2024 Eelgrass Monitoring in Newport Bay, Newport Beach, California

February 13, 2025

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Abbreviation

ac	Acre
Bay	Newport Bay
CEQA	State of California Environmental Quality Act
CEMP	California Eelgrass Mitigation Policy
City	City of Newport Beach
CRM	Coastal Resources Management Inc.
DWEH	Deep Water Eelgrass Habitat
dGPS	Differential Global Positioning System
EFH	Essential Fish Habitat
EPA	Environmental Protection Agency
EPMP	Eelgrass Protection and Mitigation Plan for Shallow Waters in Lower Newport Bay: An Ecosystem Based Management Program
FC	Federal Channels
ft	Feet/Foot
°F	Degrees Fahrenheit
GPS	Global Positioning System
HAMP	City of Newport Beach Harbor Area Management Plan
HAPC	Habitat Areas of Particular Concern
MLLW	Mean Lower Low Water
m	Meter(s)
MTS	Marine Taxonomic Services, Ltd.
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
OTS	Ocean Technology Systems
RGP	Regional General Permit
sq	Square
SAV	Submerged Aquatic Vegetation
SWEH	Shallow Water Eelgrass Habitat
TERFs	Transplanting eelgrass remotely with frames
TERR	Transplanting eelgrass remotely with rope
USACE	U.S. Army Corps of Engineers

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1 Introduction

Marine Taxonomic Services, Ltd. (MTS) and its sub-contractor, Coastal Resources Management, Inc, (CRM) was contracted by the City of Newport Beach (City) to provide eelgrass-mapping services in Newport Bay as part of the 2024 harbor-wide eelgrass assessment. The survey consisted of mapping shallow-water eelgrass habitat (SWEH) and deep-water eelgrass habitat (DWEH) in support of the City's Eelgrass Protection and Mitigation Plan for Shallow Waters in Lower Newport Bay: An Ecosystem Based Management Program (EPMP; City of Newport Beach 2015) and the City of Newport Beach Harbor Area Management Plan (HAMP; City of Newport Beach 2010). SWEH is defined as eelgrass habitat occurring in depths shallower than -15-feet mean lower low water (MLLW). DWEH is defined as eelgrass habitat deeper than -15-feet MLLW.

MTS was responsible for surveying the SWEH, data analysis, and report composition. CRM was responsible for providing MTS with survey results from DWEH and SWEH using sonar-based methods beyond 20 feet (ft) bayward of all dock structures and in areas where it was not safe to perform diver-based surveys. This was the ninth SWEH survey and sixth DWEH survey since the program was initiated in 2003. Previous eelgrass habitat assessments were conducted in 2003-2004 (CRM 2005), 2006-2008 (CRM 2010), 2009-2010 (CRM 2012), 2012-2014 (CRM 2015), 2016 (CRM 2017), 2018 (MTS 2018), 2020 (MTS and CRM 2020), and 2022 (MTS and CRM 2023). Typically, DWEH surveys are performed every other survey (every 4 years) with SWEH surveys performed every two years. The DWEH survey performed in 2022 was outside of that historical sequence due to planned dredging of federal channels (FC) in spring 2023. Subsequently, however, that project was postponed.

Caulerpa prolifera was found in 2021 in Newport Harbor. The discovery means the harbor is considered an “infected system” until eradication is achieved. The City participates in the Southern California Caulerpa Action Team (SCCAT) composed of representative local, state, and federal agencies to effectively manage the infestation by implementing surveys and removing *Caulerpa* from the system. As part of the City’s support towards removal of the invasive algae, the City directed MTS to incorporate more detailed survey techniques as part of the RFP and to incorporate the efforts into this report.

Additionally, a brief discussion regarding the current status of transects planted during the 2019 eelgrass transplant methods study is provided at the end of this document. The intent of the discussion is to provide an updated status for coverage as it relates to transplant methods. For background or additional information pertaining to the transplant effort please see MTS 2019, MTS 2020, and MTS 2023.

1-1 Project Purpose

The purpose of this assessment is to provide the City with detailed information on the distribution and abundance of eelgrass within Newport Harbor, including Lower and Upper Newport Bay (Bay) (Figure 1). Monitoring and maintaining a database of the Bay's eelgrass resources is essential for the City and regulatory and resource agencies to manage these resources. The City is committed to monitoring these resources as noted in the HAMP and EPMP. Additionally, data provided in this report will be used by the City in support of their Regional General Permit (RGP) 54 collectively issued by the U.S. Army Corps of Engineers (SPL-2013-00020-GS; USACE 2020), the California Coastal Commission (CDP 5-19-1296 and CC-0007-21), and the Santa Ana Regional Water Quality Control Board (WDID #302019-21). This dataset is valued as it helps to inform the public of existing sensitive resources during the planning of infrastructure improvement projects such as construction, repair, and maintenance for bulkheads, docks, and piers, as well as activities involving beach nourishment and harbor dredging.

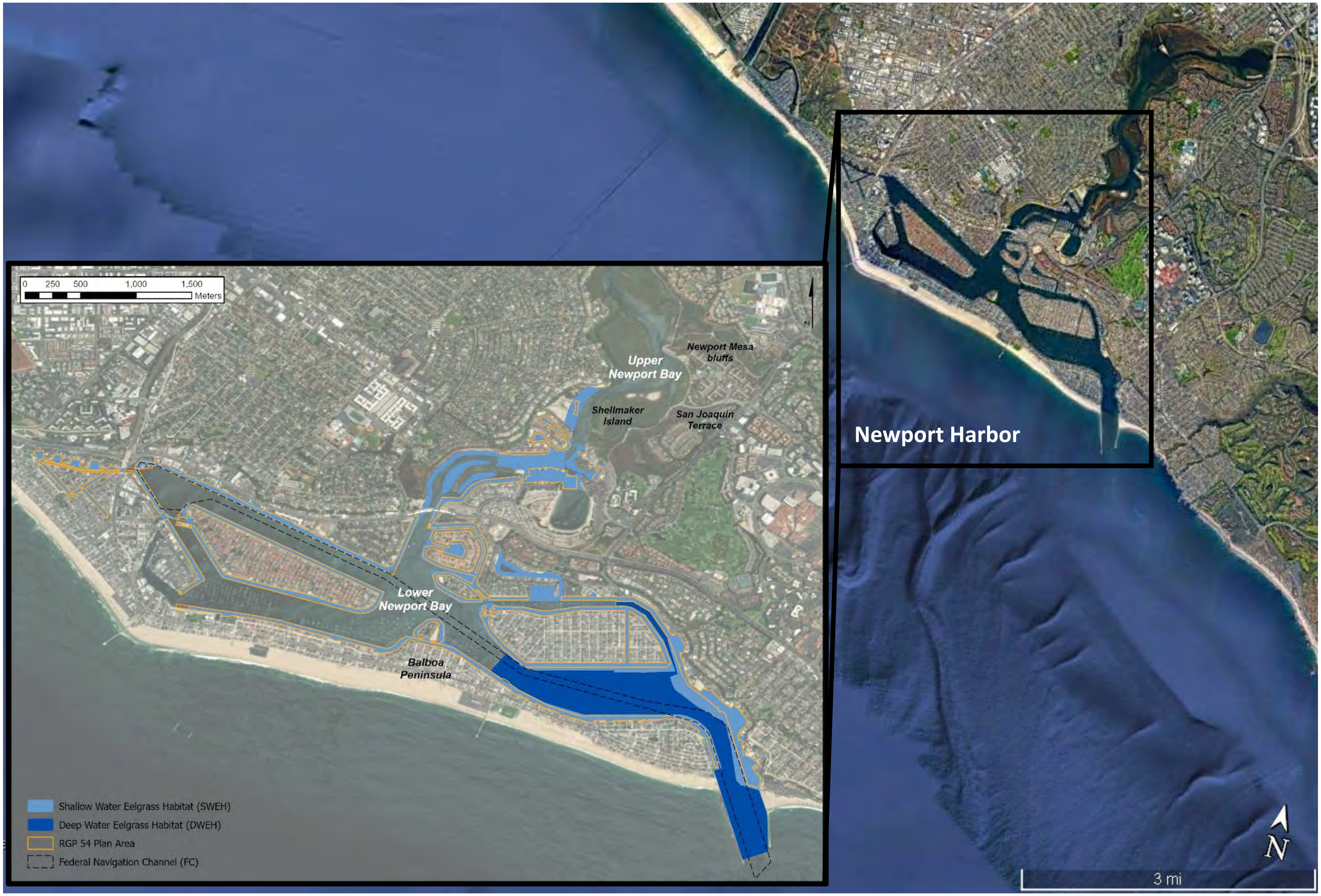

Figure 1. Regional map of Newport Bay in Newport Beach, California.

1-2 Background

Comprehensive historical surveys of eelgrass resources have occurred since 2003. These surveys were conducted by CRM until the 2018 survey which was completed by MTS. Summaries of their eelgrass mapping results in Newport Bay are provided below.

2003-2004 Survey Summary

A total of 30.4 acres (ac) of SWEH were mapped in shallow water at depths between 0-ft and -12-feet (ft) Mean Lower Low Water (MLLW). Mean station density averaged 212.8 turions per square (sq) meter (m) and ranged between 94 and 273.8 per sq m across 15 stations (CRM 2005).

2006-2008 Survey Summary

A total of 23.1 ac of SWEH were mapped between +0.7-ft and -12-ft MLLW. Turion density averaged 130.7 turions per sq m and varied between 67.1 and 221.9 turions per sq m across 10 stations (CRM 2010).

2009-2010 Survey Summary

A total of 19.92 ac of SWEH was mapped between 2009 and 2010. Turion density averaged 123.5 and ranged between 14.3 and 629 turions per sq m (CRM 2012). CRM also conducted DWEH mapping surveys in the Harbor entrance channel and navigation channels leading into Newport Harbor using sidescan sonar and mapped 45.4 ac of DWEH to depths of -28ft MLLW.

2012-2014 Survey Summary

This survey encompassed SWEH and DWEH within the Bay. A total of 88.27 ac of bottom habitat was covered by eelgrass between the low tide zone and -28.5-ft MLLW. Of this a total of 42.35 ac of vegetated SWEH was mapped between 0.0-ft and -15-ft MLLW. Turion density averaged 117 turions and ranged between 39.1 and 259.3 turions per sq m (CRM 2015).

2016 Survey Summary

This survey encompassed SWEH and DWEH within the Bay. A total of 104.5 ac of bottom habitat was covered by eelgrass between +0.5-ft and -29.5-ft MLLW. Of this a total of 53.0 ac of vegetated SWEH was mapped between +0.5-ft and -15-ft MLLW. Eelgrass turion density averaged 163.5 turions per sq m and ranged between 86.8 and 287.7 turions per sq m (CRM 2017).

2018 Survey Summary

This survey encompassed SWEH and DWEH within the Bay. A total of 58.18 ac of eelgrass were mapped between +0.5-ft and -15-ft MLLW during the 2018 survey. Eelgrass turion density averaged 223 turions per sq m and ranged between 32 and 416 turions per sq m (MTS 2018).

2020 Survey Summary

This survey encompassed SWEH and DWEH within the Bay. A total of 112.38 ac of bottom habitat was covered by eelgrass between +0.5-ft and -29.5-ft MLLW. Of this, 74.44 ac of vegetated SWEH was mapped between +0.5-ft and -15-ft MLLW. Eelgrass turion density averaged 98.6 turions per sq m and ranged between 16 and 336 turions per sq m (MTS and CRM 2020).

2022 Survey Summary

This survey encompassed SWEH and DWEH within the Bay. A total of 205.4 ac of bottom habitat was covered by eelgrass between +0.5-ft and -29.5-ft MLLW. Of this total, 109.01 ac of vegetated SWEH was mapped between +0.5-ft and -15-ft MLLW. Eelgrass turion density averaged 109 turions per sq m and ranged between 16 and 336 turions per sq m (MTS and CRM 2023).

The results of the surveys performed between 2003 and 2014 were used to identify three eelgrass stability zones in the Bay (CRM 2015). The first zone is the stable eelgrass zone where eelgrass distribution and density were relatively constant between 2003 and 2014 and underwater light levels were highest. The second zone is the transitional eelgrass zone where eelgrass acreage was observed to be highly variable and underwater light levels appeared to have had higher variation. The unvegetated eelgrass zone represents areas where eelgrass was not documented between 2003 and 2014 (CRM 2015).

1-3 Project Setting

Newport Bay is located within the City of Newport Beach, California (Figure 1). The City is bordered by three coastal cities, Huntington Beach to the northwest, Costa Mesa to the north, and Laguna Beach to the southeast. Newport Bay is generally divided into two regions**:** Lower Newport Bay and Upper Newport Bay. Prior to major development, Lower Newport Bay was a coastal lagoon. The lagoon was initially formed between 1824 and 1862 as a consequence of down current sand deposition from the Santa Ana River that formed a sand spit across the mouth of Upper Newport Bay. The sand spit eventually developed into present-day Balboa Peninsula (Stevenson and Emery 1958). Lower Newport Bay is a four-mile-long body of water orientated in a northwest-to-southeast direction, parallel to the coastline. Currently, the Bay is a multi-user system with both recreational and commercial uses. The Bay functions as a major navigational harbor and anchorage for approximately 4,500 small boats and larger vessels as well as a business center for marine-related activities and tourism. The Bay is also utilized as a transitional corridor where wildlife can move between the tidally influenced channel and the more protected marsh ecosystem of Upper Newport Bay or gain access to the open coastal marine environment.

Periodic dredging within the Bay is necessary to maintain navigation for vessel traffic, particularly in active portions of the Bay (Anchor QEA 2009). The FC in the Bay are maintained by the USACE. While dredging the FC may occur at -12-ft MLLW it generally occurs at depths deeper than -15-ft MLLW. Thus, most dredging activities for the FC are largely outside of SWEH areas. On occasion, dredging for the FC can impact eelgrass habitat that occurs at deeper depths (CRM 2017). Outside the FC, maintenance dredging is also necessary and is generally authorized under the City's RGP 54. The RGP 54 boundaries – known as the RGP 54 Plan Area – are generally entirely within the SWEH. The RGP 54 Plan Area is generally described as, "The bulkhead to pierhead line plus 20 feet bayward, including those exceptions for structures that extend beyond this boundary as of 2013 in conformance with harbor development regulations or policy."

Upper Newport Bay is characterized by mudflat, salt marsh, freshwater marsh, riparian, and upland habitats (CDFW 2018). Most of this area is primarily a salt marsh system with freshwater influence. The lower one-third of Upper Newport Bay, below Shellmaker Island, has undergone continued anthropogenic influence by dredging and filling for housing development, recreational swimming, marinas, and a boat launch. The Newport Bay watershed (~ 154 square miles), bounded by the Newport Mesa bluffs to the west and the San Joaquin Terrace to the east, drains towards the Pacific Ocean via Upper Newport Bay. The watershed is a major contributor of suspended sediments, nutrients, and other pollutants into the Bay ecosystem (EPA 2017). Major large-scale, upstream projects, improvements to water quality and runoff, coupled with the sediment catch basins maintained in the Upper Newport Bay have significantly reduced sediment loading into the Upper Newport Bay.

1-4 Eelgrass Biology

Eelgrass*, Zostera,* is a marine angiosperm (Kuo et al. 2006; Hemmings and Duarte 2000). This marine plant is one of 13 genera within 5 families of seagrasses (Les et al. 1997). Seagrasses are one of the most productive and valuable resources on earth. Seagrass beds absorb large quantities of the greenhouse gas, carbon dioxide, from the atmosphere and store it, resulting in carbon sequestration and storage (Kuwae and Hori 2019). Economically important, eelgrass provides habitat to sustain commercially important fisheries further supporting the recreational and commercial fishing industry and associated tourism industries (Phillips 1985; Dewsbury et al. 2016). In Southern California, eelgrass grows at depths ranging from the mid-to-low intertidal extending to -30-m MLLW at some protected offshore areas of the eastern Pacific Ocean (Phillips and Mendez 1988; Phillips and Echeverria 1990; Mason 1957; Coyer et al. 2007).

Two types of eelgrass are found offshore in the Channel Islands and along the coast of Santa Barbara County, *Z. pacifica* and *Z. marina* (Coyer et al. 2007). Since eelgrass varies greatly given different environmental parameters, species of *Zostera* can be challenging to identify in situ (Olesen and Sand-Jensen 1993). *Zostera* species observed during the majority of this 2018 survey were believed to be *Z. marina*. However, *Z. pacifica* was likely observed near the entrance to the channel. Hybridization of *Z. marina* and *Z. pacifica* has been observed in other settings (Olsen et al. 2014). If hybridization is occurring within Newport Bay, identification of these two species in situ may not be possible and further genetic testing may be required.

Eelgrass is a photosynthetic organism that sustains fish and other marine life through nutrient transformation and by releasing oxygen into the marine environment (Yarbro and Carlson 2008). These plants can support a diversity of life by creating structure over otherwise featureless soft-bottom habitats. Eelgrasses can form extensive beds in shallow, protected, estuarine, or other near shore environments. These seagrasses host a variety of marine species including microbes, algae, invertebrates (including lobsters, crabs, worms, snails, clams, sea stars, and octopus), and fishes (Thresher et al. 1992; Valentine and Heck 1999). Some fish species are present throughout their life stages while other fishes utilize eelgrass beds during periods of juvenile development. Other vertebrates including fishes, seabirds, sea lions, and green sea turtles utilize eelgrass beds as foraging grounds.

In addition to sustaining many forms of marine life, eelgrass reduces erosion processes and increases seafloor stability (de Boer 2007). Other marine plants, sessile organisms, and sediments are secured to the seafloor by the dense rhizome mats that penetrate these areas. Additionally, the three-dimensional blade structure of eelgrass acts to dampen waves and softens the impacts of wave action. In some areas of extreme reduction in wave action, sediments and organic matter may begin to be deposited.

Z. marina has historically grown in both Lower Newport Bay and Upper Newport Bay. However, the distribution and abundance of eelgrass in this area has varied over time (CRM 2002, 2005, 2008, 2010, 2012, 2015, 2017, MTS 2018, 2020). The importance of this habitat for marine life can sometimes conflict with the need for the City of Newport Beach to maintain and sustain a viable commercial and recreational harbor, maintain safe navigation, and for the City and its residents to maintain the integrity of their boat docks and piers. Consequently, the City has committed to consistently conduct these surveys to better understand the distribution of eelgrass over time. The resulting data help facilitate both the City's resource and the regulatory agencies' support of long-term planning and management of eelgrass within the harbor.

