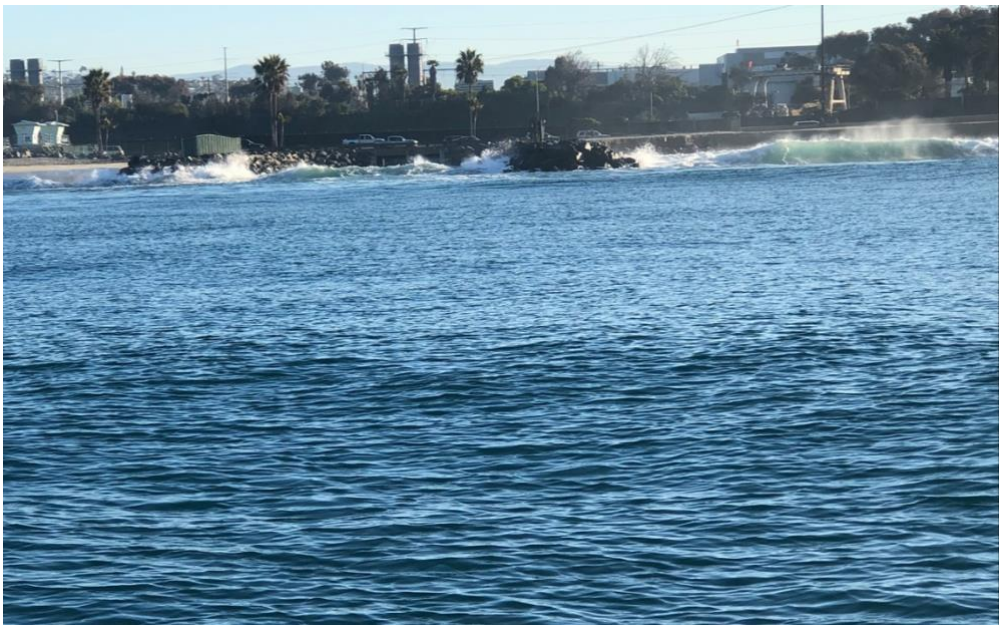
# CARLSBAD DESALINATION PLANT

## 2019-2023 State of the Ocean Report



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| Prepared For | POSEIDON WATER<br>CARLSBAD DESALINATION PLANT |
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# EXECUTIVE SUMMARY

The Carlsbad Desalination Plant (CDP) executed the annual receiving water monitoring program under San Diego Regional Water Quality Control Board Order No. R9-2019-0003, as amended by Order Number R9-2020-0004 and Order Number R9-2023-0137, (collectively, the "Order") beginning in July 2019 shortly after the Order was adopted. Monitoring has occurred in all quarters through Fall 2023 except Spring 2020 during the early days of the COVID-19 pandemic when the San Diego Regional Water Quality Control Board suspended offshore monitoring to protect the health of the boat crew and sampling team. All monitoring was conducted while the CDP was discharging brine and delivering potable water to the San Diego County Water Authority.

The State of the Ocean offshore of the City of Carlsbad is healthy where monitoring in support of the CDP has occurred. The water quality has remained consistent with the regional patterns. Occasionally, large harmful algal blooms have occurred which negatively impacted the region, including Carlsbad's coastal waters. The CDP's operation did not contribute to the harmful algal blooms. The benthic environment offshore of Carlsbad was likewise considered healthy with low levels of terrestrial pollutants deposited and none creating a toxic environment. The invertebrate infauna community in the sediments offshore Carlsbad were in reference condition indicating no effect of the CDP discharge.

The most robust monitoring program of the area ever completed demonstrated the CDP is operating in compliance with all applicable regulations and permits in harmony with the coastal marine environment.

