PLUME TRACKING MONITORING PLAN FOR THE POINT LOMA AND SOUTH BAY OCEAN OUTFALL REGIONS, SAN DIEGO, CALIFORNIA

Progress Report
March 2026

Report Period: January – December 2025

City of San Diego Point Loma Wastewater Treatment Plant
(NPDES CA0107409; Order No. R9-2017-0007 as amended by Order No. R9-2022-0078)

City of San Diego South Bay Water Reclamation Plant
(NPDES CA0109045; Order No. R9-2021-0011)

U.S. IBWC South Bay International Wastewater Treatment Plant
(NPDES CA0108928; Order No. R9-2021-0001)

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Background

The Plume Tracking Monitoring Plan (PTMP) was designed to develop new and effective procedures for enhanced water quality monitoring and adaptive plume tracking in the San Diego region. These procedures include: (a) the deployment of real-time oceanographic mooring systems (RTOMS) located near the terminal diffuser wye structures of the Point Loma Ocean Outfall (PLOO) and the South Bay Ocean Outfall (SBOO); (b) deployment of static Acoustic Doppler Current Profiler (ADCP) and thermistor moorings; and (c) deployment and testing of a remotely operated towed vehicle (ROTV; i.e., ScanFish III).

Detailed here are significant activities that have been completed during the past year to achieve the objectives outlined in the PTMP. This Progress Report also details the current timeline of activities for the next year of sampling, including expected RTOMS deployment and recovery dates.

The original scope of the PTMP outlined activities through 2025 and the City has continued to operate under these guidelines until such time that a new work plan is in place. As a result, the City has completed a new work plan draft and attached it to this progress report (see Appendix 1) for Board approval.

Activities Completed (2025)

For detailed information regarding events prior to the current reporting year, please refer to previously submitted Progress Reports. Further, for real-time data plots from RTOMS deployments in 2025, see the SIO website (PLOO-06: https://mooring.ucsd.edu/ploo/ploo_06/; SBOO-07: https://mooring.ucsd.edu/sboo/sboo_07/)

2024

December

- PLOO RTOMS – Fifth recovery of PLOO RTOMS (12/09/24)
- ROTV - ROTV survey completed in PLOO and SBOO regions (12/3-5/24)

2025

February

- PLOO Static Moorings – Two thermistor strings recovered and redeployed; static ADCP was recovered and was not deployed due to instrument malfunction (02/27/25)

March

- 2024 PTMP Progress Report submitted to the Regional Board (03/01/25)
- Completed QA/QC review and assigned qualifiers for RTOMS data through 2025
- ROTV - ROTV survey completed in PLOO and SBOO regions (3/5-10/25)

April

- PLOO RTOMS - Sixth deployment of PLOO RTOMS (04/14/25); delayed due to manufacturer delays of instruments and limited staff availability

May

- SBOO Static Moorings – ADCP recovered using ROV (05/14/25)
- SBOO Static Moorings – ADCP deployment (05/15/25)
- SBOO Static Moorings – Two thermistor strings recovered with ROV lines fouled (5/20/25)
- SBOO Static Moorings – Thermistor string deployment (05/27/25)

June

- SBOO RTOMS - Sixth recovery of SBOO RTOMS (06/04/25)
- 2024 Interim Receiving Waters Monitoring Report submitted, including RTOMS results

July

- SBOO RTOMS - Seventh deployment of SBOO RTOMS (07/10/25)

August

- ROTV - ROTV survey completed in PLOO and SBOO regions (8/26-27/25)

September

- ROTV - ROTV survey completed in SBOO region (09/15/25)
- PLOO Static Moorings – In-Lab ADCP and acoustic release quality control testing (09/15/25)
- SBOO Static Moorings – One thermistor string and ADCP recovered (09/17/25)
- PLOO Static Moorings – ADCP deployment (09/17/2025)

October

- PLOO RTOMS – Sixth recovery of PLOO RTOMS (10/29/25)

December

- PLOO RTOMS – Seventh deployment of PLOO RTOMS (12/11/25)
- ROTV - ROTV survey completed in PLOO and SBOO regions (12/18-23/25)
- Completed evaluation and revision of new draft PTMP (12/31/25)

Overview of 2025 Activities and Changes to Project Plan

Similar to 2024, several challenges to RTOMS and static mooring deployments and ROTV operations occurred in 2025. The sixth deployment of the PLOO RTOMS was delayed by four months from the planned schedule (deployed in April 2025). This occurred due to manufacturer problems and delays in the servicing of several essential oceanographic sensors, followed by both SIO and City staffing challenges and scheduling conflicts with permit mandated sampling. In order to resume a deployment/recovery schedule that better fits with other required fieldwork, the sixth PLOO RTOMS was recovered before it completed a year in the ocean (October 2025) and the seventh PLOO RTOMS was deployed on schedule (December 2025).

In addition, the sixth PLOO RTOMS had an incident where it became entangled in drift nets from a commercial fishing boat that had broken down, dragging the mooring anchor several hundred meters against the outfall pipe (June 17, 2025). Due to notification from the GPS beacon and quick action from the crew at sea, City staff were able to assess the situation and make a plan. The team returned with a remotely-operated vehicle (ROV) to survey the mooring, and were able to recover the anchor and redeploy back to its original location (July 1, 2025). While the remaining fishing nets continued to foul some of the sensors in the 30 m cage, due to the team's responsive and thoughtful approach, the outcome of this incident was resolved without any loss of instruments or equipment.

Manufacturer delays in service and calibration of instruments continued in 2025. While the instrument manufacturer Sea-Bird has continued the freeze on all servicing and production of the shallow SeapHox instrument, the City was able to acquire additional deep SeapHox instruments to provide sufficient coverage of pH monitoring. After an evaluation of the usefulness and reliability of each sensor, a decision was made to discontinue sampling of surface water pCO_2 and remove the instrument from both buoys. Instead, the deep SeapHox sensors will be used for ocean acidification monitoring. Additional details will be presented in the revised 2026 PTMP.