1-5 Eelgrass Regulatory Setting

General Eelgrass Regulations

The federal government designates eelgrass as an Essential Fish Habitat (EFH) and a Habitat Area of Particular Concern (HAPC) under the Magnuson-Stevens Fishery Conservation and Management Act of 1996 (FR 62, 244, December 19, 1997; Pacific Fishery Management Council, 2008). Eelgrass habitat is considered as EFH and a HAPC as it is a key foundation to a healthy marine habitat and provides necessary ecosystem functions to sustain populations of marine organisms. The designation as an EFH requires federal agencies to consult with the National Oceanic and Atmospheric Association (NOAA) Fisheries on ways to avoid or minimize the adverse effects of their actions on eelgrass.

NOAA provides guidelines for eelgrass management under the California Eelgrass Mitigation Policy and Implementing Guidelines (CEMP) (NOAA Fisheries, West Coast Region, 2014). These guidelines provide comprehensive and consistent information to ensure the actions taken by federal agencies result in "no net loss" of eelgrass habitat or function. Under the CEMP, biologists will assist federal agencies to mitigate for unavoidable impacts and create 20 percent more eelgrass habitat than was destroyed.

Eelgrass does not have a formal listing as a state or federal endangered, rare, or sensitive species. However, the California Department of Fish and Wildlife, U.S. Fish and Wildlife Service, and NOAA Fisheries understand the importance of protecting this resource. Additionally, eelgrass is protected under the Clean Water Act, 1972, as it is considered vegetated shallow water habitat.

Environmental legislation under the National Environmental Policy Act (NEPA) and State of California Environmental Quality Act (CEQA) dictates that project designs for coastal projects should:

- Make all possible attempts to avoid impacts to eelgrass.
- Minimize the degree or magnitude of impacts to eelgrass.
- Rectify or compensate for unavoidable eelgrass habitat loss by restoring soft-bottom habitat with eelgrass using transplant techniques.
- Reduce or eliminate impacts to eelgrass over time by preservation and maintaining eelgrass over the life of the project.

The 2018 Department of Fish and Wildlife Ocean Fishing Regulations include regulations on the collection of marine plants such as:

- There is no closed season, closed hours or minimum size limit for any species of marine aquatic plant that can be collected.
- The daily bag limit on all marine aquatic plants for which the take is authorized is 10 pounds wet weight in the aggregate.
- Marine aquatic plants may not be cut or harvested in state marine reserves.
- No eelgrass (*Zostera*), surf grass (*Phyllospadix*), or sea palm (*Postelsia*) may be cut or disturbed at any time.

The California Code of Regulations, Title 14, 650. Natural Resources, Division 1. Fish and Game Commission-Department of Fish and Wildlife. Subdivision 3, General Regulations. Chapter 1, Collecting Permits states, “Except as otherwise provided, it is unlawful to take or possess marine plants, live or dead birds, mammals, fishes, amphibians, or reptiles for scientific, educational, or propagation purposes except as authorized by a permit issued by the department."

Newport Beach Eelgrass Regulations

Additional protection is afforded under both State and local City of Newport Beach codes and plans. The City of Newport Beach Policies state that the City of Newport Beach, within its adopted Coastal Land Use Plan (City of Newport Beach 2019), acknowledges the importance of eelgrass in Newport Harbor, as well as the "…*need to maintain and develop coastal-development uses in Newport Harbor that may result in impacts to eelgrass*" and "*Avoid impacts to eelgrass (Zostera marina) to the greatest extent possible. Mitigate losses of eelgrass at 1.2 to 1 mitigation ratio and in accordance with the Southern California Eelgrass Mitigation Policy. Encourage the restoration of eelgrass throughout Newport Harbor where feasible*" (CLUP 4.2.5-1). The Southern California Eelgrass Mitigation Policy was superseded by the CEMP in 2014.

In 2015, as part of the City's RGP 54 permit, the City of Newport Beach adopted a Newport Bay specific eelgrass mitigation plan (EPMP) (City of Newport Beach, 2015). The EPMP is an outcome of the City of Newport Beach HAMP, as adopted April 2010 and approved by City Council in November 2010 (Weston Solutions Inc. et al. 2010). The HAMP was established to set goals and best management practices (BMPs) to ensure a healthy eelgrass population within Lower Newport Bay. The EPMP seeks to protect and promote a long-term sustainable eelgrass population while supporting Lower Newport Bay's navigational and recreational beneficial uses. The goal of the EPMP is an ecosystem-based approach that works by protecting a sustainable eelgrass population in the Lower Newport Bay and enforcing BMPs that will promote eelgrass growth.

Under the RGP 54, the EPMP authorizes temporary impacts to eelgrass resulting from minor maintenance dredging activity under and adjacent to private, public, and commercial docks, floats, and piers. The areal extent of temporary impacts authorized under the RGP 54 is based on these biannual eelgrass surveys and dependent on the area of eelgrass within the harbor. Demolition, repair, and in-kind replacement of docks (including piers, gangways, floats, and piles), bulkheads, and piles with similar structures are excluded from the RGP 54 and the EPMP. Impacts to eelgrass not authorized under the RGP 54 requires individual mitigation pursuant to the CEMP.

2 Methods

2-1 Project Staff

This report relies on a combination of data collected by CRM and results from this year's, 2024, diver survey efforts conducted by MTS. Integral staff for this survey included Dr. Robert Mooney (Principal Investigator), Grace Teller (Senior Biologist, M. Sc.), Eila Miller (Associate Biologist, B. A.), Madigan Boborci (Dive Technician, B. Sc.), Kyle Black (Dive Technician, M. Sc.), Erik Mahan (Dive Technician, M.A.Sc.), Jason Carroll (Dive Technician, B.Sc.), and Gavin Goya (Dive Technician, B. Sc.). Dr. Mooney contributed to project oversight, client communication, and report review. Eila acted as the field team project manager responsible for training staff, scheduling, and ensuring the quality of work conducted daily. Erik, Jason, Kyle, and Madigan acted as field team divers and topside support. Grace was responsible for supporting the field team project manager and drafting the 2024 report summary. CRM staff, Rick Ware and Tom Gerlinger, supported the 2024 survey through collection of sonar data, mapping support, and review of deliverables.

2-2 Project Location

The surveys were conducted in Newport Bay, located within Newport Beach, Orange County, California. Observations and mapping occurred between August 1, 2024, and December 13, 2024. Density measurements were taken across the Bay at the time of eelgrass mapping when a new region was surveyed (Figure 2). The survey area included intertidal and subtidal soft-bottom habitats of Newport Bay. Many of these areas parallel rip-rap shorelines and/or headwalls. Shallow water eelgrass habitat is defined as the area extending from the intertidal zone to a depth of -15-ft MLLW. For comparison to previous surveys performed by CRM, and to allow for simplified acreage counting, the Bay was divided into the same 23 SWEH mapping regions and 1 DWEH mapping region as used in prior reports. An additional SWEH mapping region (region 25) was added during this mapping effort (Figure 2).

2-3 Environmental Parameters

Horizontal and vertical visibility observations were recorded daily. After completing a continuous section of survey area, where the visibility underwent no noticeable change, horizontal visibility observations were approximated at depth. Vertical visibility was taken at the beginning of each survey day and on occasion, at the end of the survey day. This measurement was taken by using a fiberglass measuring tape to slowly lower a Secchi disk into the water. Once the Secchi disk was no longer visible in the water column the depth of the Secchi disk was recorded. Mean underwater visibility was calculated for horizontal and vertical visibility per region. The mean and standard deviation was calculated across all survey dates and compared to historical visibility values.

Surface water temperature was taken at the start and end of most survey days. The diver's computer was held at the surface of the water for at least 30 seconds or until reaching equilibrium, and then the temperature was recorded. Mean and standard deviation was calculated for surface water temperature recordings collected in each region.

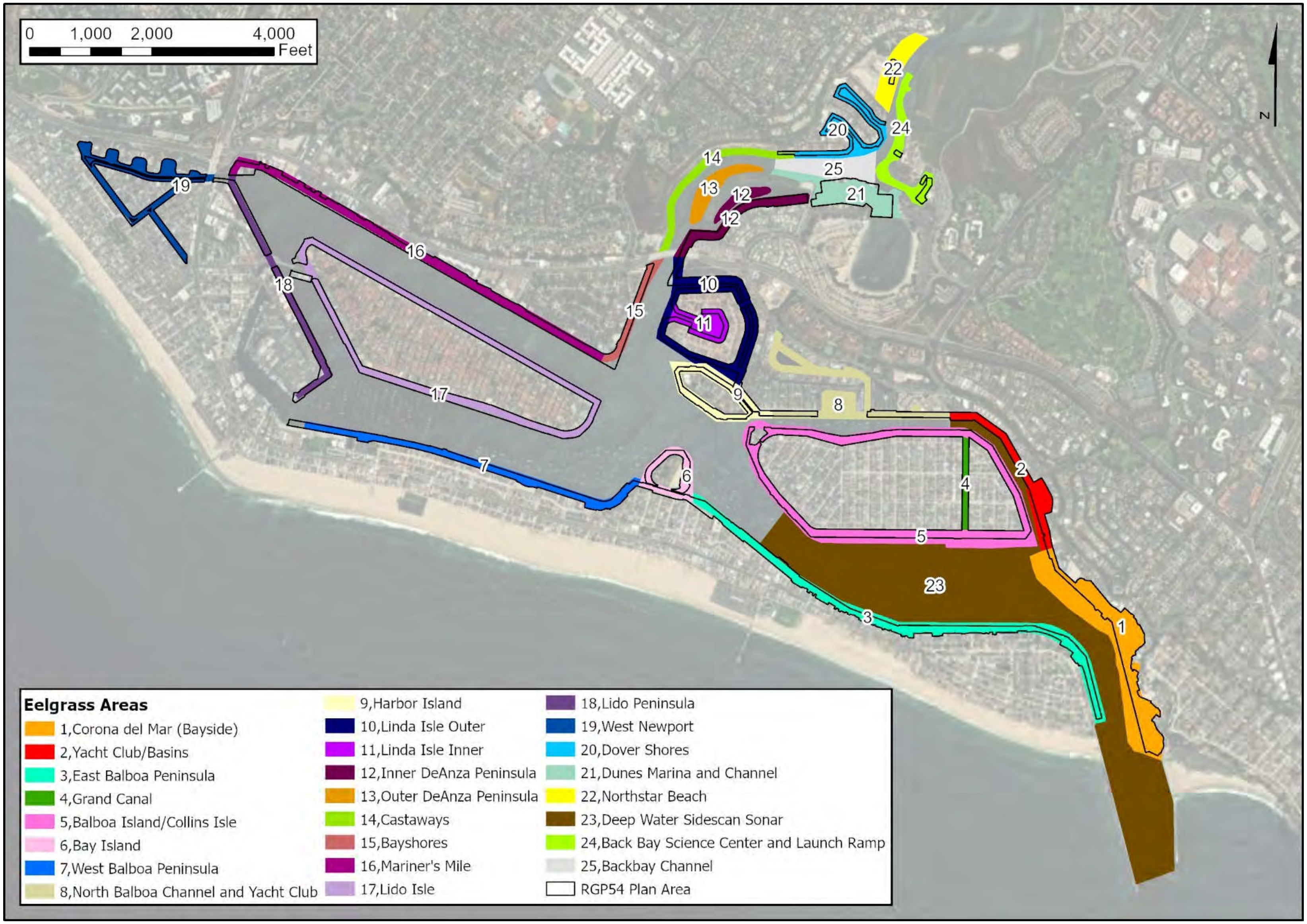

Figure 2. Map of Newport Bay showing 24 shallow water eelgrass habitat mapping regions and the deep-water eelgrass habitat mapping region.

2-4 Sonar Survey Methods

Sonar Survey – SWEH

CRM used remote sensing techniques, (traditional sonar and down-looking sonar) to supplement both the SWEH diver surveys conducted by MTS and the DWEH sidescan sonar survey conducted by CRM. The surveys were conducted from CRM's 22 foot-long research vessel. The traditional sonar and down-looking sonar systems were used to survey areas within the -2 and -28 ft contours where diver survey areas were either extremely large and/or where dive conditions were considered hazardous due to currents or vessel traffic.

Sonar methods were used to augment the SWEH diver mapping surveys in the larger areas and/or in navigational areas considered a risk to divers (Regions 1, 2, 5, 8, 9, 10, 11, 12, 13, 14, 20, and 24). An additional area (Region 25) was added because eelgrass had colonized the center of the main channel in Upper Newport Bay between Dover Shores and Shellmaker Island. Surveys were conducted on August 7, 8, 14, and 19, 2024. Video verification of eelgrass habitat was also conducted on August 19, 2024.

The CRM vessel conducted the SWEH surveys along vessel tracklines spaced 15-20 ft feet apart are illustrated in Appendix A. CRM's Lowrance HDS Carbon 12 Chartplotter/Ecosounder was used to acoustically collect data on bottom depth and vegetation biovolume from unit's 200-kilohertz (kHz) transducer acoustic signal associated with a Wide Area Augmentation System-corrected GPS position. In addition, a 455/800 kHz transducer and power module with dual channels (Structure scan and down-looking) provided a real-time 180-degree view and a down-looking view of the bay floor (data were logged on the 800-kHz channel).

Acoustic beam angle for the 200-kHz signal on the 83/200-kHz dual frequency transducer (standard transducer on HDS units) was 20 degrees; the beam coverage for the 455/800 dual frequency transducer was 180 degrees with side lobe angles of 0.9 degree and the down-looking lobe of 1.1 degrees. This narrow elliptical beam essentially "scans" seafloor bottoms. Ping rates were set at 15 per second. Pulse width was dynamic and varied depending on depth, which varied between 2 and 30 ft. Acoustic data were collected at the Lowrance default of 3,200 bytes per second. The range window on the unit was set to Auto, which maximized the resolution of the acoustic envelope at the full range of depths sampled (approximately 2 and 28 ft).

GPS positions were recorded every one second, and bottom features from pings that elapsed between positional reports were averaged for each coordinate/data point. Therefore, the attribute value (e.g., depth and plant height) of each data point along a traveled path comprised a summary of 5 to 30 pings. Each ping went through a quality test to determine whether features could be extracted and, if so, was sent on to feature detection algorithms. Those failing quality assurance tests were removed from the set considered for summarization.

Vegetation detection using down-looking sonar methods were analyzed using cloud-based software models and statistical algorithms incorporated into BioBase EcoSound cloud-based software developed by Contour Innovations, LLC, St. Paul, Minnesota (Contour Innovations LLC 2013).

Acoustic signals from HDS 200-kHz transducers travel through submerged aquatic vegetation (SAV) on their way to the bottom. Soft-bottom areas typically register a sharper echo return than the vegetation above. The distance between the seafloor acoustic signature and top of the plant canopy was recorded as the plant height for each ping. Plant height data included for analysis was limited to a minimum detection limit of 1% of bottom depth. Thus, at a three-foot depth, minimum plant height detection was 0.4 inches whereas along the offshore track lines at 20 ft depths, minimum plant height was in the approximate range of 2.4 inches. Any vegetation detections within this range were considered "present" in vegetation calculations and modeling.

Sonar Survey – DWEH

Sonar surveys were conducted in Region 1 (Corona del Mar), Region 2 (East Balboa Channel), and Region 22 (Newport Harbor Main Channel) on August 14 and 15, 2024, followed by a remote video verification survey on August 22 to verify the results of sidescan eelgrass habitat mapping.

The DWEH sonar survey utilized sidescan sonar imaging and multibeam echosounder (MBES) methods. The sidescan sonar imaging data and MBES bathymetric data were obtained using a fully-integrated Ping 3DSS-iDX Full Shallow Water Mapping/Imaging System. The 3DSS system allows for the simultaneous collection of sidescan sonar imaging data from the same transduce using Computed Angle-of-Arrival Transient Imaging (CAATI) processing. Position data was obtained from an integrated SBG Ellipse 2 Navigation System consisting of an RTK GPS and Inertial Motion Sensor. Sound velocity data was continuously recorded at the surface using an AML Micro-X Sound Velocity Probe.

Vessel navigation and data recording were accomplished using a separate computer running HYPACK software. RTK GPS corrections were obtained using the Networked Transport of RTCM via Internet Protocol (NTRIP) system. A purpose-built transducer mount was rigidly attached to the survey vessel, with the Ping 3DSS transducer attached to the mount. The surface electronics were mounted on a table protected by a dodger. All components were electronically connected. Then the various systems were started and tested for proper function.

Following completion of the equipment tests, the system calibration was conducted. The Ellipse 2 Navigation System was calibrated using SBG calibration software included with the system. The survey vessel with run, at speed, a series of Figure 8 maneuvers while running the calibration program. The program will calculate the offsets between the RTK antennas and the IMU motion sensors. When these values are known to an acceptable degree, the offsets were stored and the calibration concluded.

A MBES patch test was conducted. A series of adjacent parallel transects was run while recording sounding data. The location of the lines was determined using the following criteria:

- Near the deepest depth of the survey area;
- Separated by a distance approximately equal to the water depth;
- Over a flat seabed; and
- Over steep slope.

The vessel navigation channel met these criteria and was used for the patch test. Once the data had been collected it was processed using the HYPACK HYSWEEP patch test routine to determine the offset between the Ping 3DSS transducer and the Ellipse Navigation System.

To minimize turns during data collection, the survey area was divided into overlapping sub-regions that was covered with straight line segments. Using the navigation display of the HYPACK online software, the vessel was steered along pre-planned shore-parallel tracklines spaced 100 ft apart. Due to existing on-water obstructions such as the mooring area both north and south of the navigation channel, it was necessary to adjust these lines during the survey. Vessel tracklines along which data were collected are illustrated in Appendix A. The August 22 survey remote underwater video transects tracklines in the deep-water areas to assess the absence or presence of invasive algae are also provided in Appendix A.

The Ping 3DSS-iDX Full Shallow Water Mapping/Imaging System was operated at a 15-meter (50 ft) range (each channel) providing 100% data overlap. Infill lines were added as required to maintain approximately 100% overlap within the mooring areas. The sidescan imaging and MBES data was recorded both on the Ping 3DSS operating computer and using the HYPACK computer for redundancy. Prior to, during, and following data collection activities sound velocity profiles were recorded by lowering the AML Micro-X probe to the bottom.

Sonar Survey – Analysis

For both the SWEH and DWEH traditional and down-looking sonar surveys, processed acoustical signal depth and vegetation point features were uploaded to the BioBase ordinary point kriging algorithm that predicted values in unsampled locations based on the geostatistical relationship of the input points. The kriging algorithm is an "exact" interpolator in locations where sample points are close in proximity and do not vary widely. Kriging smooths bottom feature values where the variability of neighborhood points is high. Using this technique, kriging-generated maps were produced to illustrate spatial trends for depth contours and vegetation probability distributions based on detected acoustical returns. Eelgrass polygons shape files (.shp) were produced by tracing the outlines of the merged eelgrass vegetation heat map files which were then inputted into ArcGIS for final editing display of the final results.