# INTRODUCTION

Poseidon Resources (Channelside) LP, contracted Miller Marine Science & Consulting, Inc. to conduct the receiving water monitoring in compliance with Order No. R9-2019-0003, as amended by Order Number R9-2020-0004 and Order Number R9-2023-0137, (collectively, the "Order"). The Order was adopted on May 8, 2019, became effective July 1, 2019. The first amendment to the Order was adopted and became effective on February 12, 2020, and the second amendment to the Order was adopted and became effective September 14, 2023. Receiving water monitoring began in July 2019 was conducted during all four quarters of every year, except one, as specified in the Order. The Spring 2020 offshore monitoring was suspended in response to the COVID-19 pandemic and the spatial limitations on a boat to effectively adhere to the recommended social distancing in practice at the time. Only the surf zone stations were monitored in Spring 2020 as this effort could be accomplished while maintaining social distancing on the beach. Offshore sampling resumed in Summer 2020 as medical professionals identified usable strategies to minimize exposure risks other than social distancing. Sediment sampling occurred every year in the rotating pattern specified in the Order. Sediment characterization and sediment chemistry analysis was completed at each of the six stations annually. In 2021, sediment toxicity analysis and benthic infaunal analysis were also completed with the data available for inclusion in this report. The sediment toxicity and benthic infaunal field sampling were completed in 2023 with the analysis underway and results to be included in the 2023 Monitoring Year Receiving Water Monitoring Report to be submitted to the San Diego Regional Water Quality Control Board on or before July 1, 2024 per the Order's schedule.

The results of the monitoring conducted in compliance with the Order over the full permit term are summarized here in the State of the Ocean Report. Detailed analyses are available in the Annual Receiving Water Monitoring Reports submitted by July 1 each year to document the preceding calendar year's monitoring (MMSC 2020, 2021, 2022, and 2023).

## Facility Description

The Claude "Bud" Lewis Carlsbad Desalination Plant (CDP) is situated on a 5.7-acre parcel of land leased from Cabrillo Power I LLC near the now-retired Encina Power Station (EPS). Between July 2019 and June 2020, the CDP utilized the existing EPS seawater intake and seawater cooling pumps to intake raw seawater from the Agua Hedionda Lagoon (AHL) through the existing EPS seawater intake. In June 2020, the existing EPS seawater cooling pumps were replaced by fish-friendly seawater pumps to withdraw up to 299 million gallons per day (MGD) of seawater from the Agua Hedionda Lagoon (AHL). Seawater was withdrawn through the existing EPS seawater intake screening structure throughout the 2019 – 2023 period. A portion of the 299 MGD of seawater was pumped to the CDP for processing to produce up to 54 MGD of potable water for San Diego County. The remaining raw seawater withdrawn from the AHL was mixed with the brine from the CDP and discharged to the Pacific Ocean through a discharge channel created by two jetties extending offshore approximately 327 feet (ft) and 376 ft for the north and south jetties, respectively. The combined effluent reaches the Pacific Ocean at a daily average salinity no greater than 42 parts per thousand (ppt).

## Environmental Setting

The CDP is positioned within the Southern California Bight (SCB) in central San Diego County in Carlsbad, California along a stretch of coastline where the continental shelf narrows. Sandy bottom habitat dominates the immediate area surrounding the discharge channel with hard-bottom habitats supporting giant kelp located 0.3 miles south-southwest and 0.7 miles north-northwest of the discharge channel. Coupled with the Carlsbad Submarine Canyon located approximately one mile west by southwest of the discharge, the narrow continental shelf allows cooler and denser waters associated with the continental slope to surface in the nearshore habitat during upwelling periods, typically when winds are moderate to strong from the north. Although the California Current flows predominantly southward farther offshore, currents over the SCB shelf are more variable because of weaker driving winds and the influence of the irregular bathymetry of the Channel Islands system. The variability is most pronounced along the inner shelf and nearshore zone (within a few km of shore) where currents frequently fluctuate in direction and speed over the course of hours to days (Send and Nam 2012). Thus, the southward California Current is not a good predictor of water movement near shore.