The City continued to operate static moorings in both the PLOO and SBOO regions to act as data back-ups for the RTOMS. Although these static moorings are limited in their data collection to temperature and ocean current profiles, they are much smaller and typically less logistically challenging to retrieve and deploy. In 2025, recovery of the static moorings was problematic because two of the bottom-mounted moorings originally deployed in SBOO did not surface due to the recovery line becoming fouled during recovery. This resulted in a recovery of the thermistor anchor and ADCP mooring using a ROV. This is not uncommon, in 2024, three static moorings required an ROV for recovery. On February 27, 2025, after recovering the PLOO ADCP static mooring, we determined the ADCP pigtail cable and bulkhead connection on the sensor were compromised. We could no longer communicate with the instrument, and the ADCP was returned to the manufacturer for repairs. The PLOO ADCP was redeployed on September 19, 2025. In an effort to maximize efficiency in 2026, the City will plan to only deploy the static moorings when the real-time moorings are scheduled to be recovered and out of the water. This will allow the static moorings to fill in the gaps of missing data due to the absence of the RTOMS while still allowing the City to better allocate resources to fulfill obligations to the PTMP and other permit-mandated work.

In 2025, ROTV operations occurred over three regular sampling windows, March 5-10, August 26-27, and December 18-23, plus an additional special sampling effort in the South Bay on September 15. The September survey was intended to capture any potential changes to the outfall plume resulting from planned increased to IBWC effluent volume. A fourth potential regular sampling window (originally planned for May/June) was not possible due to scheduling conflicts related to the 2025 cathodic protection outfall survey required by the California Air Resources Board (CARB), permit mandated monitoring (SBOO RTOMS recovery/redeployment), limited staffing, and vessel unavailability due to required maintenance. City staff are currently working with the company EIVA on City-funded enhancements to the ROTV software, including the integration of real-time sensor calibration calculations and spatial interpolation of the data. Both

upgrades are intended to facilitate in-field, real-time assessment and decision making, and to anticipate and reduce the loss of survey time due to technical issues through improved data visualization tools. Concerns about the feasibility of sampling in kelp-dense areas, around commercial fishing equipment, and in the shallow South Bay persist. The risk of piloting the ROTV in the South Bay was addressed through the continued use of single transect surveys preceded by a visual assessment for potential hazards. An offshore, subsurface effluent signature was potentially detected in both the PLOO and SBOO regions during each of the sampling periods in 2025, characterized by elevated CDOM and optical brightener concentrations localized near each outfall. A protocol for assessing sensor drift between deployments has been implemented for some optical sensors starting in August 2025 in order to build confidence in the validity of comparing surveys across time.

ROTV sampling has proven to provide an excellent snapshot of the plume location during surveys. Obstacles remain regarding the implementation of an adaptive ROTV sampling program. As the City works to develop an in-house data management system for RTOMS data (currently managed by the Scripps Institution of Oceanography), a system for automated data flagging and notification is in discussion. However, ROTV surveys on the M/V *Oceanus* require preparations (e.g., winch-spool changeover to a ROTV compatible wire) that are not easily implemented in a short timeframe. The addition of a new, larger vessel to the City's fleet (planned for end of 2028) may alleviate some of these challenges.

Equipment Issues from Current Reporting Period: 2025

PLOO-06

- *January – April 2025*: Gap in RTOMS data and delay in PLOO-06 deployment due to manufacturer delays in serviced instruments, equipment problems, and limited staff availability (PLOO-06 deployed on 04/14/25).
- *June 2025:* Fishing vessel fouled its drift nets on the mooring and lost engine power, dragging the mooring approximately 660 m SSE of its nominal location and against the outfall pipe (06/17/25). Divers were able to cut free most of the fishing nets, though net sections remained. The City team surveyed the mooring with an ROV and confirmed that the anchor was up against the outfall pipe and sections of fishing net remained fouled on the mooring, particularly on the 30 m cage (06/24/25). They returned and were able to recover the anchor to relocate the intact mooring back to its original location (new anchor drop at 12:35 PDT on 07/01/25). Caution will be used to further evaluate sensor data during this period.
- *June – December 2025:* Sea-Bird ECO triplet sensor @ 30 m: noisy and spiky data occurred in all three channels (chl, CDOM, and turbidity) for most of the deployment, likely due to fouling from the fishing nets in front of the sensor face (beginning 06/22/25). In addition, the turbidity channel showed large data spikes prior to the fishing net incident (beginning 06/02/25). Data will be flagged as suspect and omitted from reporting.

- *June 2025:* Teledyne RDI ACDP instrument @ 1 m: current and backscatter values had poor data quality, likely due to the interference of the fishing vessel and drift nets (06/17 – 06/22/25).
- *June – September 2025:* Sea-Bird SBE37IM sensor @ 60 m and 87 m: salinity values in unpumped deep sensors showed downward drift that was not present in neighboring pumped sensors at similar depth ranges (e.g. 75 m and 89 m sensors). This may be a result of reduced flushing in unpumped sensors and influence from the PLOO plume and will be further evaluated and compared to CTD validation casts.
- *July 2025:* Small intermittent loss of real-time data occurred over a weeklong period in July, likely due to cell modem communication issues (07/12 – 07/16/25).