The sidescan sonar imaging data was processed using SonarWiz software: The MBES data was processed using the HYPACK HYSWEEP processing software. The horizontal datum was California State Plane, Zone 6, US Survey feet. The vertical datum was Mean Lower Low Water (MLLW) based on the NTRIP RTK GPS correction data and confirmed using NOAA water level data. Eelgrass polygon shape files (.shp) of identified eelgrass habitat were constructed based on the combined mosaic of individual tracklines and Biobase produced eelgrass polygons shape files (.shp). These files were then inputted into ArcGIS for final editing and display of final eelgrass habitat within the deep-water habitat.

Sonar Survey – Eelgrass Verification

At the completion of the sonar track line surveys and after initial sidescan sonar and traditional sonar maps had been produced, a sonar target verification survey was conducted using remotely deployed underwater video cameras to verify the presence of eelgrass as determined during the sonar surveys. In addition, this survey was conducted to assess the presence of invasive algae, per directive of the City of Newport Beach.

Figure 3. "Splash Cam" underwater camera setup.

An Ocean Systems "Splash Cam" was used to view the bay floor in real time along 7 transects using the Lowrance navigation unit's display (Figure 3). Concurrently, underwater video was recorded for later review using a GoPro 7 unit. The units were deployed from the vessel's davit.

A total of 10 underwater videos were recorded along the seven transects that totaled 1.4 hours of video. Individual videos that ranged between 4 and 18 minutes in length. Twenty-one specific individual GPS waypoints were also evaluated for the presence of eelgrass and/or invasive algae. Still photographs were also obtained from the recorded video that provided additional information.

2-5 SCUBA Diver Survey Methods

The survey involved visual SCUBA diver surveys within all SWEH extending from the intertidal zone to 20-ft in-Bay beyond the end of all channels and dock structures within Upper and Lower Newport Bay as proposed by the City.

The diver was outfitted with a full-face-mask compatible with an Ocean Technology Systems (OTS) surface-to-diver communication system. In addition to the OTS underwater communication system the diver towed a surface marker mounted with a satellite-based augmentation system (SBAS) global positioning system (GPS). The topside personnel connected to the diver-towed SBAS GPS using a computer tablet for mapping eelgrass polygons and patches, marking waypoints, and taking notes. A Juniper Systems Geode SBAS GPS was used for the entirety of the survey. The estimated error of the Geode SBAS GPS is better than half-meter accuracy. The error is based on how the GPS functions in clear open skies without any interference from structures. However, on some occasions the error was higher because the survey area occurred near bulkheads, underneath piers, and between docks where open skies were not always possible. In these instances, error was estimated to be a maximum of 1 m. In cases where GPS error produced obviously erroneous results, edits were made manually using landmarks. The GPS in use was connected to the tablet via Bluetooth. Once the tablet and GPS were connected a mapping application, mapitGIS or ArcGIS FieldMaps, was opened on the tablet and used to collect waypoints from the GPS and map the extent of eelgrass within the survey area.

At a survey site, the diver would enter the water and be followed by the topside person on a kayak until eelgrass was found. If eelgrass was not readily observed upon entry to the survey site, the topside person would then use compass navigation to direct the diver in the direction to continue searching. Once the diver, using underwater communications, signaled to the topside person that they were on the edge of an eelgrass bed, the topside person would ready the mapping application to begin mapping a new polygon. GPS signals were collected every 2 seconds via the mapping application as the topside kayaker stayed near the diver-towed GPS as the diver swam around the eelgrass bed. Once the diver got back to the first GPS recording and the entirety of the eelgrass bed was outlined, the polygon was ended. The diver then relayed details about the eelgrass bed to the topside kayaker. This information included scaled high-low density, blade height, sediment, and other marine life present. The topside kayaker would then take water depth measurements using a weighted tape measure on both the inshore and offshore edge of the polygon. If the area of eelgrass was less than 2 sq ft it was marked as a single patch waypoint and the dimensions were recorded in the mapping application. At the end of each survey day, all polygons, patches, waypoints, and notes were exported as ESRI shapefiles (SHP) and in Google Earth (KML) file formats for validation and post processing.

Data validation consisted of importing the files into Google Earth Pro to review the polygon shapes. The surveyed area was segmented into close-up sections and converted to PDF format for document annotation. Areas where outlier signals were detected, locations where merger of two or more polygons or cut outs of polygons were needed, and segments of polygons where they were mapped more than once were redlined on the PDF document. These revisions guided post-processing eelgrass survey efforts. Post processing of data used exported SHP files and referenced the redlined PDF documents to finalize eelgrass polygons using ArcMap. This combination of formats allowed the biologists who performed the survey to view and annotate data which were then processed in ArcMap by a GIS Specialist.

Eelgrass Density

Turions are eelgrass units consisting of the above-sediment portion of the eelgrass. Turions consist of a single shoot and "blades" (Leaves) that sprout from each shoot. To assess eelgrass habitat vegetation cover, 10 density measurements were collected at 25 stations throughout the study area. The 25 stations included all surveyed regions except for Lido Peninsula where only a small patch of eelgrass was reported. Upon returning to this eelgrass patch to collect density measurements later in the year this eelgrass was no longer observed. Region 5 had two sampling locations to account for the difference in sun angle around balboa Island.

The diver counted the number of live, green turions at the sediment/shoot interface within replicated 1/16th sq m quadrats at each station. These counts were collected along a transect, extending from the shallow to deep edge of an eelgrass bed at each sampling station. Along each transect, density measurements were collected at the same interval extending from shallow to deep. The collection interval was dependent on the length of the transect and ability to collect 10 measurements along the transect. All biologists taking density measurements of eelgrass were trained previously on how to appropriately assess the number of living eelgrass turions per quadrat. Coordinates of the 25 surveyed sites are provided with density results (Section 6).

Field-collected density counts were entered into an Excel spreadsheet by region and by shallow or deep location and converted into density per sq m. Summary statistics where then calculated (mean and standard deviation) for each station and location. This information was summarized in tabular and graphic format.

Caulerpa

An effort was made to search for *Caulerpa* spp. during the diver survey effort. As the diver swam the boundaries of eelgrass beds, swam along the seafloor between eelgrass beds, and collected eelgrass density measurements they were visually observing the seafloor searching for the presence of *Caulerpa* spp. The diver paths swam along the seafloor between eelgrass bed delineations were recorded. All diver paths including both during and between eelgrass bed delineations where the diver visually observed the seafloor were processed in ArcMap by a GIS Specialist. The resulting information was processed to show all areas where visual observation for the presence of *Caulerpa* species on the seafloor occurred.

3 Eelgrass Habitat Mapping Survey Results

3-1 Underwater Visibility and Temperature Measurements

Underwater Visibility

The range of horizontal and vertical visibility was dependent on environmental conditions and distance from the harbor mouth. In cloudy sky conditions, less light penetration occurred at depth resulting in overall lower visibility conditions. Additionally, storm events in November temporarily reduced underwater visibility for 3 or more days following the storm event. Vertical visibility seemed to be related to a combination of proximity to the Bay entrance and sediment disturbance. Water was generally clearer close to the Bay entrance unless currents were able to suspend sediment. Moving away from the entrance, visibility generally declined except in areas where calm water meant minimal suspension of sediment. Vertical visibility ranged from ≤ 1.0-ft to 9.0-ft (Figure 4). Patterns of horizontal visibility were like vertical visibility. Horizontal visibility was largely impacted by tidal conditions. Two parameters, direction of tidal flow and rate of tidal exchange, influenced horizontal visibility. Water depth also impacted horizontal visibility where, generally, in most regions deeper waters were clearer than shallow nearshore water. The best visibility was observed during periods of rising tides with moderate to low tidal exchange. Tidal influence was reduced north of the Highway 1 bridge and in protected areas around Linda Isle and West Newport. In these areas, visibility was generally moderate as the more stagnant water reduced sediment suspension. Horizontal visibility ranged between ≤ 1.0-ft and 9.0-ft (Figure 5). On average horizontal visibility ranged between 1-ft and 6-ft. However, on occasion less than 1-ft of horizontal visibility was observed for short periods of time. Average horizontal visibility is comparable to historical averages and was greater than average horizontal visibility reported in 2022 (Figure 6).

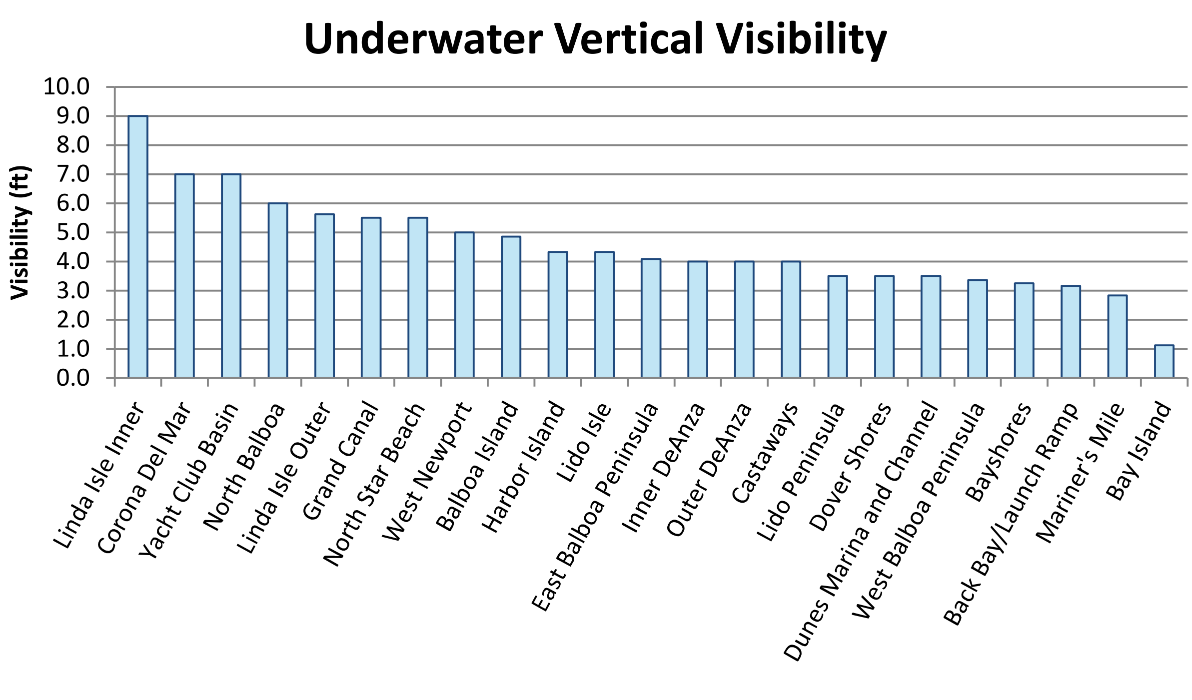

Figure 4. Underwater vertical visibility in feet at survey areas throughout Newport Bay in 2024. Note that vertical visibility is a function of conditions at the time of the survey and does not necessarily indicate a consistent poor water quality condition at any given location.

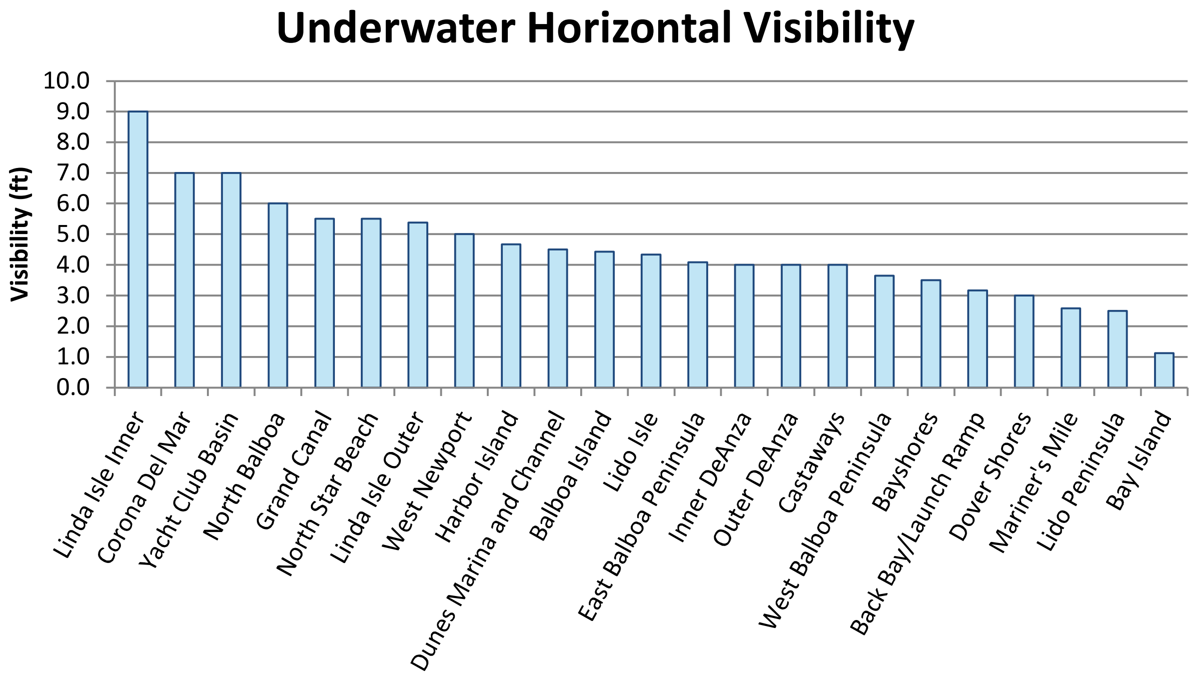

Figure 5. Underwater horizontal visibility in feet at survey areas throughout Newport Bay in 2024. Note that horizontal visibility is a function of conditions at the time of the survey and does not necessarily indicate a consistent poor water quality condition at any given location.

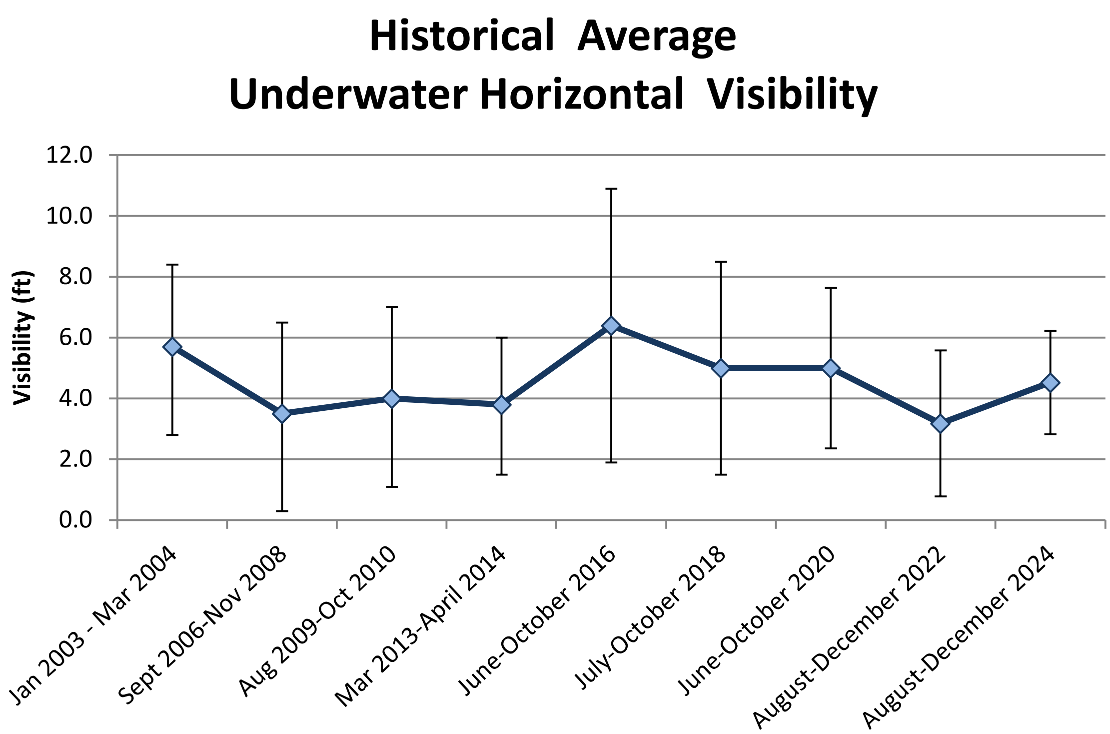

Figure 6. Historical averages of underwater horizontal visibility from 2003 through 2022. Error bars are one standard deviation.

Water Temperature

Location within the Bay and time of the year affects the surface temperature readings collected. Surface water temperature ranged from a low of 60 degrees Fahrenheit (°F) in Region 8 North Balboa, Region 2 Yacht Club Basin, and Region 1 Corona Del Mar during early December, to a high of 73.5 °F in Lido Isle and West Balboa Peninsula , near the middle to end of August (Figure 7). In general, average surface water temperature was warmer in regions surveyed in summer/early fall months (August-October) and cooler in late fall/winter months (November-December) (Figure 8).

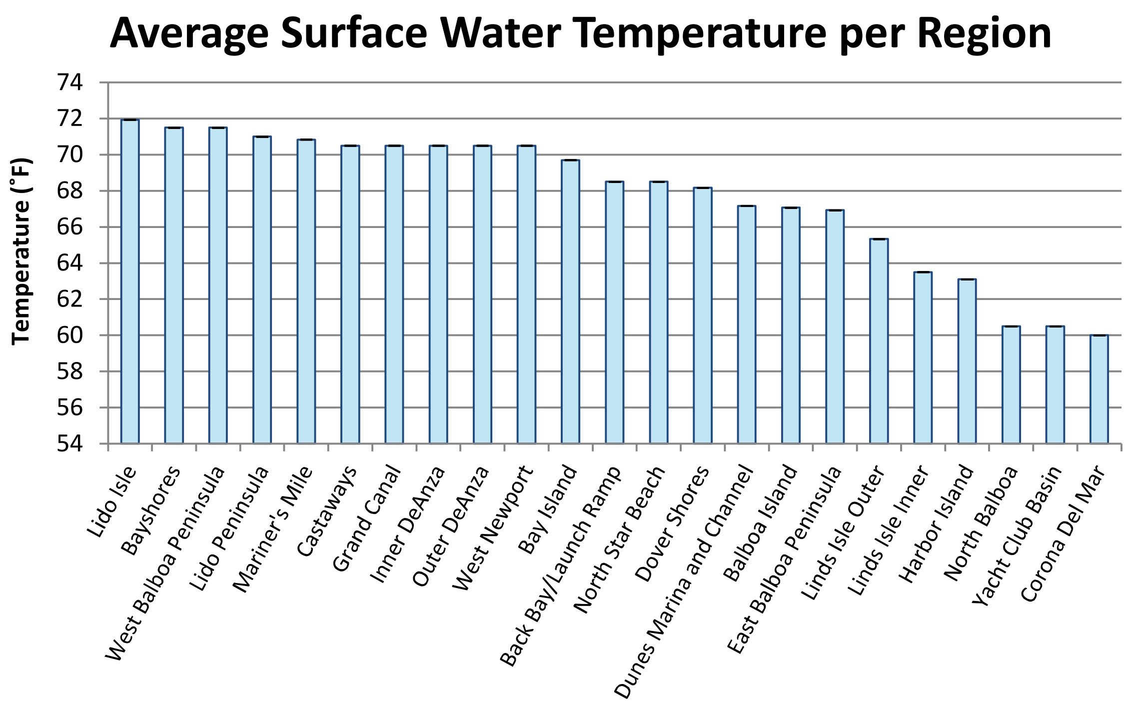

Figure 7. Average surface water temperature by region during the 2024 eelgrass mapping survey. Error bars are one standard deviation.