Predominant wave direction, often caused by distant weather systems, is another factor that may influence the current direction and results in strong swells from the northwest or southwest resulting in alongshore flow to the north or south. Surface and subsurface currents may also diverge from one another, particularly during summer and fall when a warm stratified surface layer forms a boundary and isolates deeper water (Frieder et al. 2012; Nam et al. 2015). Stratification can limit vertical mixing and slow the dispersion of any discharge.

Seawaters in the area since 2013, as measured at the Scripps Institute of Oceanography Pier (Pier), located approximately 19 miles south of the CDP, have gradual cooled during the CDP Order period from 64.6° F before the Order was adopted to 63.7° F since the adoption (Table 1). The cooling waters were also nearly identical in salinity at 33.3 ppt before the Order's adoption and 33.4 ppt since the adoption. The Order period was also marked by multiple large harmful algal blooms that impacted large swaths of the Southern California Bight from the Mexican Border north to at least Orange County and, in some instances, Los Angeles County (https://sccoos.org/archive-ca-hab-bulletins/).

**Table 1. Mean water temperature (°F) and salinity (ppt) recorded at Scripps Institution of Oceanography Pier, January 1, 2013 - November 30, 2023.**

| Time Periods | Temp °F | Sal ppt |
|---|---|---|
| 2013-2023 | 64.2 | 33.4 |
| 2013-2019 | 64.6 | 33.3 |
| 2019-2023 | 63.7 | 33.4 |

Precipitation in San Diego County during the Order's period was dynamic ranging from very dry to very wet (Figure 1). Stormwater runoff, or lack thereof, contributes to coastal water quality and the benthic environment's condition along the shallow continental shelf that receives coastal discharge. Sediment and terrestrial contaminants can be carried into the coastal waters during wet weather. These contaminants may register in the sediment samples collected and tested in compliance with the Order.

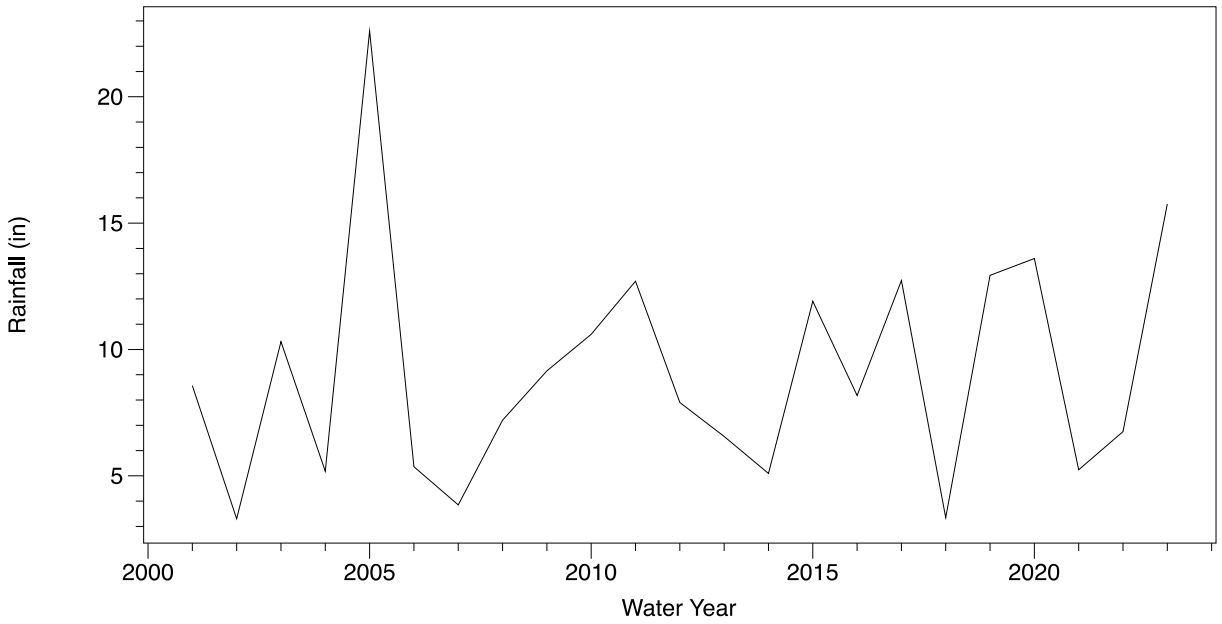


**Figure 1. Annual (Water Year) rainfall (in) recorded in San Diego County, 2001-2023. Source: https://www.weather.gov/wrh/climate?wfo=sgx**