SBOO-06

- *January 2025:* Small loss of all real-time data occurred due to a software bug in SIO anti-malware software on the data server (01/28/25 - 01/31/25). The bug was resolved quickly and real-time data communications resumed.
- *January – June 2025*: Sea-Bird SUNA nitrate sensor @ 26 m: intermittent issue that started in August 2024 and continued through the end of the deployment. In 2025, occasional values spiked high and then flatlined to -1 uM. At times, the sensor appeared to recover and report reasonable values, so the sensor will be further investigated upon recovery and values will be compared to nitrate water sample results.
- *January – June 2025*: Sea-Bird SUNA nitrate sensor @ 1 m: sensor drifted low into negative values, so an attempt will be made to drift correct values compared to nitrate water sample results.
- *January – June 2025*: Sea-Bird ECO triplet sensor @ 18 m: CDOM data spiked to high values far outside typical ranges that were not observed at other depths (beginning 12/21/24). In addition, the turbidity channel drifted to high values (beginning 03/18/25). Data will be further evaluated and flagged as suspect.

SBOO-07

- *July – December 2025*: Sea-Bird SUNA nitrate sensor @ 1 m and 26 m: surface sensor reported consistent negative values. Bottom sensor continued to drift low throughout the entire deployment. An attempt will be made to drift correct sensor values compared to nitrate water sample results where possible.
- *August – December 2025*: Sea-Bird ECO triplet sensor @ 26 m: All three channels (chl, CDOM, and turbidity) showed very low or negative values for over two months (08/27 - 11/06/25), and then recovered to higher values. Data will be further evaluated and flagged as suspect.
- *November – December 2025*: Sea-Bird ECO triplet sensor @ 18 m: CDOM data spiked with intermittent high values far outside typical ranges (beginning 11/14/25). Biofouling is suspected and data will be further evaluated.
- *December 2025:* Sea-Bird SeapHOx pH sensor @ 1 m (surface): salinity and pH values jumped low for two days (12/20 - 12/21/25) and then resumed reasonable values. Data will be further evaluated and compared to CTD validation casts.

ROTV

- *March 2025:* Replaced temperature, conductivity, and oxygen sensors on ROTV with newly calibrated sensors (03/10/25).
- *August 2025:* NaviPac software crashed, loss of ability to calculate location. NaviPac software also experiencing NaviPac kernel errors (08/26/25). ROTV deflection cable eye pulled off the ROTV body and bolts rattled loose during deployment (08/27/25). Lost communication with SBE-25plus CTD on two separate occasions. ScanFish flight software also lost communication to ROTV. After recovering ROTV, power cycling CTD and laptops repaired the issue (08/27/25).
- *September 2025:* Lost communication with SBE-25plus CTD on three separate occasions. ScanFish Flight software also lost communication to ROTV. After recovering ROTV, power cycling CTD and laptops repaired the issue (09/15/25).
- *December 2025*: System failure notice in flight software was resolved by restarting NaviPac and flight software on multiple occasions (12/18-19/25; 12/22/25). Lost communication with SBE-25plus CTD and ScanFish flight software to ROTV on several occasions (12/18-19/25). This issue required recovery of the ROTV, then power cycling CTD and laptops repaired the issue (12/18-19/25). Chlorophyll-a and optical brightener sensors were swapped incorrectly in the Sea-Bird configuration file and the issue was corrected (12/18/25).

Static Moorings

- *February 2025:* PLOO ADCP was recovered with a faulty bulkhead and pigtail connection, and it was not possible to download the data or redeploy the instrument (02/27/25). Data was recovered and the repairs were made at the manufacturer prior to redeployment (September 2025).
- *May 2025:* SBOO ADCP required an ROV recovery, as the acoustic release did not work as expected when the recovery lines fouled after deployment (05/14/25). SBOO thermistor also required an ROV recovery due to a similar issue where the recovery lines fouled after deployment (05/20/25).
- *December 2025:* Two PLOO thermistor strings were recovered; however, the sacrificial lobster float, along with associated thermistors, was missing and not recovered from one of the sites (12/30/25).

Planned Activities (2026)

The City is continually assessing the effectiveness of the PTMP and plans to submit a revised workplan for future mooring and ROTV deployments in the first half of 2026. In the meantime, the City will continue to implement the *2018 Plume Tracking Monitoring Plan for the Point Loma and South Bay Ocean Outfall Regions*, with some changes in deployments due to sensor performance and efficiency, as described in the above section on "Overview of 2025 Activities and Changes to Project Plan."

2026

March

- Submit 2025 PTMP Progress Report

- Submit Revised 2026 PTMP
- Complete QA/QC review and assign qualifiers for RTOMS data through 2025
- Complete analysis of data from PLOO and SBOO RTOMS and ROTV surveys for inclusion in the City's 2024 - 2025 Biennial Receiving Waters Monitoring Report
- ROTV – Tentative ROTV surveys in PLOO/SBOO regions

April

- SBOO static moorings – Redeploy both ADCP and thermistor prior to SBOO RTOMS recovery

May

- SBOO RTOMS – Tentative retrieval of seventh SBOO RTOMS
- ROTV – Tentative ROTV survey in PLOO/SBOO following quarterly water quality
- RTOMS – Tentative capital improvement project – Initial roll-out phase of new data acquisition and website, transferring from SIO servers to City servers on the cloud with the help of CGI and Zensar.