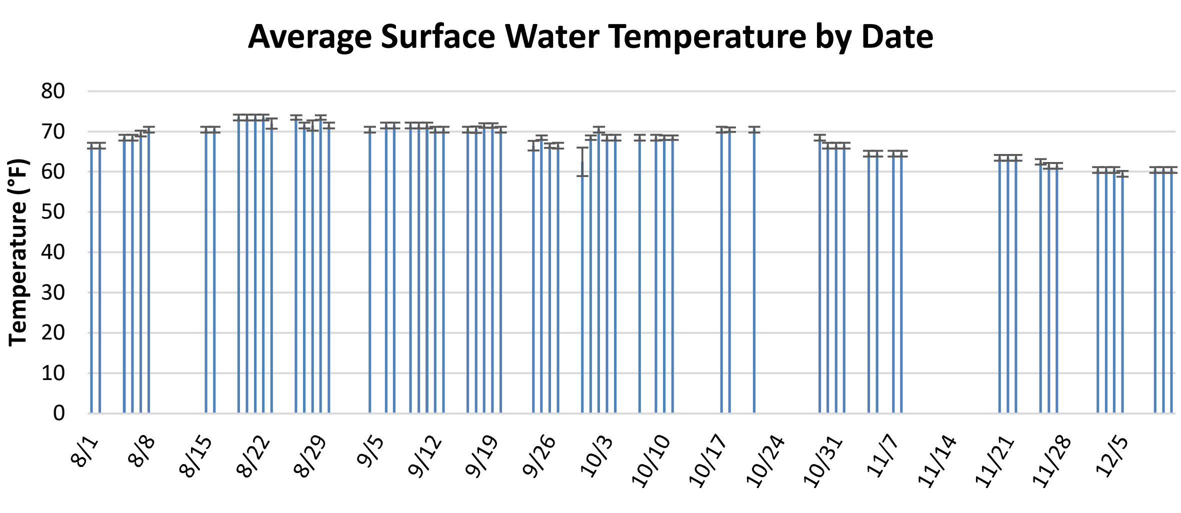

Figure 8. Average surface water temperature by date during the 2024 eelgrass mapping survey. Error bars are one standard deviation.

3-2 Eelgrass Distribution and Abundance

A total area of 190.0 ac was mapped depicting eelgrass beds in Newport Bay during this 2024 survey. This included 125.5 acres of SWEH and 64.5 acres of DWEH. Total acreage and percent of total reported acreage by region are provided in Table 1. A summary of eelgrass polygons and patches mapped within SWEH are provided in Figure 9.

SWEH was mapped at depths between +0.5 and -15-ft MLLW. The -15-ft MLLW limit was a survey limit for the SWEH and not an eelgrass depth limit. DWEH was mapped at depths between -15 and -25-ft MLLW that included the Newport harbor Entrance Channel, and the Balboa Reach located in the FC. To compile this information, the survey team used a combination of diver/GPS tracking methods and down-looking sonar survey methods.

Zostera marina was the most widespread species of eelgrass within the Bay. MTS corroborates CRM 2016 findings that a second species of eelgrass was also present. *Zostera pacifica* was present and was observed in the entrance channel and along Corona del Mar. There was no indication that *Z. pacifica* was localized to certain depth ranges within the regions it was observed.

Table 1. Table summarizing eelgrass acreage and percent of total reported eelgrass within the 25 survey regions.

ID	Region	Acreage	% of Total
1	Corona del Mar (Bayside)	21.18	11.14%
2	Yacht Club/Basins	5.38	2.83%
3	East Balboa Peninsula	6.84	3.60%
4	Grand Canal	1.19	0.63%
5	Balboa Island/Collins Isle	18.99	9.99%
6	Bay Island	1.67	0.88%
7	West Balboa Peninsula	0.77	0.40%
8	North Balboa Channel and Yacht Club	2.60	1.37%
9	Harbor Island	6.94	3.65%
10	Linda Isle Outer	8.17	4.30%
11	Linda Isle Inner	5.16	2.71%
12	Inner DeAnza Peninsula	11.90	6.26%
13	Outer DeAnza Peninsula	7.33	3.86%
14	Castaways	5.14	2.70%
15	Bayshores	1.08	0.57%
16	Mariner's Mile	1.72	0.90%
17	Lido Isle	2.02	1.06%
18	Lido Peninsula	0.00	0.00%
19	West Newport	0.15	0.08%
20	Dover Shores	6.40	3.37%
21	Dunes Marina and Channel	3.85	2.03%
22	Northstar Beach	0.33	0.18%
23	Deep Water Sidescan Sonar	64.53	33.95%
24	Back Bay Science Center and Launch Ramp	4.28	2.25%
25	Back Bay Channel	2.45	1.29%

Figure 9. Map of eelgrass coverage observed during the 2024 survey.

3-3 Deep Water Eelgrass Distribution

Region 23. Deep Water Eelgrass Habitat (64.53)

The results of the detailed sidescan and downlooking sonar surveys identified 64.53 ac of DWEH within the Newport Bay Entrance Channel and Balboa Reach (Figure 10). DWEH was mapped between -15-ft and -25-ft MLLW in the entrance channel and occurred slightly shallower extending away from the harbor entrance. DWEH accounted for 8.03% of the Newport Bay soft bottom habitat during the 2024 survey.

Figure 10. 2024 Eelgrass Habitat Map. Region 23 (Deep Water Eelgrass Habitat).

3-4 Shallow Water Eelgrass Distribution by Region

The greatest eelgrass coverage was observed in Region 1, Corona del Mar (Bayside). Here eelgrass covered 21.18 ac and accounted for 16.87% of the total mapped SWEH. Any eelgrass mapped within SWEH that fell outside the Region boundary is included within the total acreage for the nearest associated region, with the exception of Region 25 that was added during this year's survey effort.

Three shallow water regions accounted for 41.48% of total SWEH mapped:

- Corona del Mar (Bayside) (21.18 ac)
- Balboa Island/Collins Isle (18.99 ac)
- DeAnza Peninsula – Inner (11.90 ac)

Table 2. Table summarizing eelgrass acreage and percent of total SWEH reported in the 24-shallow water survey regions. Region 23 is excluded from the table because that was a DWEH region.

ID	Region	Acreage	% of Total
1	Corona del Mar (Bayside)	21.18	16.87%
2	Yacht Club/Basins	5.38	4.28%
3	East Balboa Peninsula	6.84	5.45%
4	Grand Canal	1.19	0.95%
5	Balboa Island/Collins Isle	18.99	15.13%
6	Bay Island	1.67	1.33%
7	West Balboa Peninsula	0.77	0.61%
8	North Balboa Channel and Yacht Club	2.60	2.07%
9	Harbor Island	6.94	5.53%
10	Linda Isle Outer	8.17	6.51%
11	Linda Isle Inner	5.16	4.11%
12	Inner DeAnza Peninsula	11.90	9.48%
13	Outer DeAnza Peninsula	7.33	5.84%
14	Castaways	5.14	4.09%
15	Bayshores	1.08	0.86%
16	Mariner's Mile	1.72	1.37%
17	Lido Isle	2.02	1.61%
18	Lido Peninsula	0.00	0.00%
19	West Newport	0.15	0.12%
20	Dover Shores	6.40	5.10%
21	Dunes Marina and Channel	3.85	3.07%
22	Northstar Beach	0.33	0.27%
24	Back Bay Science Center and Launch Ramp	4.28	3.41%
25	Back Bay Channel	2.45	1.95%

Region 1. Corona del Mar (21.18 ac)

The most expansive SWEH was mapped in Region 1 (Figure 11).

The 2024 mapping results indicate an increase in eelgrass coverage since the previous mapping effort in 2022 (MTS and CRM 2023). Currently more eelgrass is mapped within Region 1 than has been mapped during any previous eelgrass survey (CRM 2005, 2008, 2010, 2012, 2015, 2017, 2020, 2022). The region had a 2.5 ac increase over the past two years. The depth range of eelgrass generally extended between the low intertidal and the -15-ft MLLW survey limit.

Eelgrass generally occurred across the same areas as mapped in 2022. The 2024 eelgrass coverage is more refined than the coverage provided in 2022 where adjustments to coverage values were required to account for the coarseness of the 2022 eelgrass cover dataset. It is possible that gaps in coverage presented in this 2024 mapping effort were also present in 2022 and do not reflect a recession of eelgrass bed boundaries.

Eelgrass meadows continue to cover large continuous areas within the dockside areas of this Region. Due to the height of the dock piers in this area, sunlight can penetrate areas underneath these dock features which promotes eelgrass growth and bed connectivity.

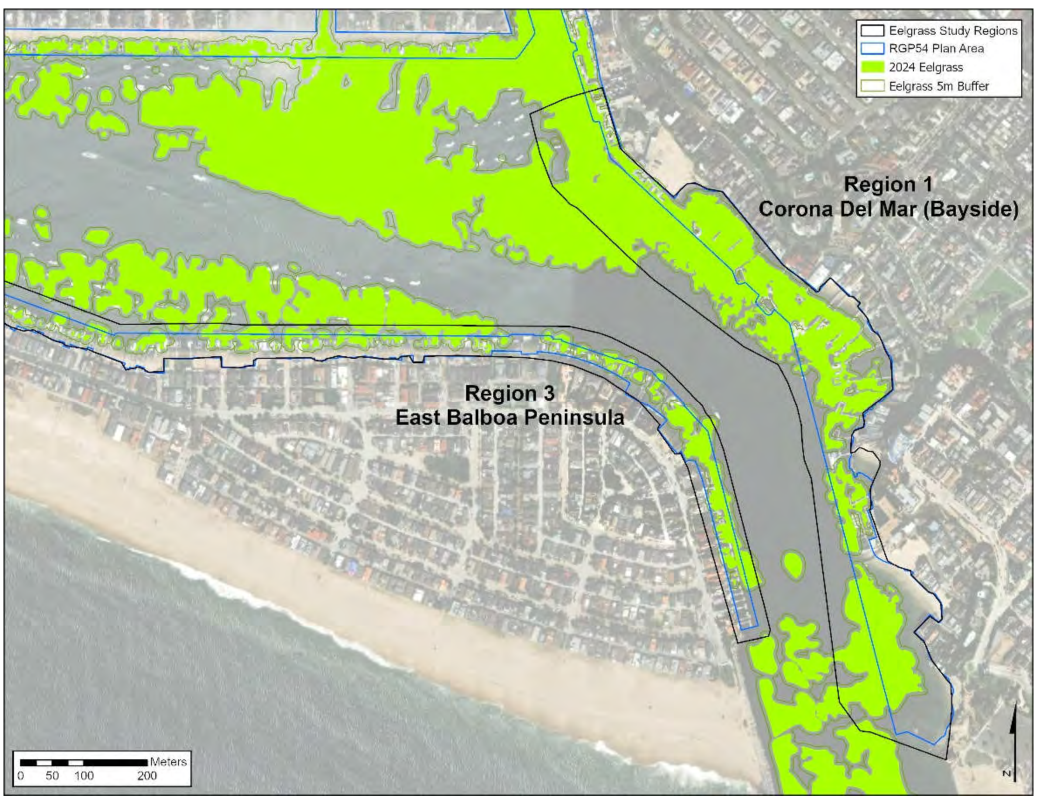

Figure 11. 2024 Eelgrass Habitat Map. Region 1 (Corona del Mar/Bayside) and Region 3 (Balboa Peninsula-East of Bay Island, Partial). See Figure 13 for the remainder of Region 3.

Region 2. Yacht Club Basins and Marinas (5.38 ac)

Region 2 supported eelgrass throughout much of the area, extending from the Balboa Yacht Club to the Balboa Island Bridge (Figure 12). Eelgrass in this area occurred at depths extending from 0.50-ft to -12.5-ft MLLW. Region 2 was ranked 9th for eelgrass acreage, containing 5.38 ac. Eelgrass in this area covers 4.28% of total SWEH reported. Much of Region 2 eelgrass was contained within the Bahia Corinthian Yacht Club Boat Basin, the Balboa Yacht Club Basin, and the Bayside Marina. Eelgrass expansion was most notable in the northern part of this Region where eelgrass coverage expanded to the north. Eelgrass in this Region has continued to increase since the 2009-2010 survey (CMR 2011) and is 1.15 ac greater than reported during the previous 2022 survey (MTS and CRM 2023).

Region 3. Balboa Peninsula – East (6.84 ac)

Region 3 includes SWEH between the bulkhead and the bayward ends of docks from the Entrance Channel to Bay Island (not including Bay Island) (Figure 11 and Figure 13). Region 3 was ranked 7th for eelgrass acreage, containing 6.84 ac. Acreage increases occurred from eelgrass expanding within the RGP54 area. However, connectivity and expansion of eelgrass beds outside the RGP54 area mapped during the 2022 survey also contributed to eelgrass increases in this Region. Eelgrass coverage in Region 3 has increased by 0.93 ac since the 2022 survey (MTS and CRM 2023). Eelgrass in this Region occurred at depths between 0.1-ft and -15.5-ft MLLW. Eelgrass here constitutes 5.45% of total reported SWEH.

Region 4. Grand Canal (1.19 ac)

The Grand Canal, Region 4, separating "Little Balboa" and "Balboa Island" was almost completely covered by eelgrass (Figure 12). Eelgrass beds extend between depths of 1.3-ft to -7.8-ft MLLW. Region 4 ranked 19th for SWEH coverage and accounted for 0.95% of total SWEH reported. Eelgrass here has been consistent with little fluctuation among the survey years. The 1.19 ac of eelgrass mapped here represents a decrease of 0.07 ac since the 2022 survey (MTS and CRM 2023). The small decline in eelgrass coverage may be caused by changes in coverage from vessels moored within the channel.

Region 5. Balboa Island and Collins Isle (18.99 ac)

Region 5 extends around the perimeter of Balboa Island and Collins Isle (Figure 12). Eelgrass in this area ranked 2nd, covering 18.99 ac, and accounted for 15.13% of SWEH reported. Eelgrass beds extended between depths of 1.86-ft to -15.5-ft MLLW. Eelgrass has continued to increase since the 2009-2010 survey (CRM 2011, 2015, 2017, MTS 2018, MTS and CRM 2020, MTS and CRM 2023). Since the 2022 survey, eelgrass has increased by 2.13 ac. Overall, eelgrass coverage shows bed expansion throughout the region, but most notably in the more offshore northern and southwestern areas of the Region.

Figure 12. 2024 Eelgrass Habitat Map. Regions 2 (East balboa Channel Yacht Clubs/Basins), 4 (Grand Canal), and 5 (Balboa and Collins Island).

Figure 13. 2024 Eelgrass Habitat Map. Region 3 (Balboa Peninsula – East of Bay Island, Partial).

Region 6. Bay Island (1.67 ac)

Bay Island, Region 6, accounts for a small amount of eelgrass habitat, 1.67 ac (Figure 14). This region is ranked 18th and accounts for 1.33% of total SWEH reported. Eelgrass beds in this area extend from 0.86-ft to -14.8-ft MLLW. Eelgrass around Bay Island increased between the 2013-2014 survey through the 2022 survey (CRM 2015, MTS and RCM 2023). Since the 2022 survey, eelgrass has declined by 0.29 ac (MTS and CRM 2023). In general, acreage changes were observed along offshore boundaries of eelgrass beds surrounding the island.

Region 7. Balboa Peninsula – West (0.77 ac)

Region 7 eelgrass extends from the Bay Island Bridge to 11th street, covering 0.77 ac (Figure 14). Region 7 was ranked 21st for eelgrass coverage and accounts for 0.61% of total SWEH reported. Eelgrass extends from 0.78-ft to -9.7-ft MLLW in the region. Eelgrass along Balboa Peninsula increased between the 2013-2014 survey through the 2022 survey (CRM 2015, MTS and RCM 2023). Since the 2022 survey, eelgrass has declined by 0.04 ac (MTS and CRM 2023). No notable declines in eelgrass boundaries were observed.

Figure 14. 2024 Eelgrass Habitat Map. West Balboa Peninsula. Region 6 (Bay Island) and Region 7 (Balboa Peninsula – West, Partial).

Region 8. North Balboa Channel and Yacht Basin (2.60 ac)

Region 8 includes eelgrass from the north side of the North Balboa Channel between the Balboa Island Bridge and Beacon Bay, covering 2.60 ac (Figure 15). Eelgrass occurred between 0.50-ft and -12.3-ft MLLW between the bulkhead and dock head walk, and fairways of the marina. Eelgrass here contributed 2.07% of total reported SWEH. Since the previous 2022 survey, eelgrass coverage has expanded by 1.40 ac (MTS and CRM 2023). Much of the eelgrass growth appears to have occurred in the fairways of Balboa Yacht Basin and in the channel headed into the Yacht Basin.

Region 9. Harbor Island (6.94 ac)

Eelgrass around Harbor Island, Region 9, accounted for 6.94 ac of mapped SWEH (Figure 16). Eelgrass extended from 0.88-ft to approximately -13-ft MLLW and contributed 5.53% of total SWEH reported. Eelgrass may occur in deeper waters within this Region; however, water depths were not collected in areas beyond where diver surveys occurred. Increases in eelgrass coverage within this region are likely due to the additional eelgrass mapped to the south of Harbor Island which was not included as part of the survey area previously.

Sidescan data collected around Harbor Island was able to detect eelgrass further offshore than recorded in previous survey efforts (CRM 2011, 2015, 2017, MTS 2018, MTS and CRM 2020, MTS and CRM 2023). Increases in eelgrass cover in this Region likely reflect both general expansion of the resource and the additional sidescan survey efforts performed to detect eelgrass further offshore in this Region.

Most increases in eelgrass resources identified in this Region fall beyond the general SWEH mapping area. It is possible that eelgrass was present within this region during previous survey efforts, however the methodologies utilized during those survey efforts and areas surveyed may not have allowed for the detection of eelgrass. Alternatively, the density of the eelgrass may have been too low to result in positive identification of eelgrass.