## Regulatory Setting

The Order prescribes the receiving water monitoring specifications for the CDP. These specifications were designed to monitor, assess, and quantify the effects of the CDP discharge on the surrounding marine environment and all applicable beneficial uses as defined by the Water Quality Control Plan for the San Diego Basin (Basin Plan) and the Water Quality Control Plan for Ocean Waters of California (Ocean Plan). The San Diego Regional Water Quality Control Board (Water Board) designed the monitoring program with the intent of answering four core questions:

- Does the receiving water meet water quality standards?
- Are the receiving water conditions getting better or worse over time?
- What is the relative contribution of the Facility's discharge to pollution in the receiving water?
- What are the effects of the discharge on the receiving waters?

Core water quality standards were phrased as the following questions in the Order.

- Does the discharge cause an increase in salinity of >2.0 ppt above ambient conditions?
- The discharge of waste shall not cause the temperature of the receiving water to be altered in a manner that adversely impacts beneficial uses.
- Is the wastewater plume adversely impacting receiving water areas used for swimming, surfing, diving, and shellfish harvesting?
- Is natural light significantly reduced at any point outside the ZID as a result of the discharge?

- Does the discharge cause a discoloration of the ocean surface?
- Does the discharge of oxygen demanding waste cause the dissolved oxygen concentration to be depressed at any time more than 10 percent from that which occurs naturally?
- Does the discharge of waste cause the pH to change at any time more than 0.2 units from that which occurs naturally?
- What is the fate of the discharge plume?

Core sediment quality standards were phrased as the following questions in the Order

- Is the concentration of substances set forth in Table 1 of the Ocean Plan, for the protection of marine aquatic life in marine sediments, at levels which would degrade the benthic community?
- Is the concentration of organic pollutants in marine sediments at levels that would degrade the benthic community?
- Are benthic communities degraded as a result of the discharge?
- Is the sediment quality changing over time?

Beneficial uses were listed in Tables F-6 and F-7 of the Order as:

**Industrial service supply (PROC)** - Uses of water for industrial activities that depend primarily on water quality.

**Navigation (NAV)** - Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

**Contact water recreation (REC-1)** - Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

**Non-contact water recreation (REC-2)** - Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

**Commercial and sport fishing (COMM)** - Uses of water for commercial or recreational collection of fish and shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

**Preservation of biological habitats of special significance (BIOL)** - Uses of water that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological Significance (ASBS), where the preservation or enhancement of natural resources requires special protection.

**Wildlife habitat (WILD)** - Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

**Rare, threatened, or endangered species (RARE)** - Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered.

**Marine habitat (MAR)** - Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

**Aquaculture (AQUA)** - Uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes. California Ocean Plan beneficial use mariculture is included under this AQUA designation.

**Migration of aquatic organisms (MIGR)** - Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.

**Spawning, reproduction, and/or early development (SPWN)** - Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish. California Ocean Plan beneficial use fish spawning is included under this SPWN designation.

**Shellfish harvesting (SHELL)** - Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters and mussels) for human consumption, commercial or sport purposes.

**Preservation and enhancement of designated Areas of Special Biological Significance (ASBS)** - Includes marine life refuges, ecological reserves and designated areas of special biological significance, such as areas where kelp propagation and maintenance are features of the marine environment requiring special protection.

# RECEIVING WATER QUALITY

Water quality monitoring was required quarterly during the Order period at a suite of 17 unique offshore locations and seven surf zone locations (Figure 2). It should be noted that while 18 stations are described in the Order, two stations, Stations B-10 and D-10, occupy the same unique location: 656 ft offshore of the end of the discharge channel.