June

- Submit 2024 - 2025 Biennial Receiving Waters Monitoring Report, including results from RTOMS and ROTV surveys
- SBOO RTOMS – Tentative deployment of eighth SBOO RTOMS

July

- SBOO static moorings – Tentative recovery of both ADCP and thermistor following SBOO RTOMS deployment

August

- ROTV – Tentative ROTV survey in PLOO/SBOO following quarterly water quality

October

- PLOO static moorings – Redeploy ADCP and two thermistor strings prior to PLOO RTOMS recovery
- PLOO RTOMS – Tentative retrieval of seventh PLOO RTOMS

November

- ROTV – Tentative ROTV survey in PLOO/SBOO following quarterly water quality

December

- PLOO RTOMS – Tentative deployment of eighth PLOO RTOMS
- PLOO static moorings – Tentative recovery of ADCP and thermistors following PLOO RTOMS deployment

Appendix 1

2026 PLUME TRACKING MONITORING PLAN FOR THE POINT LOMA AND SOUTH BAY OCEAN OUTFALL REGIONS, SAN DIEGO, CALIFORNIA

2026 Plume Tracking Monitoring Plan for the Point Loma and South Bay Ocean Outfall Regions, San Diego, California

Submitted by

City of San Diego Public Utilities Department
Environmental Monitoring & Technical Services Division

March 2026

City of San Diego Point Loma Wastewater Treatment Plant
(NPDES CA0107409; Order No. R9-2017-0007 as amended by Order No. R9-2022-0078)

City of San Diego South Bay Water Reclamation Plant
(NPDES CA0109045; Order No. R9-2021-0011)

U.S. IBWC South Bay International Wastewater Treatment Plant
(NPDES CA0108928; Order No. R9-2021-0001)

INTRODUCTION

This updated Plume Tracking Monitoring Plan (hereafter 'PTMP') is submitted pursuant to the above referenced orders and National Pollutant Discharge Elimination System (NPDES) permits issued to the City of San Diego (City) and the U.S. Section of the International Boundary and Water Commission (USIBWC) to govern the discharge of wastewater to the Pacific Ocean from: (a) the City's Point Loma Wastewater Treatment Plant (PLWTP) via the Point Loma Ocean Outfall (PLOO); (b) the City's South Bay Water Reclamation Plant (SBWRP) via the South Bay Ocean Outfall (SBOO); and (c) the USIBWC's South Bay International Wastewater Treatment Plant (SBIWTP) via the SBOO. These ocean discharges fall under the jurisdiction of the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) and the U.S. Environmental Protection Agency, Region IX (USEPA). Accordingly, this PTMP summarizes steps the City, USIBWC, San Diego Water Board and USEPA intend to implement in order to address plume tracking and other advanced ocean monitoring requirements for the San Diego coastal ocean.

This updated PTMP reflects nearly a decade of implementation experience under the original 2018 PTMP and is intended to strengthen data reliability, continuity, and regulatory defensibility. The modifications described herein are informed by operational performance, data utility, and lessons learned, and are designed to ensure that monitoring efforts continue to meet permit intent while improving efficiency and reducing data gaps associated with equipment reliability and maintenance constraints.

BRIEF HISTORY

Following a 2004 Scripps Institution of Oceanography (SIO) evaluation of the City's Ocean Monitoring Program, the City, in collaboration with SIO, initiated studies to enhance the understanding of coastal water circulation and wastewater plume dispersion. This included a pilot study initiated in 2006 using moored temperature loggers (thermistor strings) and Acoustic Doppler Current Profilers (ADCPs) to obtain an initial characterization of the thermocline structure and current regime in the area surrounding the PLOO discharge site (see Storms et al. 2006). The use of these thermistors and ADCP moorings was later expanded to include both the PLOO and SBOO regions where the resultant data have been a valuable part of the City's annual monitoring and assessment reports (e.g., City of San Diego 2024). Additionally, the USIBWC and the City commissioned subsequent studies of the fate and behavior of wastewater discharged to the ocean via the SBOO (Terrill et al. 2009) and the PLOO (Rogowski et al. 2012a, 2012b, 2013). The findings of these studies included recommendations to use real-time oceanographic moorings and advanced sampling technologies to better monitor and understand near-shore coastal water quality and the impacts of local ocean currents and tidal fluxes on effluent plume dynamics.

As a result of these studies, the City began to design, build and initiate field testing of two customized real-time mooring systems capable of being deployed from City research vessels in 2015. As of late 2017 (October 1, 2017 for the PLOO; December 13, 2017 for the SBOO), the Regional Water Quality Control Board (RWQCB) implemented a regulatory requirement for a PTMP, and the City formalized its work plan in 2018 (City of San Diego, 2018).

Since the initiation of the PTMP in 2018 to the present day, the City has continued to operate real-time oceanographic moorings and has submitted annual progress reports documenting the successes and challenges of deploying and operating these complex mooring systems. Furthermore, the City has continued to refine the suite of sensors utilized and optimize the overall program operations to balance feasibility with effective evaluation of wastewater plume behavior and ocean dynamics.

Upon the renewal of the NPDES permits for the SBIWTP and the SBWRP in 2021, language was added in reference to the 2018 PTMP which stated the following: *"The Discharger shall continue to implement the Plume Tracking Monitoring Plan…and provide updates on the status of new work plans that have been developed or are under development."* With nearly a decade of data collected using these real-time mooring systems, the City has prepared an update to the PTMP to reflect lessons learned from both successes and challenges, and to establish a refined approach for the next 5–10 years of monitoring.

2018 GENERAL APPROACH

The 2018 PTMP for the San Diego ocean outfall regions revolved around three main components: (1) A Real-Time Oceanographic Monitoring System (RTOMS) for the PLOO and SBOO regions to characterize year round ocean conditions that may affect plume dynamics; (2) Static ADCP and Thermistor Moorings to characterize thermocline structure and current patterns at various locations around the outfalls; and (3) The deployment of a Remotely Operated Towed Vehicle (ROTV) in order to adaptively track plume dispersion. For this updated 2026 PTMP, we propose modifications to all three components based on the successes and challenges since the program's inception. See below for details of the proposed modifications.