Region 10. Linda Isle – Outer (8.17 ac)

Eelgrass in Region 10, Linda Isle – Outer, covered 8.17 ac (Figure 15). Region 10 was ranked 4th and accounted for 6.51% of total SWEH reported. Eelgrass in this region occurs at depths from 1.1-ft to -12.5-ft MLLW. Coverage has continuously increased since the 2013-2014 survey (CRM 2015). Since the 2022 survey, eelgrass coverage in Region 10 has increased by 56% (MTS and CRM 2023). This notable increase in eelgrass coverage was observed throughout the navigation channel surrounding Linda Isle. Eelgrass beds expanded across the navigation channel in many areas resulting in more contiguous eelgrass coverage throughout this region, particularly in the northern portion of the Region. Eelgrass increased by by 2.93 ac since 2022 (MTS and CRM 2023).

Region 11. Linda Isle – Inner (5.16 ac)

Region 11, Linda Isle – Inner, eelgrass covers 5.16 ac and accounts for 4.11% of total SWEH reported (Figure 15). Eelgrass occurs from -2.0-ft to -8.2-ft MLLW. Episodic dredge events at Linda Isle, likely contributed to historical fluctuations of eelgrass cover. Since the 2022 survey, eelgrass has decreased by 0.08 ac (MTS and CRM 2023). The small reduction in eelgrass coverage within this region may be attributed to changes in overwater coverage by berthed vessels since all of the seafloor inside the turning basin of Linda Isle remains covered by eelgrass as was observed in 2022 (MTS and CRM 2023).

Figure 15. 2024 Eelgrass Habitat Map. Regions 8 (North Balboa Channel and Yacht Basins), 10, Linda Isle, Outer), and 11 (Linda Isle, Inner).

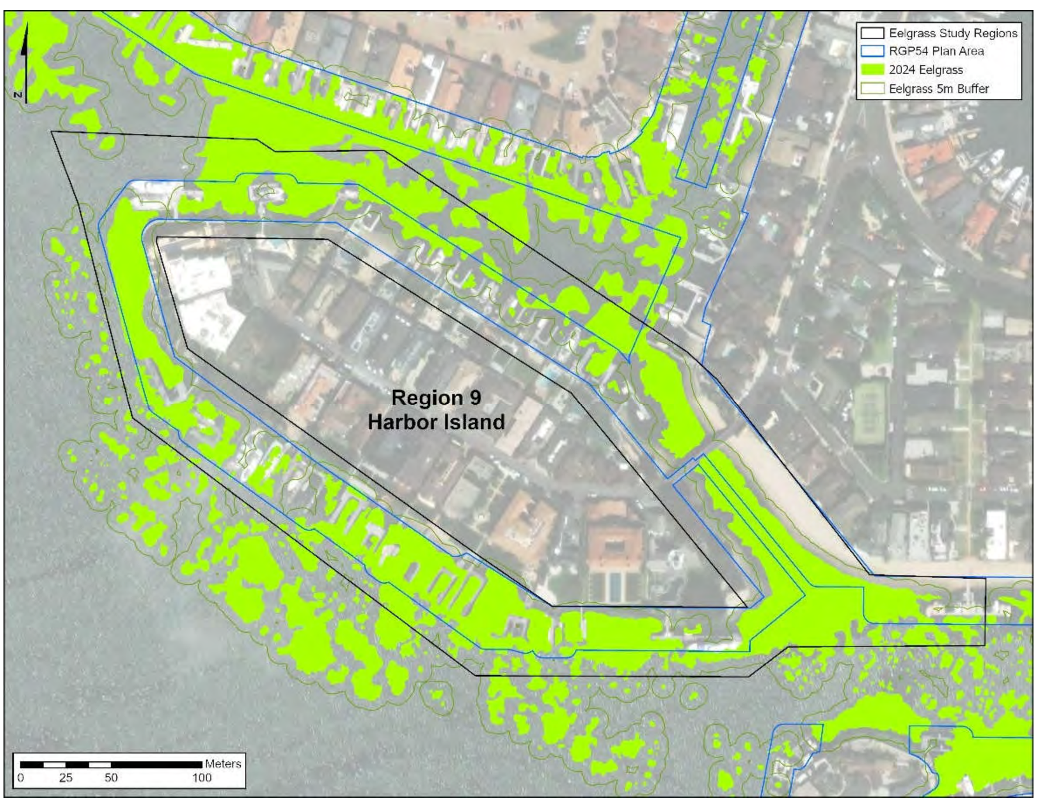

Figure 16. 2024 Eelgrass Habitat Map. Region 9 (Harbor Island).

Region 12. DeAnza Peninsula – Inner (11.90 ac)

Region 12, DeAnza Peninsula – Inner, eelgrass covers 11.90 ac (Figure 17). Eelgrass beds occurred from 0.00-ft to -12.8-ft MLLW and account for 9.48% of total reported SWEH. Since the most recent survey in 2022, eelgrass has increased by 1.73 ac (MTS and CRM 2023). Reported increases to SWEH are likely a factor of eelgrass filling in in the eastern and western part of this region.

Region 13. DeAnza Peninsula – Outer (7.33 ac)

Ranked 5th, Region 13, DeAnza Peninsula – Outer, has 7.33 ac of eelgrass coverage (Figure 17). Eelgrass here accounts for 5.84% of total SWEH reported. Depth data was approximated from collected sonar data as eelgrass bed outlines in this region were not collected by diver. Eelgrass was present in water depths ranging between 0.0-ft and -10.0-ft MLLW. Eelgrass currently covers approximately six times the area since it was first mapped in 2003-2004 (CRM 2005). Since the 2022 survey, eelgrass coverage increased by 0.56 ac (MTS and CRM 2023). Reported changes to SWEH may be attributed to minor changes in eelgrass coverage along the periphery of the mapped bed.

Region 14. Castaways 5.14 ac)

Region 14, Castaways, contributes 5.14 ac of eelgrass coverage, accounting for 4.09% of total eelgrass reported. Eelgrass here occurs a depths extending from 0.24-ft to -10.00-ft MLLW. The majority of prior survey efforts in Region 14 resulted in less than 1.00 ac. Since the 2018 survey, where 0.84 ac were mapped, eelgrass has more than quadrupled (MTS 2018). Eelgrass beds mapped in 2018 became connected in 2020 and continue to maintain connectivity, extending alongshore (MTS and CRM 2020). Increased eelgrass coverage is generally attributed to the connectivity of eelgrass beds in the southern portion of this Region and expansion into the channel.

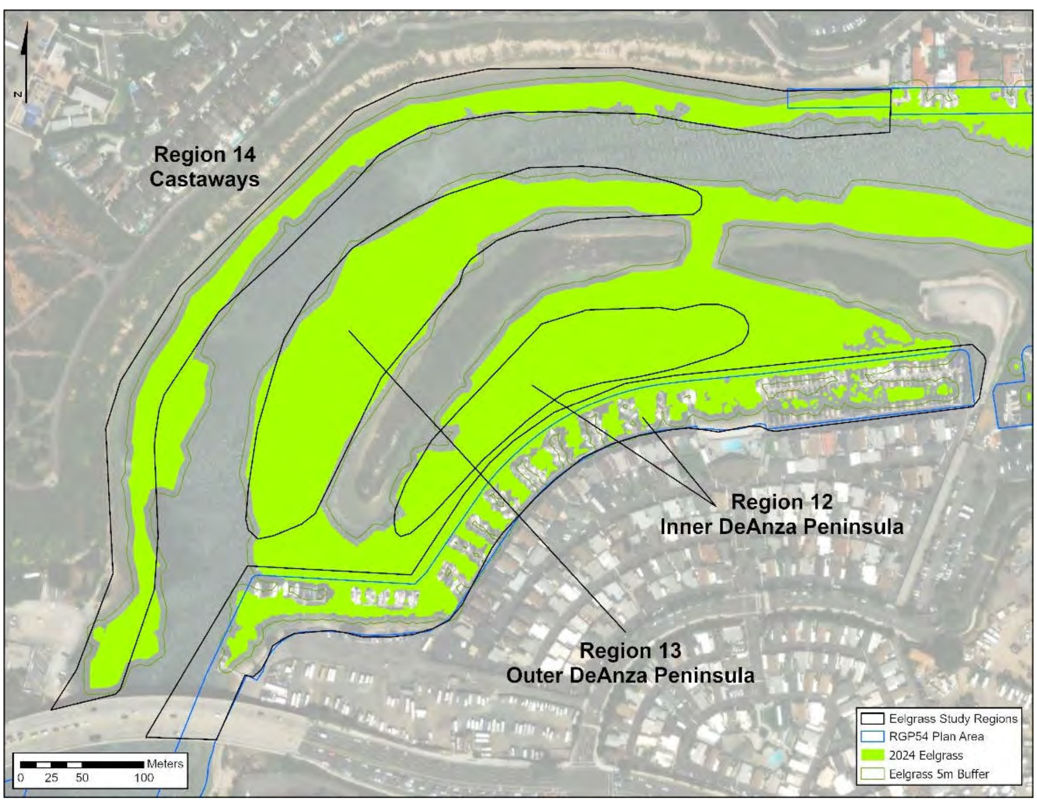

Figure 17. 2024 Eelgrass Habitat Map. Regions 12 (DeAnza/bayside Peninsula, East – Inner), 13 (DeAnza/Bayside Peninsula, West – Outer), and 14 (Castaways to Dover Shores).

Region 15. Bayshores (1.08 ac)

Region 15 extends from the Coast Highway Bridge to the junction of the Lido Reach (Figure 18). The eelgrass in Region 15 covered 1.08 ac and accounted for 0.86% of total eelgrass reported. Eelgrass occurs between 0.50-ft and -10.5-ft MLLW within the Bayshores region. Eelgrass in this area has generally fluctuated, but remained less than 1.00 ac, from the initial survey in 2003-2004 (CRM 2005) to the more recent survey in 2018 (MTS 2018). Eelgrass coverage rose above 1.00 ac in 2020 and since then increased by 0.25 ac in 2022 (MTS and CRM 2020, MTS and CRM 2023). Since 2022, eelgrass has declined by 0.18 ac (MTS and CRM 2023). Notable declines in eelgrass coverage were observed in the northern extent of this region where a shoal occurs just south of the PCH Bridge. Eelgrass within this area generally occurs as moderate size beds between the headwall and dock structures, marina fairways, and open water beach/swim areas.

Region 16. Mariner's Mile (1.27 ac)

Along the southern portion of Bayshores and Mariner's Mile, Region 16, eelgrass covered 1.27 ac and accounted for 1.37% of total SWEH reported (Figure 18). Eelgrass here extended from 0.50-ft to -12-ft MLLW. In past survey efforts, eelgrass was less than 0.69 ac (CRM 2005, 2008, 2011, 2017). Expansion of existing eelgrass beds into larger eelgrass beds resulted in an increase of 0.31 ac since 2022 (MTS and CRM 2023).

Region 17. Lido Isle (2.02 ac)

Region 17, Lido Isle, eelgrass cover extended primarily along the northern and eastern portions of the island (Figure 18). Eelgrass here was present in water depths ranging between 0.60-ft to -10.50-ft MLLW. Much of the southwestern and western portion of the island was unvegetated. Eelgrass mapped during this survey represents the greatest amount of eelgrass mapped in recent surveys of this region. Since the 2022 survey, eelgrass has continued to expand along the northern and southern portions of Lido Isle and has increased by 0.74 ac (MTS and CRM 2023).

Region 18. Lido Peninsula (0.00 ac)

No eelgrass has been reported in Region 18, Lido Peninsula, during any survey performed prior to 2018. During the 2018 survey a 0.13 ac eelgrass bed was discovered for the first time between Lido Peninsula and Lido Isle. Eelgrass here occurred between -3.1-ft to -10.8-ft MLLW. This same eelgrass was mapped in 2020 and 2022 (MTS and CRM 2020, MTS and CRM 2023). Eelgrass coverage continued to decline since it was reported in 2018. Eelgrass was either absent or too small of a size to be detected during this survey period.

Region 19. West Newport (0.15 ac)

No eelgrass has been reported in Region 19, West Newport, during any survey performed prior to 2022. The 2022 survey marked the first time where SWEH was found in Region 19 (MTS and CRM 2023). Additional eelgrass beds were detected during this survey effort. A total of 0.15 ac of eelgrass was mapped offshore of dock structures within this region (Figure 19). Eelgrass in this region was found in water depths ranging between -5.2-ft and -10.8-ft MLLW.

Figure 18. 2024 Eelgrass habitat Map. Regions 7 (Balboa Peninsula – West of Bay Island, Partial), 15 (Bayshores), 16 (Mariner's Mile), 17 (Lido Isle), and 18 (Lido Peninsula).

Figure 19. 2024 Eelgrass Habitat Map. Region 19 (West Newport).

Region 20. Dover Shores (6.40 ac)

Region 20, Dover Shores, was first surveyed in 2013-2014 (Figure 20; CRM 2015). Since that survey, eelgrass cover has continued to increase. Much of the eelgrass contributing to this acreage occurs within the fairway entrances and in the southern portions of the region. Eelgrass covers 6.40 ac, accounting for 5.10% of total reported SWEH, and extends from 0.40-ft to -12.0-ft MLLW. Since the recent 2022 survey, eelgrass has increased by 0.33 ac (MTS and CRM 2022). Notable increases to eelgrass coverage were observed in the southern fairway and turning basin where small beds and patches of eelgrass mapped in 2022 have expanded into a contiguous eelgrass bed.

Region 21 Dunes Marina and Channel (3.85 ac)

Dunes Marina, Region 21, was first surveyed in 2013-2014 (Figure 20; CRM 2015). Since that survey, eelgrass has continued to increase. Instances of small eelgrass patches within the marina's fairways reported in 2020 were mapped as small eelgrass beds during the 2022 survey effort (MTS and CRM 2023). Eelgrass has continued to expand in the fairways and offshore of the marina dock structures. Eelgrass here covers 3.85 ac and accounts for 3.07% of SWEH reported. Eelgrass in this region was present between 0.50-ft and -9.2-ft MLLW.

Region 22. Northstar Beach (0.33 ac)

Northstar Beach, Region 22, was first surveyed in 2016 (Figure 20; CRM 2017). During the first survey 0.003 ac of eelgrass were reported. During the following 2018 survey, no eelgrass was observed (MTS 2018). However, during the 2020 survey, 0.01 ac of SWEH was mapped (MTS and CRM 2020). Eelgrass continued to increase in 2022 and has since increased (MTS and CRM 2023). During this survey effort eelgrass covered 0.33 ac and accounts for 0.27% of reported SWEH. Eelgrass in this region occurred at depths from -2.8-ft to -7.4-ft MLLW.

Region 24. Back Bay Science Center and Launch Ramp (4.28 ac)

The Back Bay Science Center and Launch Ramp was first surveyed in 2016 and was included under Region 21 eelgrass acreage (CRM 2017). During that survey one small eelgrass bed was mapped between the CDFW boat dock and Shellmaker Island. Due to the amount of eelgrass mapped around Regions 21 and 24, it is appropriate to delineate these areas as separate regions. During this 2024 survey, 4.28 ac of SWEH was reported and accounts for 3.41% of reported SWEH. An increase of 1.53 ac since the previous survey in 2022 (MTS and CRM 2023). Eelgrass in this region occurred at depths ranging between -5.5-ft and -11.0-ft MLLW. During this survey, eelgrass not only expanded within areas mapped in 2022, but an additional effort was made to map eelgrass further north of the Back Bay Science Center. The boundaries of Region 24 were expanded during this survey effort to include this additional eelgrass resulting in the large increase in eelgrass acreage in this region.

Region 25. Back Bay Channel (2.45 ac)

Region 25, Back Bay Channel, was delineated during this year's survey effort. This region was added to account for eelgrass expansion within channel portions between Region 20, 21, and 24 (Figure 20). During this survey effort eelgrass covered 2.45 ac and accounts for 1.95% of reported SWEH.

Figure 20. 2022 Eelgrass Habitat Map. Regions 20 (Dover Shores), 21 (Dunes Marina and Channel), 22 (Northstar Beach), 24 (Back Bay Science Center and Launch Ramp), and 25 (Back Bay Channel).

4 Historical Eelgrass Coverage

In general, eelgrass in the Bay has fluctuated. However, the overall acreage has steadily increased since these detailed surveys began in 2003. (Figure 21, Table 3). For all survey periods, Corona del Mar, Region 1, accounted for most of the eelgrass cover reported. From 2002 to 2010 the Bay's eelgrass was declining overall. However, coverage in Region 1 remained consistent with little fluctuation in eelgrass cover, indicating that other areas of the Bay were undergoing eelgrass die-off and contributing to the overall reduction in eelgrass coverage. Conversely, since the 2009-2010 survey, eelgrass across the entire Bay has increased considerably. This dramatic increase can be attributed to overall eelgrass expansion throughout the Bay, most notably in Regions 5, 7 through 12, 14, and 20, including areas around Balboa Island, Harbor Island, Linda Isle, Castaways, and Dover Shores. Eelgrass in these regions continued to increase in more recent surveys completed in 2018 and 2020. It is likely that restoration and dredging of Upper Newport Bay in 2010 has improved water quality throughout Newport Bay leading to increased eelgrass coverage over the past decade.

The most recent survey, summarized here, indicates that eelgrass acreage, again, is largely controlled by Region 1, however the overall increase in Newport Bay shallow water eelgrass can be attributed to eelgrass bed expansion in other areas of the Bay. Eelgrass expansion is most notable in Regions 1 (Corona del Mar) and 5 (Balboa Island/Collins Isle), where a 4.83 ac and 6.75 ac increases to eelgrass coverage were reported, respectively. Other notable increases were reported in Regions 2, 3, 12, 20, and 24, including areas around East Balboa Channel Yacht Club and Basins, East Balboa Peninsula, Inner DeAnza Peninsula, and the Back Bay Science Center and Launch Ramp, where all areas reported at least an acre increase in eelgrass coverage since the 2020 survey (MTS and CRM 2020). In general, eelgrass has expanded to some degree within most regions surveyed. This indicates that conditions in the Bay are suitable for eelgrass growth and expansion. Future surveys will provide additional insight as to the progression and regression of eelgrass coverage within the Bay.