The salinity reference for all monitoring stations was designated as the automated shore station located at the end of the Scripps Institution of Oceanography Pier (Pier). For all other water quality parameters, reference stations located in the Carlsbad area were used as described below. All the monitoring stations were arranged to measure a suite of parameters at points radiating away from the discharge channel.

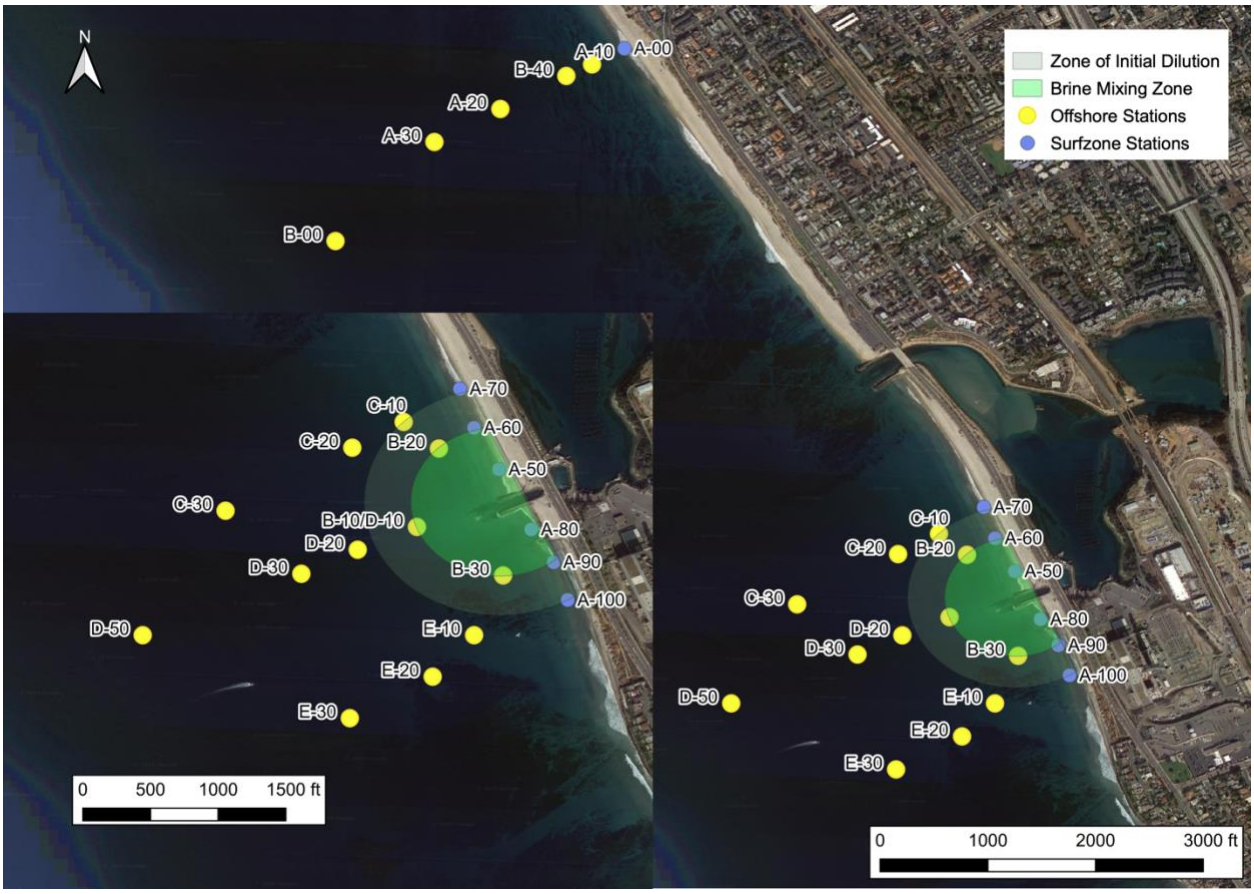


**Figure 2. Water quality stations monitored in compliance with Order No. R9-2019-0003 for receiving water quality. The Brine Mixing Zone and Zone of Initial Dilution are both depicted.**

