data.

For additional details, contact the Estuary Program at 805-772-3834 or staff@mbnep.org