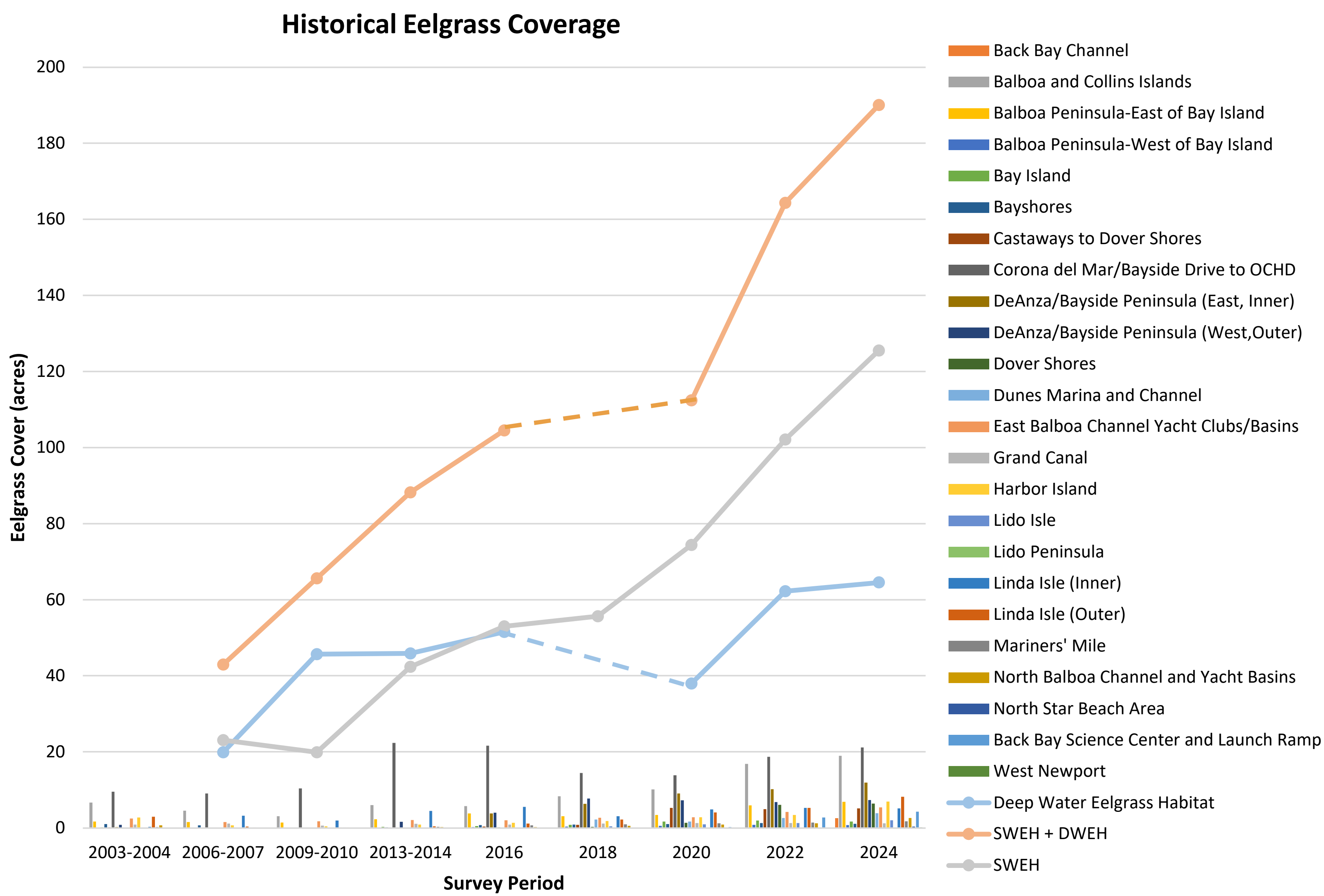

Figure 21. Historical coverage of eelgrass by region and survey period within Newport Bay. Deep water eelgrass habitat (DEH) was not surveyed for in 2018, thus dashed lines represent the overall change observed since the 2016 survey (CRM 2016).

Table 3. Table of historical eelgrass coverage by region per survey period in Newport Bay.

Description	Historical Eelgrass Acreage									
	2003-2004	2006-2007	2009-2010	2013-2014	2016	2018	2020	2022	2024	Mean
Corona del Mar/Bayside Drive to OCHD	9.52	9.08	10.36	22.37	21.65	14.47	13.85	18.68	21.18	15.68
East Balboa Channel Yacht Clubs/Basins	2.47	1.54	1.76	2.06	2.02	2.67	2.78	4.23	5.38	2.77
Balboa Peninsula-East of Bay Island	1.67	1.56	1.39	2.27	3.78	3.08	3.39	5.91	6.84	3.32
Grand Canal	0.90	1.14	0.62	1.06	0.89	1.13	1.29	1.27	1.19	1.05
Balboa and Collins Islands	6.69	4.55	3.05	5.98	5.74	8.30	10.11	16.86	18.99	8.92
Bay Island	0.13	0.05	0.04	0.30	0.50	0.80	1.67	1.96	1.67	0.79
Balboa Peninsula-West of Bay Island	0.03	0.03	0.01	0.10	0.21	0.35	0.57	0.81	0.77	0.32
North Balboa Channel / Yacht Basins	0.70	0.12	0.12	0.24	0.25	0.55	0.90	1.21	2.60	0.74
Harbor Island	2.72	0.71	0.45	0.91	1.35	1.78	2.83	3.41	6.94	2.34
Linda Isle (Outer)	2.92	0.33	0.07	0.39	1.16	2.23	4.07	5.24	8.17	2.73
Linda Isle (Inner)	0.28	3.22	1.97	4.50	5.55	3.09	4.84	5.24	5.16	3.76
DeAnza/Bayside Peninsula (East, Inner)	0.21	0.01	0.00	0.08	3.83	6.32	9.09	10.17	11.90	4.62
DeAnza/Bayside Peninsula (West, Outer)	0.79	0.00	0.00	1.60	4.01	7.75	7.27	6.77	7.33	3.95
Castaways to Dover Shores	0.13	0.00	0.00	0.01	0.34	0.84	5.24	4.97	5.14	1.85
Bayshores	0.99	0.66	0.00	0.16	0.76	0.91	1.01	1.25	1.08	0.76
Mariners' Mile	0.23	0.07	0.07	0.31	0.71	0.97	1.24	1.41	1.72	0.75
Lido Isle	0.03	0.00	0.00	0.02	0.07	0.41	0.92	1.28	2.02	0.53
Lido Peninsula	No Data	0.00	0.00	0.00	0.00	0.13	0.07	0.02	0.00	0.03
West Newport	No Data	No Data	No Data	0.00	No Data	0.00	0.00	0.00	0.15	0.03
Dover Shores	No Data	No Data	No Data	0.01	0.18	0.32	1.38	6.07	6.40	2.39
Dunes Marina and Channel	No Data	No Data	No Data	0.00	0.03	2.23	1.69	2.63	3.85	1.74
North Star Beach Area	No Data	No Data	No Data	No Data	0.00	0.00	0.01	0.06	0.33	0.08
Back Bay Science Center and Launch Ramp	No Data	No Data	No Data	No Data	0.00	0.00	0.22	2.74	4.28	1.45
Back Bay Channel	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	2.45	2.45
SWEH Subtotal	30.41	23.07	19.92	42.35	53.02	58.18	74.42	102.21	125.53	2.63
Deep Water Eelgrass Habitat	No Data	19.90	45.70	45.90	51.50	No Data	37.94	62.20	64.53	44.95
SWEH + DWEH Total	30.41	42.97	65.62	88.25	104.52	58.18	112.36	164.41	190.06	*109.74

*average of SWEH and DWEH over years where both habitats were surveyed (2003-2004 and 2018 are excluded).

5 Eelgrass Distributional Zones in Newport Bay

Previous CRM surveys developed a second grouping for summarizing eelgrass coverage (CRM 2017). The zones were developed using an eelgrass distributional model predicated upon knowledge gathered during the 2003-2004 and 2006-2007 Bay-wide eelgrass surveys (CRM 2005 & 2008). This included the modeled tidal residence time periods in the Bay (Everest International 2009) and the 2008-2009 Newport Bay oceanographic survey results (CRM 2010). The model identified three distributional zones (Figure 22). The zones describe stable, transitional, and unvegetated sections of the Bay.

The Stable Eelgrass Zone, describes locations where eelgrass distribution appears relatively stable from year-to-year. This zone encompasses the lower Bay, including the entrance channel, southern and eastern portions of Balboa Island and Grand Canal, Corona del Mar, and the eastern portion of the Balboa Peninsula. This zone is characterized by a tidal flushing time of less than six days. The short flushing time is thought to contribute to higher water clarity and near-bottom underwater light levels that promote eelgrass growth. Linda Isle Inner is also grouped into this zone because of the long-term presence and large amount of eelgrass present between 2006 and 2016.

The Transitional Eelgrass Zone, describes areas where eelgrass is susceptible to year-to-year variation in coverage and density. This zone encompasses much of the central part of the Lower Bay including Harbor Island, Linda Isle, northern and western portions of Balboa Island, and the northern side of Lido Channel. This zone is characterized by flushing times of 7 to 14 days. Influenced by the San Diego Creek discharges during the winter months, turbidity impacts this zone by lowering water clarity and lowering near-bottom light levels. This area will expand or contract depending on environmental conditions and other influences on eelgrass growth.

The Unvegetated Zone, describes areas where eelgrass has historically not been found or is only incidentally found. This zone is located within the western portion of Lower Newport Bay and in Upper Newport Bay above DeAnza Bayside Peninsula and north of Castaways Park and the Dunes Marina. These areas are characterized by tidal flushing greater than 14 days.

During this survey, a total of 125.53 ac of SWEH was mapped within the three eelgrass zones (Figure 23). In the Stable Eelgrass Zone 50.24 ac of eelgrass was mapped. The Transition Eelgrass Zone accounted for 74.75 ac of eelgrass, Lastly, the Unvegetated Zone had only 0.54 ac of eelgrass. If DWEH was included in the eelgrass assessment by zones, the Stable Zone eelgrass would total 110.45 ac, and the Transitional Zone would total 79.07 ac. Stable Zone eelgrass cover is impacted more by the inclusion of DWEH.

Since the 2022 survey, eelgrass has increased in the Stable and Transitional Zones, increasing by 1.93 ac and 21.16 ac, respectively. Both the Stable and Transitional Zones continue to expand and have both contributed to overall increases to SWEH. The high degree of change within the Transitional Zone is likely due to a combination of the expanded survey coverage and improving conditions. The expanded survey coverage means greater detection of eelgrass coverage around north Balboa Island, Harbor Island, and Back Bay. However, the Transitional Zone in general is likely improving due to the greater tidal prism that resulted from the restoration of the Upper Bay in 2010. The restoration also included the creation of sediment basins that may trap fine material and improve water clarity in the Lower Bay. For the third year SWEH cover within the Transition Zone has surpassed coverage in the Stable Eelgrass Zone. It should be noted that the Transition Zone is larger than the Stable Eelgrass Zone.

Figure 22. Map of eelgrass mapped within the three distributional zones within Newport Bay.

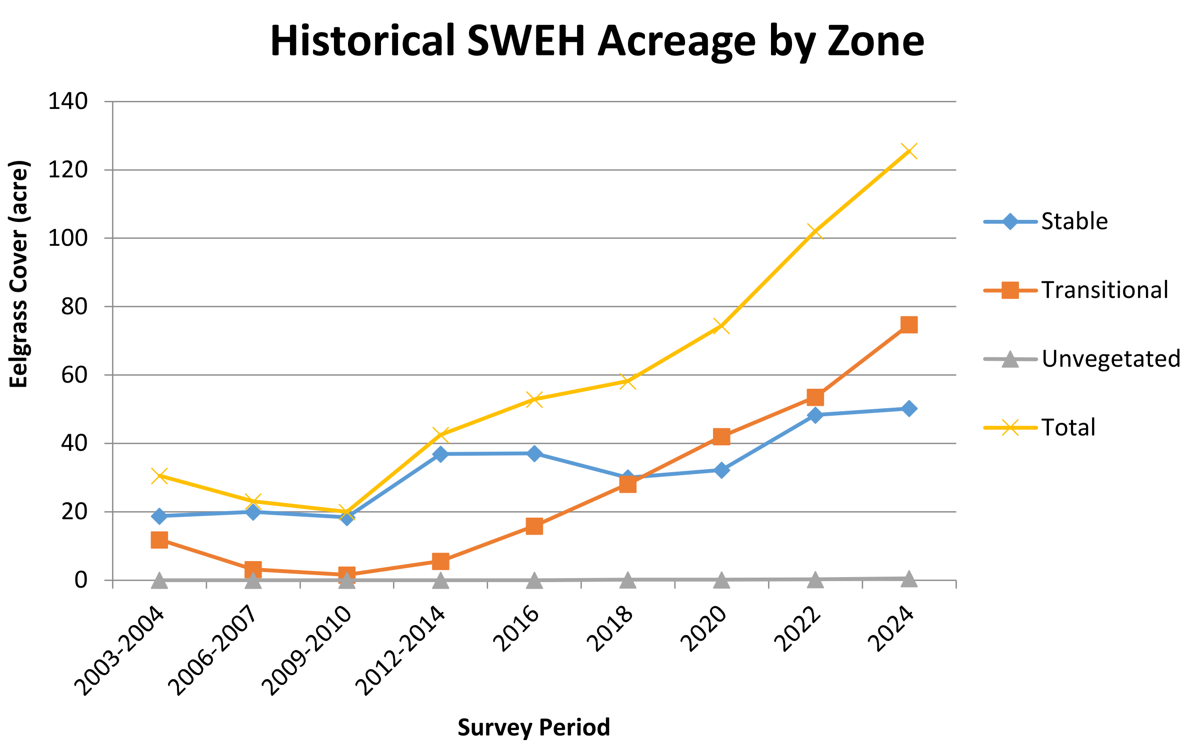

Figure 23. Historical SWEH coverage by zone in Newport Bay.

6 Density

Density measurements were taken at 25 stations throughout the Bay and represent 23 of the 24 Regions (Figure 24). Region 18, Lido Peninsula was not sampled as no eelgrass was present in that region. Region 25, Back Bay Channel was not sampled as this Region was added after final review of the sonar data after diver survey completion.

Region 1, Corona del Mar, had the highest reported offshore density. Inshore density was greatest in Regions 11, 14, and 16, where all three regions reported average density greater than 200 turions/sq m.

The average density for all 25 stations was 126 turions/sq m and ranged between 24 and 334 turions/sq m. No apparent trend in density was observed based on sampling location (shallow/inshore or deep/offshore).

Per station, average inshore density was 130 turions/sq m and average offshore density was 122 turions/sq m (Figure 25). Region 11 has the highest reported average inshore density at 224 turions/sq m, followed by Regions 14 and 16 where eelgrass density was 202 turions/sq m in each region. Offshore eelgrass density was greatest for Region 1, 264 turions/sq m followed by region 11 where eelgrass density was 190 turions/sq m.

Table 4. Table of stations where eelgrass density measurements were collected.

Region ID	Coordinates (dd.ddddd˚) Latitude	Longitude
1	33.602131	-117.882351
2	33.605834	-117.884362
3	33.603277	-117.899578
4	33.604597	-117.888893
5 - east	33.607752	-117.885919
5 - west	33.607752	-117.900148
6	33.606172	-117.904357
7	33.615748	-117.901427
8	33.609791	-117.896547
9	33.611008	-117.902190
10	33.615034	-117.901525
11	33.613972	-117.903255
12	33.620054	-117.900509
13	33.620449	-117.901267
14	33.621427	-117.901969
15	33.612210	-117.907910
16	33.614367	-117.913012
17	3.614973	-117.919356
18	NA	NA
19	33.620144	-117.932859
20	33.622753	-117.895687
21	33.619242	-117.892864
22	33.625318	-117.893036
23	33.600828	-117.893555
24	33.619461	-117.891283
25	NA	NA

Over time, eelgrass density has fluctuated (Figure 26). The initial survey performed in 2004 reported the highest average density of 231 turions/sq m. Eelgrass density decreased between the 2004 and 2008 survey periods and continued to show signs of decay through 2014. The 2016 survey marked the first instance of eelgrass average density increase from 118 turions/sq m in 2013-2014 to 162 turions/sq m in 2016. Eelgrass density was stable through 2018 where values were 160 turions/sq m. Eelgrass density has continued to fluctuate. During the 2020 survey eelgrass density measurements indicated a decline, 99 turions/sq m. Since the 2020 survey average eelgrass density increased, presently exceeding values reported in 2013-2014.

Figure 24. Map of locations where density measurements were taken in Newport Bay during the 2024 survey. The numerical value icons on the map indicate the region and location where density measurements were collected. For Region 5 more than one location was visited for collection of density.

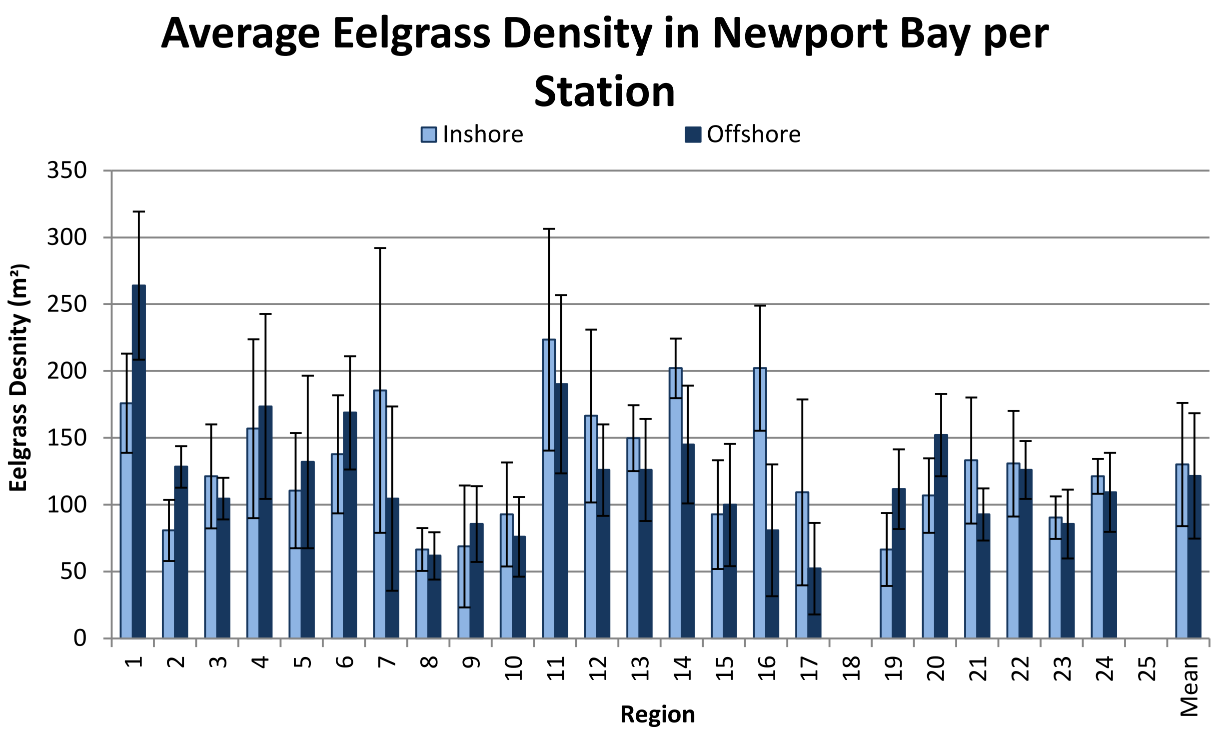

Figure 25. Average eelgrass density per Region in Newport Bay. Error bars are one standard deviation.