2026 MODIFIED APPROACH

Overall, we propose a general continuation of the broad PTMP implemented in 2018 with some modifications summarized here and detailed throughout this workplan. We propose the continuation of the three major components from the 2018 workplan to be implemented on an ongoing basis or until such time that an updated workplan is submitted by the City to the Regional Water Quality Control Board (RWQCB). For (1) the RTOMS, we have investigated the effectiveness and usefulness of various oceanographic sensors that make up these moorings and as such we are proposing an updated design to increase efficiency and remove known unreliable equipment (see Table 1). For (2) the static ADCP, and Thermistor Moorings, we have found that their most useful function is in serving as a backup data source for the RTOMS. Therefore, instead of deploying static moorings at additional locations concurrent with the RTOMS, we propose deploying them only when the RTOMS are removed for maintenance, or otherwise unable to collect data. In effect, the RTOMS function as the primary long-term monitoring backbone for plume-relevant oceanographic conditions, while static ADCP and thermistor moorings serve as continuity safeguards during periods when RTOMS units are offline for maintenance or repair. Finally, for (3) the ROTV, we propose to continue limited, semi-annual deployments, supplemented by occasional targeted surveys, to characterize plume behavior as forthcoming infrastructure modifications are expected to change discharge flows to both the PLOO and SBOO over the next several years. Although the ROTV involves substantial logistical constraints that preclude frequent or rapid deployment, it continues to provide critical value by delivering high-resolution, broad-spatial-coverage snapshots of plume location and dynamics across a wide range of ocean conditions beyond what is captured through regular, grided CTD surveys.

Major PTMP Components:

1. Real-Time Oceanographic Mooring System (RTOMS)

The City proposes the continued deployment of two RTOMS – each placed near the offshore discharge site for the PLOO and SBOO (as shown in Figure 1). The primary goal is to enable the City to collect a continuous set of high temporal resolution environmental monitoring data that can be used to better evaluate oceanographic conditions in the San Diego region and address emerging issues related to climate change or other factors. The data collected by these RTOMS give immediate insight into current oceanographic conditions as features develop and provide information on physical factors (such as ocean stratification and ocean current dynamics) that influence plume dispersion.

Oceanographic conditions can be extremely dynamic. Immediate access to high temporal resolution data provides valuable information to field scientists, even while a cruise is underway. For example, City Environmental Scientists often use the RTOMS data to "check" anomalous conditions during fixed-grid CTD sampling cruises, such as high concentrations of phytoplankton blooms or low-oxygen events. This provides an independent measure of anomalous events that can help rule out the possibility of sensor malfunction. ROTV cruises also benefit from immediate access to oceanographic data, as the degree of water column stratification and the dominant direction of ocean currents affects the concentration and location of the outfall plume. In addition, as parameters are sampled continuously over time, data on oceanographic events are available for the entire duration of the event, including before and after conditions, as long as the system is operating as designed. This continuous near-real-time data helps fill in the gaps left by temporally discrete sampling, such as weekly and quarterly CTD surveys. These RTOMS data are used to provide a more complete picture of ocean conditions throughout the year near the ocean outfalls, improving our understanding of regional events such as El Niño-Southern Oscillation events and upwelling impacts, ocean acidification changes, and algal bloom dynamics.

As has been the case to date, each mooring will be operated for a deployment period of up to 12 months, during which time City staff will closely monitor and evaluate technical performance of the component sensors and supporting hardware to verify overall system functionality. In addition, side-by-side CTD casts and bottle sample collection will be completed on a quarterly basis (and at the beginning and end of each deployment) in order to independently verify data quality and check for issues such as biofouling drift. If any issues are detected that cannot be corrected remotely on surface buoy equipment, City staff will be deployed to assist with a site visit in an attempt to repair the problem. At the end of each deployment, City staff will retrieve the respective mooring and conduct a complete overhaul of systems and components.

Through a detailed evaluation of RTOMS sensor performance and data utility, and an effort to improve efficiency in performance and maintenance, the City has proposed a modified mooring configuration in Table 1 for the PLOO and SBOO moorings. Due to low reliability and consistent underperformance of certain sensors, the City proposes to remove some parameters, as detailed in Table 2. We believe all the remaining parameters are collected at the necessary frequency and depth range to characterize major oceanographic conditions and events in the region, as well as environmental factors that influence plume dispersion. In addition, this configuration will help to minimize equipment issues and data challenges. However, the City reserves the right to modify the sensor configuration to ensure consistency and reliability of data on an as-needed basis.

2. Static ADCP/Thermistor Moorings

Upon recovery of the RTOMS, to minimize data interruption, ADCP and thermistor static moorings will be temporarily deployed in their place to act as data back-ups until the RTOMS can be redeployed. The typical RTOMS downtime between deployments varies between four and six weeks; however, lack of instruments/equipment and limited staff availability can delay RTOMS redeployments and result in downtime up to several months. Therefore, by always having static moorings deployed during these periods, we ensure that critical data are still being collected year-round.