**Surf Zone Conditions** – Surf zone monitoring measured near ambient-to-ambient conditions at all stations throughout the Order's monitoring period. One anomalous pH reading was reported for July 2019 that was determined to be due to probe-operator error as the probe was not allowed to equilibrate per the manufacturer's instructions. Retraining of field staff eliminated the problem going forward and all subsequent readings for all parameters were within expected ranges. The station-specific values for all parameters complied with the requirements in the Order in all subsequent seasons from fall 2019 through fall 2023.

**Offshore Conditions** – The offshore monitoring consistently documented compliance with the salinity dilution requirements of the Order at all stations in all seasons during the Order's July 2019 – December 2023 monitoring period. The daily mean salinity measured at each station was consistently less than 2.0 ppt over the ambient salinity at and beyond the brine mixing zone's boundary. The remaining parameters were almost universally in compliance with the Order's specifications at all stations. Dissolved oxygen in 2022, especially during spring and summer monitoring, was depressed below normal expected values. The timing of this depression coincided with a large harmful algal bloom and its lingering effects on the coastal waters rather than an effect of the brine discharge plume (MMSC 2023).

The CDP brine discharge plume is, initially, negatively buoyant due to its higher salinity. As it mixes with the receiving water it dilutes. Accurate comparisons of the areas where the brine plume has been detected during the Order's lifespan and the corresponding reference stations the 5 ft above the seafloor were examined. Figure 3 depicts the mean values for water temperature (°F), salinity (ppt), dissolved oxygen (mg/l), pH, and light transmission (%) measured at the stations where the discharge plume was detected (D) and the reference stations (R). Measurements from each station in the two categories were averaged across the 5 ft above the seafloor for each of the four seasons monitored annually. Note, monitoring did not begin until summer (Q3) of 2019 and no spring (Q2) survey was completed in 2020 due to COVID-19 transmission concerns.