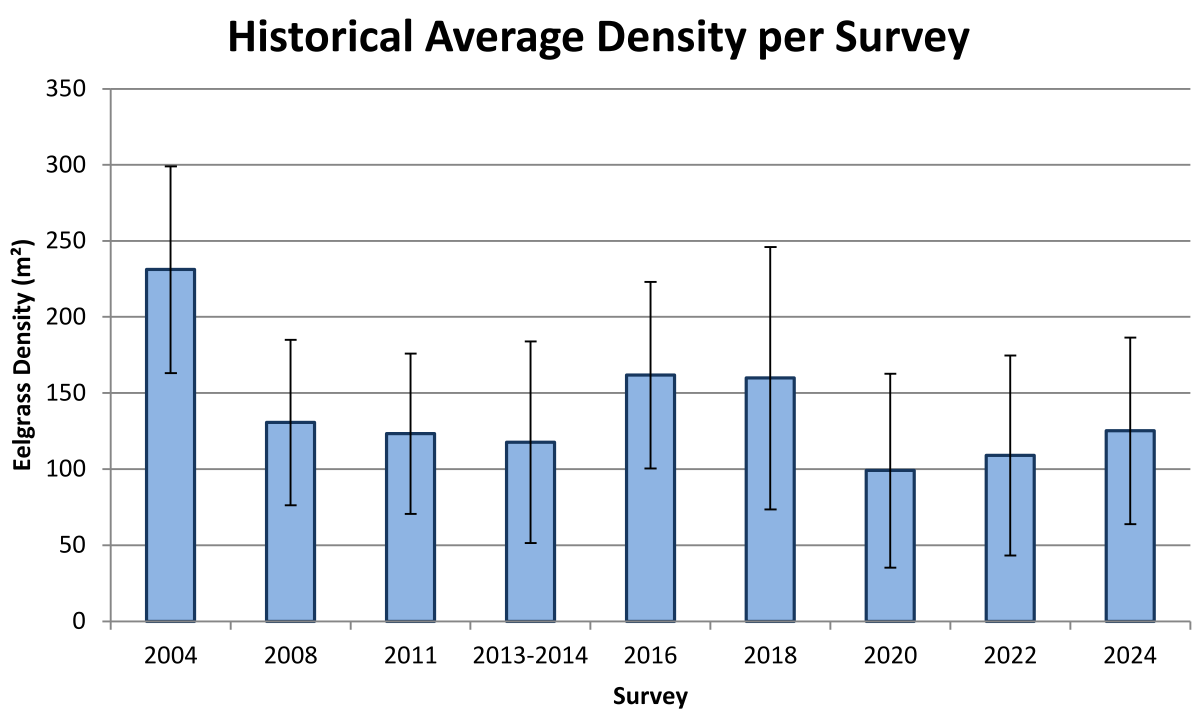

Figure 26. Historical average eelgrass density per survey in Newport Bay. Error bars represent one standard deviation.

7 Marine Life

7-1 Marine Life Observed

Numerous marine species were observed during the 2024 eelgrass habitat mapping survey (Table 5). Species presence varied with distance and direction from the mouth of the Bay. However, many species were present throughout most surveyed areas in the Bay. Species observed were associated with either hard substrate including, dock structures, seawalls, and riprap, or soft bottom habitat including both vegetated and unvegetated habitats. While some species were only observed within specific Zones, many species observed were prevalent across all Zones surveyed.

A few species were only observed within Zone 1 at the entrance to the Bay. These species included the California spiny lobster (*Panulirus interruptus*), California garibaldi (*Hypsypops rubicundus*), California scorpionfish (*Scorpaena guttata*), white seaperch (*Phanerodon furcatus*), echinoderms including the ochre star (*Pisaster ochraceus*), purple urchin (*Strongylocntrotus purpuratus*), red urchin (*Mesocentrotus franciscanus*), and sand dollar (*Clypeasteroida* sp.), mollusks including the chestnut cowrie (*Cypraea spadicea*), giant rock scallop (*Crassadoma gigantea*), Kellet's whelk (*Kelletia kelletii*), and dwarf purple olive snail (*Callianax biplicata*). Giant kelp (*Macrocystis pyrifera*), wakame (*Undaria pinnatifida*), and Pacific eelgrass (*Zostera pacifica*) were also observed only in Zone 1. The entrance to the Bay is the only area where two species of eelgrass (*Z. marina* and *Z. pacifica*) were observed together. While California sea lions (*Zalophus californianus*) may transit through different areas of the Bay, individuals were observed hauled out on dock structures only within Zone 1.

When moving farther away from the mouth of the Bay the biodiversity appeared to change. More fish species and soft bottom inhabiting species were observed further away from the Bay mouth, beyond Zone 1. Species only observed in Zones 2 and 3 included bay goby (*Lepidogobius lepidus*), blacksmith (*Chromis punctipinnis*), California butterfly ray (*Gymnura marmorata*), kelpfish (*Heterostichus rostratus*), rock wrasse (*Halichoeres semicinctus*), and speckled sanddab (*Citharichthys stigmaeus*). Additionally, most Cnidarians observed including, anemones, gorgonians, and hydroids were only observed in Zones 2 and 3. Most tunicate and all sponge species observed were only reported in Zones 2 and 3.

On multiple occasions, California sea lion (*Zalophus californianus*) and seabirds such as surf scoter (*Melanitta perspicllata*), western grebe (*Aechmophorus occidentalis*), California brown pelican (*Pelecanus occidentalis californicus*), Brant's cormorant (*Phalacrocorax penicillatus*), double-crested cormorant (*Phalacrocorax auritus*), California gull (*Larus californicus*), Heermann's gull (*Larus heermanni*), western gull (*Larus occidentalis*), great blue heron (*Ardea herodias*), snowy egret (*Egretta thula*), black crowned night heron (*Nycticorax nycticorax*), and bufflehead (*Bucephala albeola*) were observed.

Additionally, short-beaked common dolphin (*Delphinus delphis*) were observed during this survey effort. Observations of *D. delphis* occurred within Zones 1 and 2 near Upper Newport Harbor and the Balboa Yacht Basin.

Table 5. Table of species observed during the 2024 Newport Bay shallow water eelgrass survey (table continues on next page)

Phylum	Common Name	Species Name	All Zones		Zone 1		Zone 2		Zone 3	
			Hard	Soft	Hard	Soft	Hard	Soft	Hard	Soft
Bacteria										
	red/rust bacteria, unID	rust bacteria, unID					X		X	
Brown Algae-Phaeophyta										
	giant kelp	*Macrocystis pyrifera*			X					
	kelp	*Laminariales* sp. (unID)			X					
	Wakame	*Undaria pinnatifida*			X					
		Codium fragile					X		X	
		Colpomenia sinuosa				X		X		
		Dictyopteris undulata	X					X		
		Dictyota flabellata		X					X	
		Hydroclathrus clathratus						X		
		Sargassum muticum		X						
Crustacean-Arthropoda										
	acorn barnacle	*Balanus glandula*	X					X		X
	acorn barnacle	*Chthalamus dalli*	X					X		X
	California spiny lobster	*Panulirus interruptus*			X	X				
	cancer crab	*Cancer* sp.					X		X	
	lined shore crab	*Pachygrapsus crassipes*	X			X		X		
Fish-Pisces										
	barred sand bass	*Paralabrax nebulifer*		X						
	barred surfperch	*Amphistichus argenteus*		X						
	bat ray	*Myliobatis californica*		X						
	bay goby	*Lepidogobius lepidus*						X		X
	blacksmith	*Chromis punctipinnis*						X		X
	California butterfly ray	*Gymnura marmorata*						X		X
	California garibaldi	*Hypsypops rubicundus*				X				
	California halibut	*Paralichthys californicus*		X						
	California lizardfish	*Synodus lucioceps*		X						

Phylum	Common Name	Species Name	All Zones		Zone 1		Zone 2		Zone 3	
			Hard	Soft	Hard	Soft	Hard	Soft	Hard	Soft
	California sargo	*Diplodus sargus*		X						
	California scorpionfish	*Scorpaena guttata*				X				
	kelp bass	*Paralabrax clathratus*		X						
	kelp perch	*Brachyistius frenatus*		X						
	kelpfish	*Heterostichus rostratus*						X		X
	mullet	*Mugil cephalus*		X						
	opaleye	*Girella nigricans*		X			X		X	
	pile perch	*Domalichthys vacca*				X				
	rock wrasse	*Halichoeres semicinctus*						X		X
	rock-pool blenny	*Parablennius parvicornis*			X		X			
	round stingray	*Urobatis halleri*		X			X		X	
	rubberlip surfperch	*Rhacochilus toxotes*						X		X
	shiner perch	*Cymatogaster aggregata*				X		X		
	speckled sanddab	*Citharichthys stigmaeus*						X		X
	spotted sand bass	*Paralabrax maculatofasciatus*		X						
	spotted sand bass (+juv)	*Paralabrax maculatofasciatus*		X						
	topsmelt	*Atherinops affinis*		X						
	white seaperch	*Phanerodon furcatus*				X				
Flatworms-Platyhelminthes										
	Polyclad worm, unID	polyclaid worm, unID						X		X
Green Algae-Chlorophyta										
	Caulerpa	*Caulerpa prolifera*						X		
	green algae					X				
		Chaetomorpha aerea		X						
		Ulva intestinalis		X						
		Ulva lactuca		X						
Jellyfish and Anemones-Cnidaria										
	anemone	*Diadumene* sp.		X			X		X	
	brown gorgonian	*Muricea fruticosa*					X		X	

Phylum	Common Name	Species Name	All Zones		Zone 1		Zone 2		Zone 3	
			Hard	Soft	Hard	Soft	Hard	Soft	Hard	Soft
	burrowing anemone	*Pachycerianthis fimbriatus*						X		X
	hydroid	*Aglaophenia dispar*						X		X
	sea pen	*Styalatula elongata* (> 11ft MLLW only)				X		X		
Marine Mammal-Mammalia										
	California sea lion	*Zalophus californianus*			X (dock)					
	Short-beaked common dolphin	*Delphinus delphis*				X		X		
Moss Animals-Bryozoa/Ectoprocta										
	red chip bryozoan	*Watersipora subtorquata*					X			
	spaghetti bryozoan	*Amathia verticillatata*		X						
Red Algae-Rhodophyta										
	red algae					X				
		Asparagopsis sp.		X						
		Gelidium sp.		X			X		X	
		Gracilaria sp.		X						
		Gracilariopsis sjoestedtii		X						
		Grateloupia sp.						X		X
		Microcladia sp.			X	X				
		Polysiphonia sp.						X		
Sea Stars / Urchins etc-Echinodermata										
	bat star	*Patiria miniata*				X	X		X	
	ochre star	*Pisaster ochraceus*				X				
	purple urchin	*Strongylocentrotus purpuratus*				X				
	red urchin	*Mesocentrotus franciscanus*				X				
	sand dollar	*Clypeasteroida* sp.				X				
	spiney sand star	*Astropecten armatus*				X	X	X	X	
Seagrasses-Zosteracea										
	ditchgrass	*Ruppia maritima*		X						
	eelgrass	*Zostera marina*		X						

Phylum	Common Name	Species Name	All Zones		Zone 1		Zone 2		Zone 3	
			Hard	Soft	Hard	Soft	Hard	Soft	Hard	Soft
	eelgrass	*Zostera pacifica*				X				
	surf grass	*Phyllospadix torreyi*		X			X			
Snails and Octopus-Mollusca										
	Asian date mussel	*Musculista senhousia*					X		X	
	bay mussel	*Mytilus galloprovincialis*	X							
	California horn snail	*Cerithideopsis californica*						X		X
	California sea hare	*Aplysia californica*		X						
	California two-spot octopus	*Octopus bimaculatus*		X	X		X			
	chestnut cowrie	*Neobernaya spadicea*			X					
	dorid nudibranch	*Doriopsilla albopunctata*		X	X					
	giant pacific oyster	*Crassostrea gigas*	X							
	giant rock scallop	*Crassadoma gigantea*				X				
	Gould's bubble snail	*Bulla gouldiana*		X						
	Kellet's whelk	*Kelletia kelletii*			X	X				
	kelp scallop	*Leptopecten latiauratus*		X						
	Lewis' moon snail	*Neverita lewisii*						X		X
	native oyster	*Ostrea lurida*			X		X			
	Pacific calico scallop	*Argopecten ventricosus*				X		X		
	predatory sea slug	*Navanax intermis*		X			X		X	
	purple dwarf olive snail	*Callianax biplicata*				X				
	scaled worm snail	*Serpulorbis squamigerus*						X		X
	wavy turban snail	*Megastrea undosa*		X						
Sponges-Porifera										
	Sponge	*Haliclona* sp.	X							
	Sponge	*Porifera*					X	X	X	X
	Yellow Sponge	*Cliona* sp.					X	X	X	X
Tunicates-Urochordata										
	colonial sea squirt, unID	colonial *Ascidiacea*, unID						X		X
	colonial tunicate	*Botryllus/Botrylloides* complex	X					X		X

Phylum	Common Name	Species Name	All Zones		Zone 1		Zone 2		Zone 3	
			Hard	Soft	Hard	Soft	Hard	Soft	Hard	Soft
	sea squirt, unID	*Ascidiacea,* unID						X		X
	solitary tunicate	*Styela clava*			X		X			
	solitary tunicate	*Styela montereyensis*			X		X			
	solitary tunicate	*Styela plicata*	X					X		X
	solitary tunicate	*Styela* sp.			X		X	X		X

7-2 Caulerpa spp.

Caulerpa spp. is a noxious species of marine algae. *Caulerpa taxifolia* is an invasive green alga that was eradicated from California after two introductions were discovered in 2000 (Anderson et al 2005). *Caulerpa prolifera* was found in 2021 in Newport Harbor. This species of marine algae was observed on October 31, 2024, near the southeastern corner of outer Linda Isle (Figure 27). Upon observation of this invasive species, MTS staff followed specified protocols outlined in the Caulerpa Control Protocol (NOAA and CDFW 2021) and notified the Southern California Caulerpa Action Team (SCCAT) immediately. Instances where the diver was visually observing the seafloor were recorded and are included as Appendix B. The infestation in this area was treated and continues to be surveyed periodically for any additional *Caulerpa.*

Figure 27. Survey map showing the location of documented *Caulerpa taxifolia* coverage mapped during the 2024 survey. Note that some points appear to occur on land due to the relative orientation of the base map.

8 Conclusion

Eelgrass plays an important role for many organisms and environmental processes in bays and nearshore estuaries. There are many important roles performed by eelgrass which include:

- Providing habitat for marine fish and invertebrate species.
- Providing protective cover and refuge for its inhabitants.
- Providing spawning areas for many species, including commercially important California halibut and barred sand bass.
- Providing a foraging center for seabirds, sea turtles, and marine mammals.
- Contribute to decaying organic material as part of marine/estuary food web.
- Filters pollutants from the water, sequesters carbon dioxide gas.
- Protects shorelines from erosion by dampening wave energy.

Shallow-water and deep-water eelgrass surveys were conducted in Newport Bay in support of the City of Newport Beach Harbor Area Management Plan between August and December 2024. This was the ninth survey conducted in a series of surveys since 2003.

The Bay was divided into three zones enveloping 24 shallow-water mapping regions and 1 deep-water mapping region. The results of this survey indicate that eelgrass is present in many parts of Newport Bay and covers 125.53 ac within the SWEH regions and 64.53 ac within the DWEH region. Eelgrass was found to extend from intertidal areas to -25.0-ft MLLW. Eelgrass occupied sediment ranging from fine silt to coarse sand and shell hash.

SWEH and DWEH eelgrass was abundant in Zone 1 near the Entrance Channel between Corona del Mar and Balboa Island extending to Bay Island at depths between low intertidal to -25.0-ft MLLW. Significant amounts of eelgrass were also mapped at Linda Isle Inner and Outer, DeAnza Peninsula-Inner and Outer, Castaways, and Balboa Island. Of the majority of SWEH reported, 41.48%, was found in Corona del Mar (Region 1), Balboa Island/Collins Isle (Region 5), and Inner DeAnza Peninsula (Region 12).

Reductions in eelgrass cover were reported for Regions 4, 6, 7, 11, 15, 18. In all other regions, eelgrass coverage was greater than values reported in the previous 2022 survey (MTS and CRM 2023). Many of the Regions where eelgrass increased occurred within the Stable and Transitional Eelgrass Zones (Zones 1 and 2). No trend was observed for losses to eelgrass coverage where losses were observed.

Eelgrass density collected at 23 regions indicates that density has increased when compared to the previous 2022 survey (MTS and CRM 2023). Generally, density was greatest along the shallower portions of mapped eelgrass polygons. While density was greatest in these shallow areas, Region1 displayed offshore density values far above all other densities collected in other regions. Inshore densities were greatest in Regions 11, 14, and 16. Overall, average density fell within the range of values historically reported. Eelgrass density was not collected in every region surveyed since no eelgrass was found in Region 19 and Region 25 was added after survey completion.

Many species were observed throughout the survey effort. Species diversity generally decreased moving away from the entrance channel. The noxious alga, *Caulerpa* spp., was found in Newport Bay during this survey effort. The finding of *Caulerpa prolifera* on the southeastern corner of Region 10, Linda Isle Outer, was documented during this survey period. Appropriate procedures were followed upon discovering the establishment of *C. prolifera.*

9 Eelgrass Transplant Methods Discussion

Marine Taxonomic Services, Ltd. (MTS) was contracted by the City of Newport Beach to evaluate various restoration techniques for eelgrass (*Zostera marina*) in Newport Harbor, in Newport Beach, CA. The City of Newport Beach (City) is obligated under its approved eelgrass plan "Eelgrass Protection and Mitigation Plan for Shallow Waters in Lower Newport Bay: An Ecosystem Based Management Program" (October 2015), to "test, and/or improve methods to collect and use eelgrass seeds for deployable seed bagging and to construct or use eelgrass TERFS™ devices."

As such, the following study was devised to evaluate the success and efficiency of various eelgrass transplanting methods for mitigating necessary harbor maintenance dredging projects. Specifically, MTS was contracted by the City to develop an eelgrass restoration techniques evaluation study, with the intent of evaluating the relative effectiveness of eelgrass transplanting efforts utilizing both new and traditional eelgrass transplanting methods. To the extent practical, MTS built upon existing eelgrass transplanting information by designing a study to evaluate the relative effectiveness in performance and cost of three unique eelgrass transplanting methods: 1) traditional bare-root bundle planting 2) transplanting eelgrass remotely with frames (TERFs), and 3) Transplanting eelgrass remotely with rope (TERR).