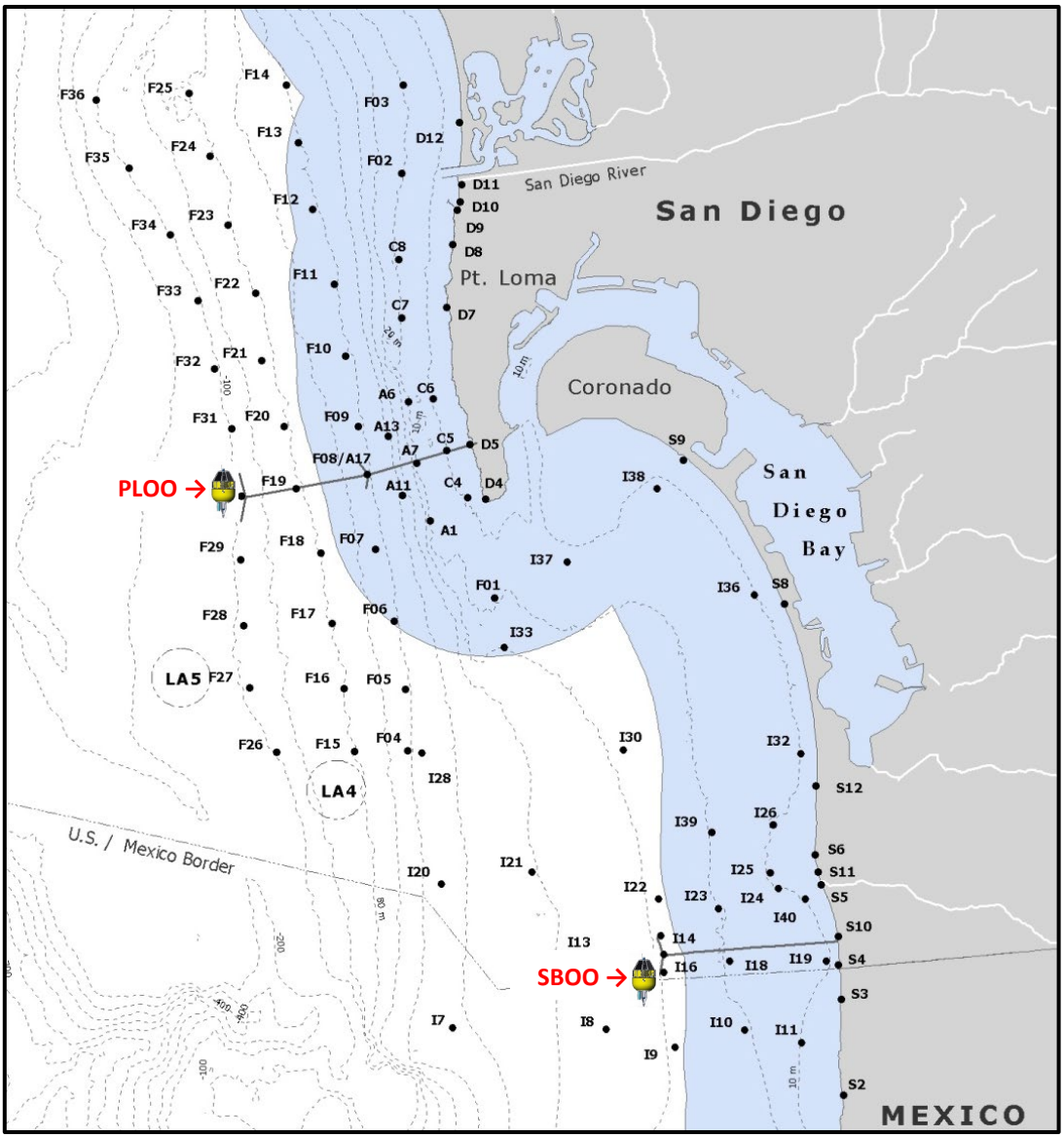

Figure 1
Map showing approximate locations of new Point Loma Ocean Outfall (PLOO) and South Bay Ocean Outfall (SBOO) real-time moorings along with regular water quality monitoring stations for both regions. Blue shading represents the 3-nm boundary representative of California state waters north of the border.

Table 1
Example configuration for the PLOO and SBOO RTOMS. Specific configuration, sensor depths, and sensor types may vary between deployments depending on priorities and sensor availability. CDOM is an abbreviation for colored (or fluorescent) dissolved organic matter.

Depth		Parameters Measured	Permit Justification*
PLOO (~100 m)	**SBOO** (~30 m)		
1 m (surface)	1 m (surface)	· Temperature	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
		· Salinity	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
		· pH	*E.4.1.2.4 (SBWRP; SBIWTP), E.IV.B.4 (PLWTP)*
		· Dissolved Oxygen	*E.4.1.2.3 (SBWRP; SBIWTP), E.IV.B.3 (PLWTP)*
		· Ocean currents/direction	*E.4.1.2.9 (SBWRP; SBIWTP), E.IV.B.5 (PLWTP)*
		· Chlorophyll *a*	*E.3.2.5 (SBWRP; SBIWTP)*
		· CDOM	*E.4.1.2.2 (SBWRP; SBIWTP), E.IV.B.2 (PLWTP)*
		· Nitrate	*E.4.1.2.9/10 (SBWRP; SBIWTP)*
10 m	10 m	· Temperature	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
		· Salinity	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
	18 m	· Temperature	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
		· Salinity	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
		· Dissolved Oxygen	*E.4.1.2.3 (SBWRP; SBIWTP), E.IV.B.3 (PLWTP)*
		· Chlorophyll *a*	*E.3.2.5 (SBWRP; SBIWTP)*
		· CDOM	*E.4.1.2.2 (SBWRP; SBIWTP), E.IV.B.2 (PLWTP)*
20 m		· Temperature	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
		· Salinity	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
	26 m (cage)	· Temperature	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
		· Salinity	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
		· pH	*E.4.1.2.4 (SBWRP; SBIWTP), E.IV.B.4 (PLWTP)*
		· Dissolved Oxygen	*E.4.1.2.3 (SBWRP; SBIWTP), E.IV.B.3 (PLWTP)*
		· Chlorophyll *a*	*E.3.2.5 (SBWRP; SBIWTP)*
		· CDOM	*E.4.1.2.2 (SBWRP; SBIWTP), E.IV.B.2 (PLWTP)*
		· Nitrate	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
30m		· Temperature	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
		· Salinity	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
		· Dissolved Oxygen	*E.4.1.2.3 (SBWRP; SBIWTP), E.IV.B.3 (PLWTP)*
		· Chlorophyll a	*E.3.2.5 (SBWRP; SBIWTP)*
		· Nitrate	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
45 m		· Temperature	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
		· Salinity	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
60 m		· Temperature	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
		· Salinity	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
75 m		· Temperature	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*