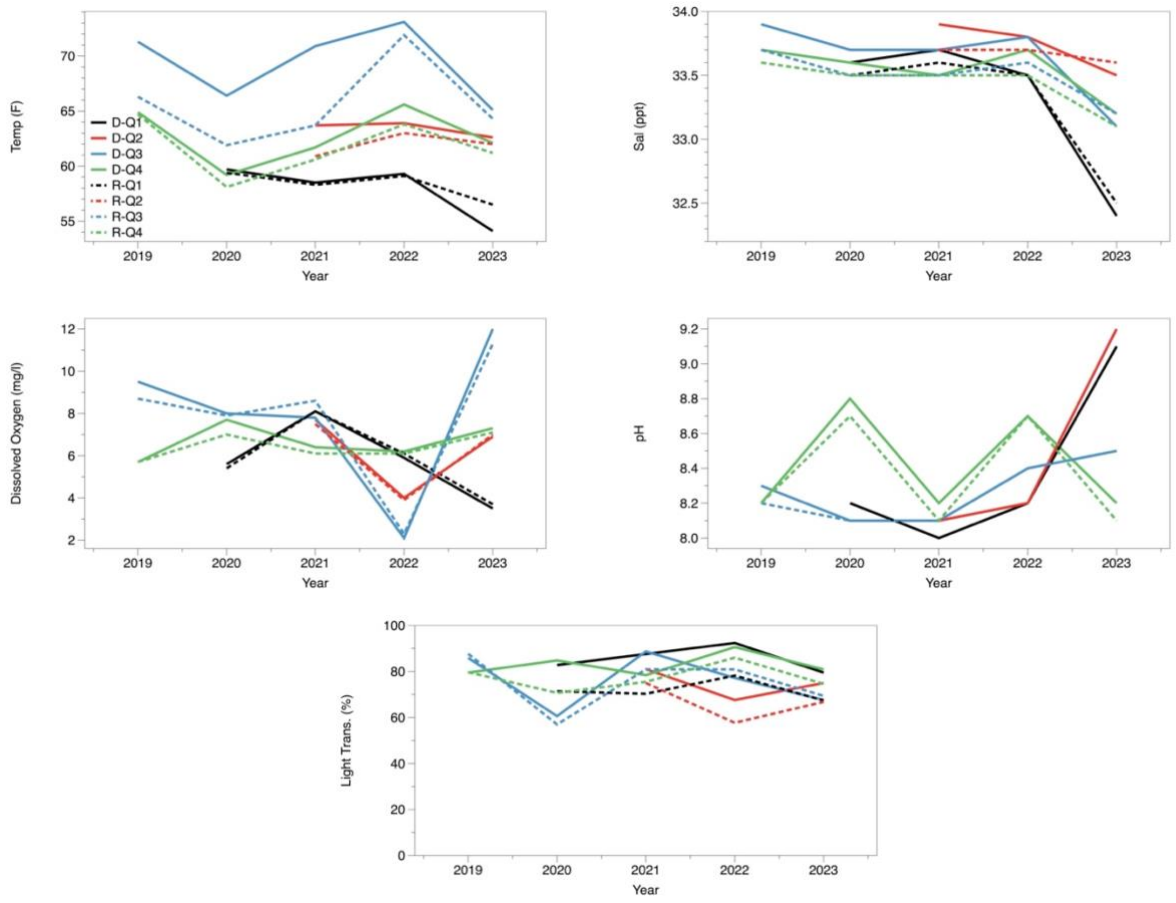


**Figure 3. Mean values for five monitored water quality parameters in the 5 ft of the water column above the seafloor averaged for discharge stations (D) and reference stations (R) annually during each of the four seasons monitored. Q1 = Winter, Q2 = Spring, Q3 = Summer, and Q4 = Fall**

Across all five parameters, the quarterly average measurements in the discharge area were at least similar if not nearly identical to those recorded at the reference stations. Water temperature showed the largest difference between the areas, primarily during the summer months when the discharge area was warmer than the reference area. In all other seasons, the measurements from the two areas were similar. The mean near-bottom salinity was very similar between the two areas and across all four seasons and years. The most noticeable feature was the dramatic decline in

salinity during winter (Q1) in 2023 in response to the above-average rainfall that occurred. The winter 2023 salinity measurements were the most different from previous years, but nearly all seasons showed a decline in salinity in 2023 as more freshwater runoff occurred in comparison to the preceding drought years. Dissolved oxygen and pH were the most consistent across the area with minimal difference between the discharge and reference areas across all seasons. The pervasive harmful algal bloom that occurred in 2022 was indicated in sharp decline detected in the spring and summer 2022 dissolved oxygen area-wide means. The winter, spring, and most summer pH readings were the same across the complete monitoring area with no difference between the discharge and reference areas detected. Only during summer was a difference detected during most years, but the difference was less than 0.2 pH units in all cases. Moreover, the discharge area was more basic than the reference areas where the coastal waters tended to be more acidic. Light transmission was the most variable across the seasons and years, but the discharge area had a higher percent light transmission, on average, than was recorded in the reference area.

# BENTHIC ENVIRONMENT

Benthic monitoring under the Order varied on a two-year cycle and was completed in compliance with the Benthic Monitoring Plan (MMSC 2019). Benthic sampling began in 2020 with sediment sampling to characterize the grain size distribution and chemical concentrations. This represented the core monitoring that occurred each year. In 2021, sediment toxicity and infaunal community analysis was added to the characterization of the grain size distribution and measuring the chemical concentrations in the sediments. This level of sediment investigation occurred during the odd-numbered years during the Order's period. Only results of the 2020 – 2022 monitoring are available for this State of the Ocean Report. The 2023 benthic environment monitoring results are under analysis and will be reported in the Annual Receiving Water Monitoring Report due to the San Diego Regional Water Quality Control Board by July 1, 2024.

The sampling stations were placed along the 16-ft (5-m) and 33-ft (10-m) isobaths offshore the Carlsbad coastline (Figure 3). Two sets of stations were positioned outside of the discharge plume's potential influence. These two sets of stations were located upcoast and downcoast of the discharge, respectively. The use of both upcoast and downcoast reference stations capture the potential variability in conditions driven by the ambient currents, point and non-point discharges in the area, and the multiple lagoon's that discharge into the general area, including the Buena Vista Lagoon located upcoast of the Agua Hedionda Lagoon.

Offshore of the discharge, one station BEN-D05 is located at the edge of the BMZ and within the ZID. The Order defines the ZID as the area extending 1,000 ft offshore from the end of the discharge channel. This is also the area that received the discharge from the now-retired Encina Power Station during its 1954 – 2018 operational life.

**Sediment Grain Size** – Sand was the dominant sediment type across the area as it comprised at least 85% of the sediments collected at any of the six stations in each of the three years of sampling. Gravel was absent across the sampling area. Silt was variably distributed across the sampling area while clay was uniformly present in approximately 1% of all sediments at each station. In general, the shallow stations had the coarsest sediments with a shift towards finer

sediments at the deeper stations. Sediments were generally finer at the stations located near the mouth of Buena Vista Lagoon and coarsest near the discharge.

**Sediment Chemistry Analysis** – Sediment collected at each of the six stations was subjected to chemical analysis to determine its composition. The Order specifies 56 chemical compounds to be included in the chemistry analysis, but only a subset of these compounds was detected each year. Metals were the most consistently detected and, of those, chromium and zinc were the most ubiquitous. Regional Bight surveys consistently detect metals in coastal sediments frequently in higher concentrations near outfalls and storm drain discharges as terrestrial deposition is washed into the coastal receiving waters. The presence of the metals in coastal sediments offshore Carlsbad did not result in toxic conditions when tested in 2021.


**Figure 4. Carlsbad Desalination Plant benthic sampling stations in relation to the discharge channel, brine mixing zone (BMZ), and zone of initial dilution (ZID).**

**Benthic Infaunal Community Analysis** – The benthic infaunal community was assessed, and data available for this report, in 2021. The resulting data was analyzed using the nearshore, coastal Benthic Response Index (Smith et al. 2001; Ranasinghe et al. 2009). All stations were in reference condition (BRI < 25) indicating healthy communities across the sampling area.

**Benthic Environment Conclusion** – The Order requires an attempt to integrate the three lines of evidence to determine the health of the marine sediments and associated community.

The Sediment Quality Objective was used as it represents the only available model designed for this purpose. The SQO integrated the sediment chemistry, sediment toxicity, and benthic infaunal community analyses into one metric. Using the CalSQOCalcToolVer5.8 from www.sccwrrp.org, the sediments at all six sampling stations were unimpacted indicating a healthy benthic environment.

# STATE OF THE OCEAN CONCLUSIONS

The receiving water monitoring program required under the Order represents the most intense effort ever required of the Encina Power Station/Carlsbad Desalination Plant site. Therefore, attempts to place the results of the current Order into a historical context is limited. Where possible, the annual monitoring results were compared to other monitoring programs in the area or across the region. In each case, Carlsbad's coastal water quality and marine environment were commensurate or healthier than elsewhere in the Southern California Bight. From this, the following conclusions can be drawn:

1. The Carlsbad coastal marine environment continues to support its full suite of beneficial use.
2. The Carlsbad Desalination Plant's discharge is not disturbing the receiving water quality or environment outside the brine mixing zone.
3. The Carlsbad Desalination Plant is not discharging toxic substances to the detriment of the environment. The Plant's operations result in an environmentally safe discharge to the marine environment in compliance with all regulations.
4. Poseidon Resources (Channelside) LP recommends maintaining the existing receiving water monitoring and reporting program in the next Order. This program has demonstrated and will continue to demonstrate compliance with the California Ocean Plan and the San Diego Regional Water Quality Control Board's Basin Plan.

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