		· Salinity	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
		· DO	*E.4.1.2.3 (SBWRP; SBIWTP), E.IV.B.3 (PLWTP)*
87 m		· Temperature	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
		· Salinity	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
90 m		· Temperature	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
		· Salinity	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
		· pH	*E.4.1.2.4 (SBWRP; SBIWTP), E.IV.B.4 (PLWTP)*
		· Dissolved Oxygen	*E.4.1.2.3 (SBWRP; SBIWTP), E.IV.B.3 (PLWTP)*
		· Chlorophyll *a*	*E.3.2.5 (SBWRP; SBIWTP)*
		· CDOM	*E.4.1.2.2 (SBWRP; SBIWTP), E.IV.B.2 (PLWTP)*
		· Nitrate	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*

**Parameter selection is primarily based on permit requirements established for receiving water monitoring in Attachment E, Section 4 of the following NPDES permits: Point Loma Wastewater Treatment Plant (PLWTP CA0107409; Order No. R9-2017-0007 as amended by Order No. R9-2022-0078); South Bay Water Reclamation Plant (SBWRP CA0109045; Order No. R9-2021-0011); and South Bay International Wastewater Treatment Plant (SBIWTP CA0108928; Order No. R9-2021-0001).*

Table 2

Through an evaluation of long-term sensor performance, data quality, and relevance to permit objectives, certain parameters originally proposed in the 2018 PTMP were determined to provide limited additional value for plume characterization or receiving water assessment when compared to remaining core parameters. The parameters listed in Table 2 are therefore proposed for removal based on demonstrated reliability issues, data limitations, and lack of material contribution to regulatory decision-making, while ensuring that all permit monitoring objectives continue to be met through alternative or remaining measurements. Additionally, turbidity (backscatter) data will not be reported since these data have not been useful for evaluation of ocean conditions; however, this parameter is included by default in available sensors that measure chlorophyll *a* and CDOM, so it can be useful for sensor troubleshooting or diagnostic purposes.

Parameters No Longer Collected	**Justification for Discontinuation**
pCO_2	*Unreliable data due to sensor calibration issues and frequent solar power system failures. Evaluation of long-term datasets indicates that pH provides a more reliable and defensible indicator for tracking ocean acidification trends relevant to permit objectives.*
BOD (biological oxygen demand)	*Data are not useful due to unreliability of available sensors on this platform, no correspondence with other parameters on this platform*

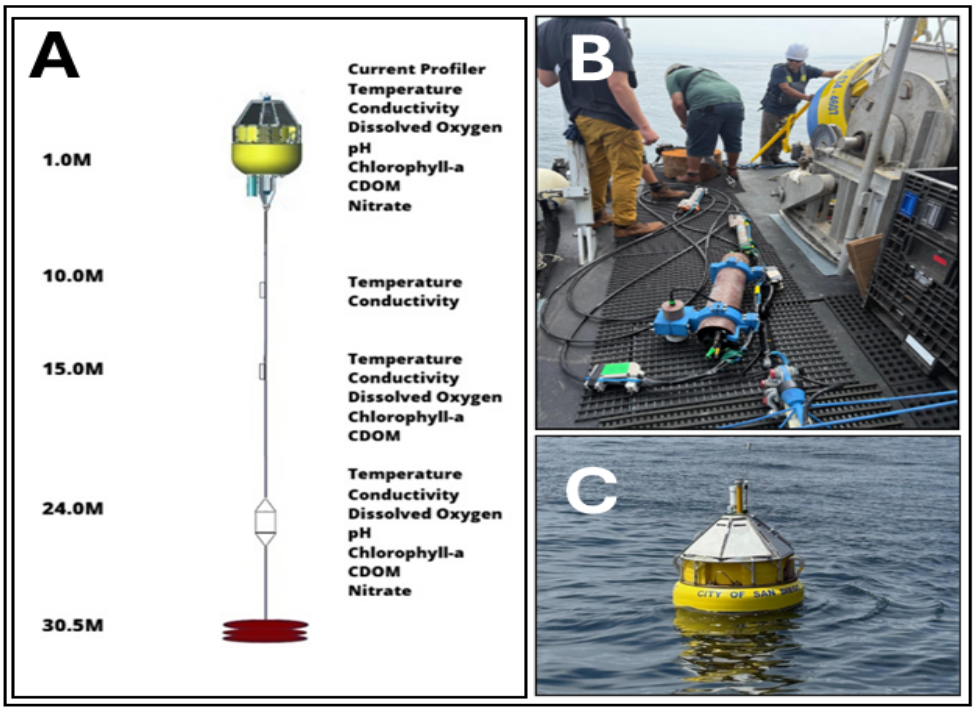

Figure 2
(A) Example diagram of real-time mooring system showing general sensor configuration. (B) Mooring being readied for deployment aboard City research vessel. (C) Mooring surface buoy post deployment.

3. Remotely Operated Towed Vehicle (ROTV)

This component of the 2026 PTMP is singularly devoted to assessing the location and behavior of the discharged effluent plume. The City will continue to strategically deploy an ROTV, such as the wing-shaped ScanFish (Figure 3), to corroborate plume dynamics inferred from other data collection methods used as part of the ocean monitoring program, such as from the RTOMS, CTD, and satellite imagery. As such, ROTV deployments will likely be used as an investigative tool to better understand which local conditions may impact effluent plume dynamics, such as region wide climate events, or if effluent flows change, as they are expected to for the PLOO with the onset of Pure Water and for the SBOO with the diversion of flows from the Tijuana River. In addition, the ROTV will be deployed at least twice per year to maintain staff proficiency with the equipment and to build a continual library of high-resolution, broad-spatial-coverage plume observations under a range of ocean conditions. This baseline dataset will support future evaluations of changes in effluent dynamics. ROTV deployments are intended to function as an investigative and interpretive tool to supplement fixed-station monitoring and are not proposed as a replacement for required compliance monitoring or routine receiving water sampling.

An ROTV provides a highly flexible multi-purpose platform that can be programmed to automatically track fixed depths in the water column, move in an undulating pattern from surface to seabed, or move in a terrain-following mode while being towed by a vessel at normal cruising speeds. A wide variety of sensors can be integrated in the ROTV that can be configured to collect and transmit continuous data in real-time, thereby providing in-motion profile information about the water column through which it is being towed. The ScanFish ROTV can capture 4x or more spatial resolution than the City's regular CTD sampling grid, provides flexibility to survey outside of normal grid boundaries when appropriate, and can cover 3-4x the spatial extent of a CTD survey in a given mission-day. The ROTV cannot, however, replace

CTD sampling due to its inability to collect water samples and logistical complexities of deployment. Based on the City's use of the ScanFish ROTV equipment, we propose to streamline the sensor package used in the ROTV moving forward to focus solely on the identification of plume signatures. A modified ROTV sensor configuration is provided in Table 3, and Table 4 highlights sensors which were originally proposed for use on the ROTV and details why they will no longer be used.

Table 3

Example parameters collected by the ROTV for the purpose of plume tracking. Specific configuration and sensor types may vary between deployments depending on priorities and sensor availability.

Parameters Measured	Permit Justification*
Temperature	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
Salinity	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
CDOM	*E.4.1.2.9/10 (SBWRP; SBIWTP), E.IV.B.5/6 (PLWTP)*
Turbidity	*E.4.1.2.1 (SBWRP; SBIWTP), E.IV.B.1 (PLWTP)*
Chlorophyll *a*	*Plume and phytoplankton bloom differentiation*
Optical Brightener	*Shown to be valuable parameters used for plume tracking.*
Dissolved Oxygen	
Tryptophan	

**Parameter selection is primarily based on permit requirements established for receiving water monitoring in Attachment E, Section 4 of the following NPDES permits: Point Loma Wastewater Treatment Plant (PLWTP CA0107409; Order No. R9-2017-0007 as amended by Order No. R9-2022-0078); South Bay Water Reclamation Plant (SBWRP CA0109045; Order No. R9-2021-0011); and South Bay International Wastewater Treatment Plant (SBIWTP CA0108928; Order No. R9-2021-0001).*

Table 4

Parameters from original work plan that are no longer monitored via the ROTV due to consistent underperformance, reliability issues, and/or logistical challenges.

Parameters No Longer Collected	Justification for Discontinuation
pH	*Parameters were never sampled due to not being useful for plume tracking*
Transmissivity	

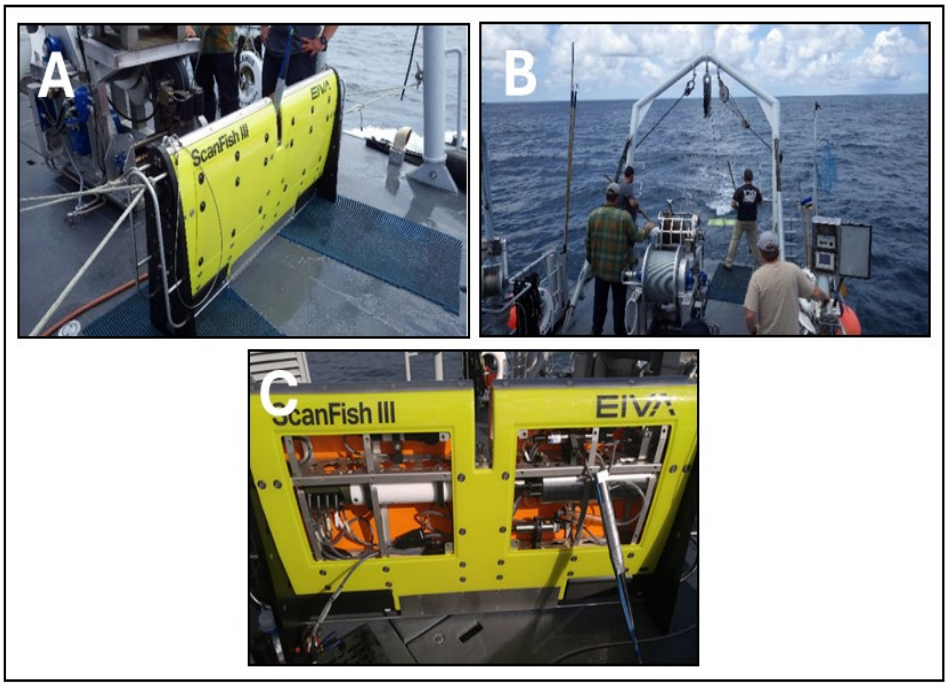

Figure 3
ScanFish III Remotely Operated Towed Vehicle. (A-B) ROTV training and testing aboard City of San Diego research vessel, *Oceanus*. (C) ScanFish with main compartment covers removed to highlight location of CTD unit and other sensors.

REPORTS & MEETINGS

The City shall report on the results of the RTOMS and ROTV work every year in accordance with the schedule for the combined Biennial and Interim Receiving Waters Monitoring and Assessment Reports as specified in the orders and permits for the PLWTP, SBWRP and SBIWTP. The Interim reports shall include summary results of RTOMS data on ocean conditions. The Biennial reports shall include in-depth evaluations, interpretations, discussions and conclusions concerning the state of the local receiving waters and the estimated dynamics of the PLOO and SBOO plumes throughout the reporting period using a combination of data from RTOMS, Static Moorings, and ROTV data.

City staff will be available to meet with San Diego Water Board, USEPA or USIBWC staff at any time during the project to discuss results and interpretations, or provide summary presentations upon request, while data for the project will be made available as appropriate. RTOMS and ROTV data that passed quality assurance review will be posted to the City's Open Data Portal on an annual basis. Only datasets that have successfully completed quality assurance and quality control review will be used for regulatory interpretation and public reporting, and data availability may lag collection to allow for appropriate validation. Informal meetings between the City and all parties may be scheduled as desired throughout the project.

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