In 2019 the initial eelgrass transplant effort was completed (MTS 2019). Subsequent monitoring of the transplanted areas was performed in 2020 (MTS 2020) and 2022 (MTS 2023). This 2024 monitoring event was completed 5 years after the eelgrass transplant. Eelgrass was found on transects within Areas 1, 2, 3, 4, and 5. Eelgrass was not mapped in Area 6.

In Area 1, eelgrass filled nearly all of the transects transplanted (Figure 28). Near total coverage by eelgrass within this area may indicate that transplant location rather than transplant method is preferential for eelgrass transplant unit success.

In Area 2, the western (bare root) and middle (TERR) transect show increased eelgrass coverage (Figure 29). All eelgrass mapped along the eastern (TERF) transect was absent during this monitoring period. The continued presence of eelgrass along the western and middle transect may indicate successful eelgrass transplant methodologies. Expansive eelgrass beds were mapped in this area during the 2024 survey effort. It is challenging to determine if the transplantation of eelgrass within Area 2 contributed to the overall expansion and/or connection of eelgrass resources surrounding the transplanted transects or if the surrounding eelgrass has expanded to cover the Area 2 transects.

In Area 3, eelgrass was found on the nearshore portion of the bare root transplant transect (Figure 30). Eelgrass covered approximately the same portion of this transect in 2022 (MTS 2023). The continued presence of eelgrass along this portion of the bare root transect, lack of establishment or growth of eelgrass on the remainder of the bare root transect or the other transplant transects, and lack of eelgrass resources surrounding the transplant area is likely caused by environmental factors limiting growth opposed to transplant methodology.

In Area 4, eelgrass continues to cover the majority of transects (Figure 31). While eelgrass remains along transects in this area the distribution of coverage has changed. The change in location of eelgrass resources likely represents natural variation of the resource and does not indicate a more desirable transplant methodology.

In Area 5, eelgrass was only observed along a small portions of the western most transect where bare root method was used (Figure 32). However, when these transects were surveyed in 2022, eelgrass was present on the middle TERF transect and absent on the western transect. The lack of coverage along these transects in this area is likely caused by the water depth and/or distance away from the harbor mouth rather than the transplant methodology. Additionally, the presence of eelgrass along the western transect is likely due to eelgrass resources expanding into the transect and does not represent transplant method.

The absence of eelgrass on transects in Area 6 is likely caused by the water depth and/or distance away from the harbor mouth rather than the transplant methodology as minimal eelgrass coverage was reported in Area 3 and no eelgrass coverage was reported in Area 6 during the 2022 survey effort (MTS 2023).

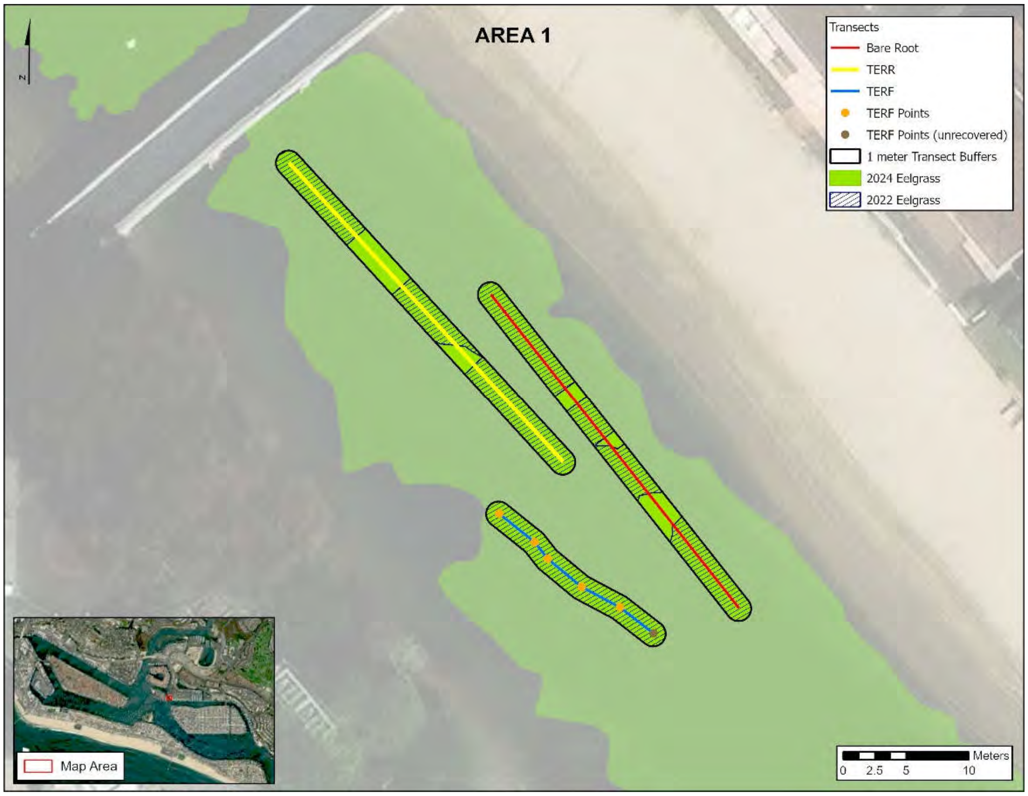

Figure 28. Map of Area 1 transplant transects.

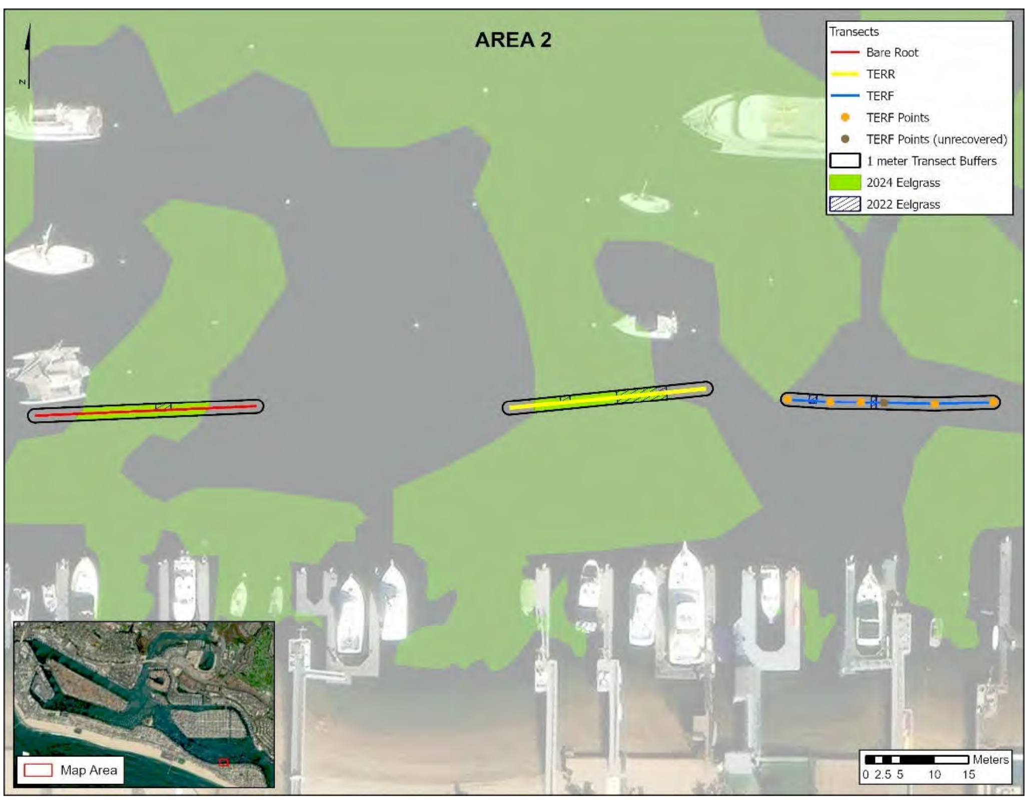

Figure 29. Map of Area 2 transplant transects.

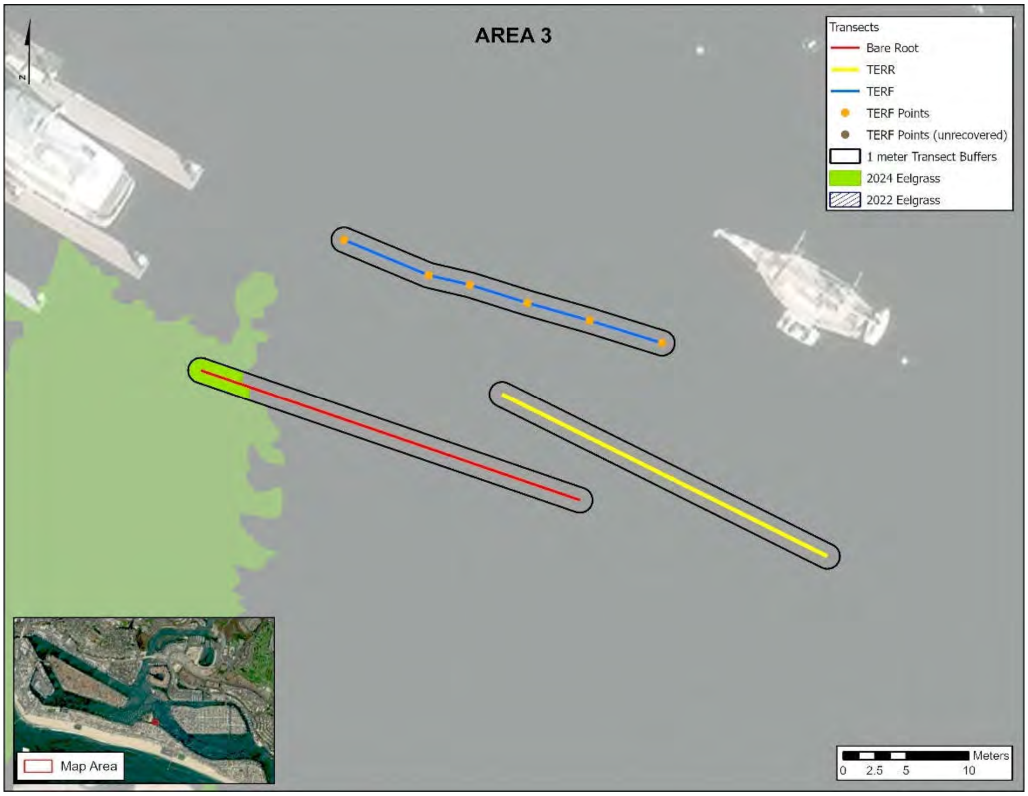

Figure 30. Map of Area 3 transplant transects.

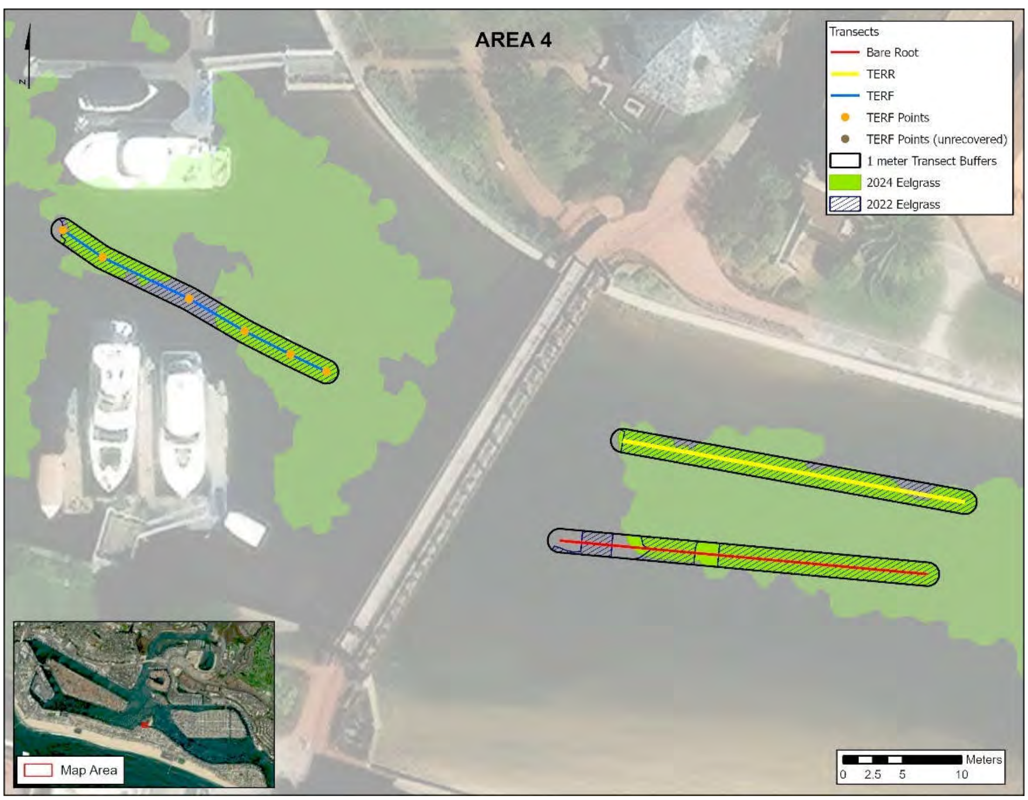

Figure 31. Map of Area 4 transplant transects.

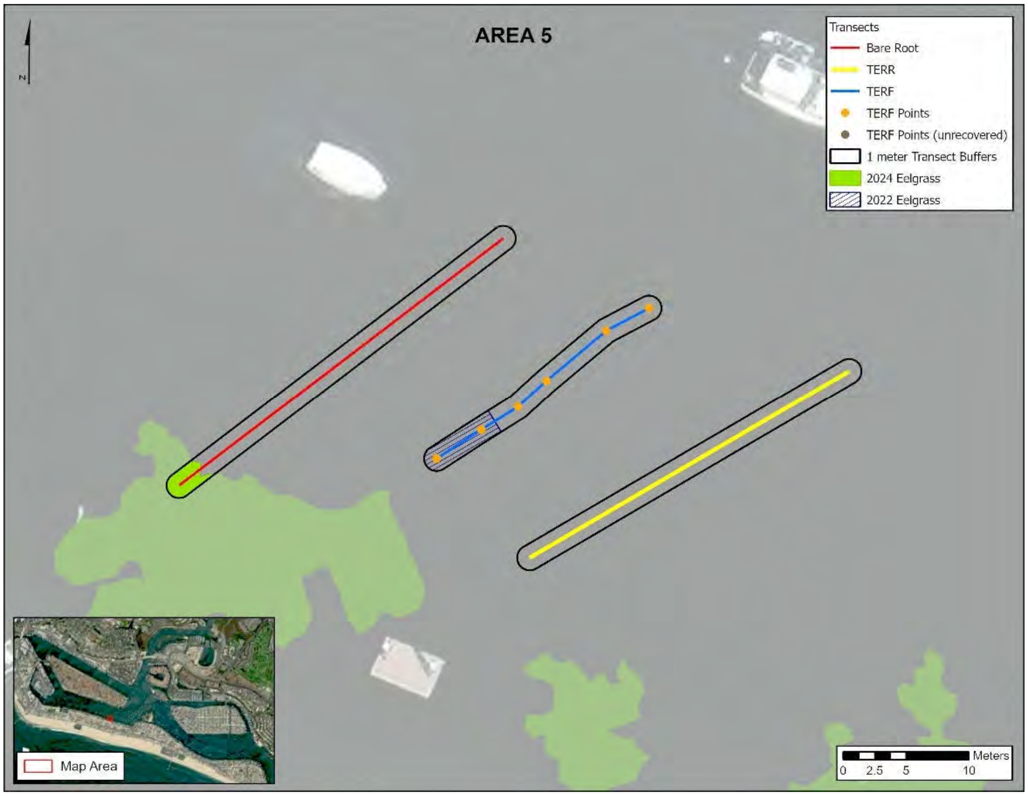

Figure 32. Map of Area 5 transplant transects.

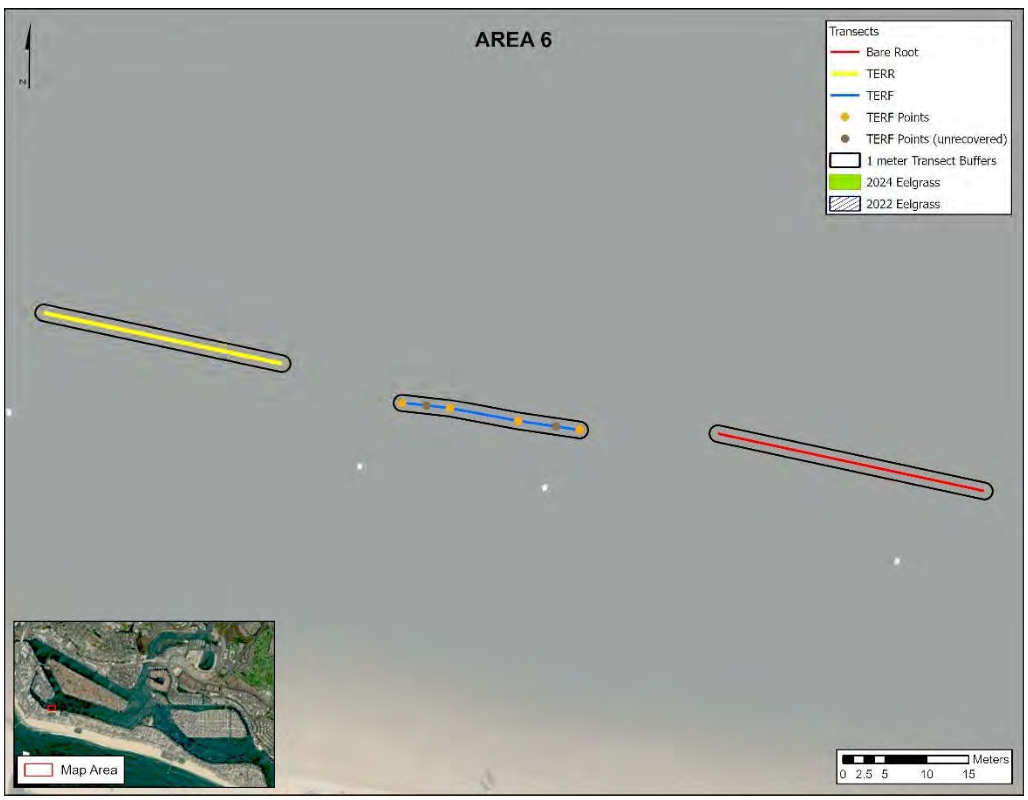

Figure 33. Map of Area 6 transplant transects.

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Appendix A: SWEH and DWEH Sonar Track Lines

SWEH Sonar Tracklines

500 ft

MN
11°15'

DWEH Sonar Tracklines

500 ft

MN
11°15'

Invasive Algae Remote Video Tracklines

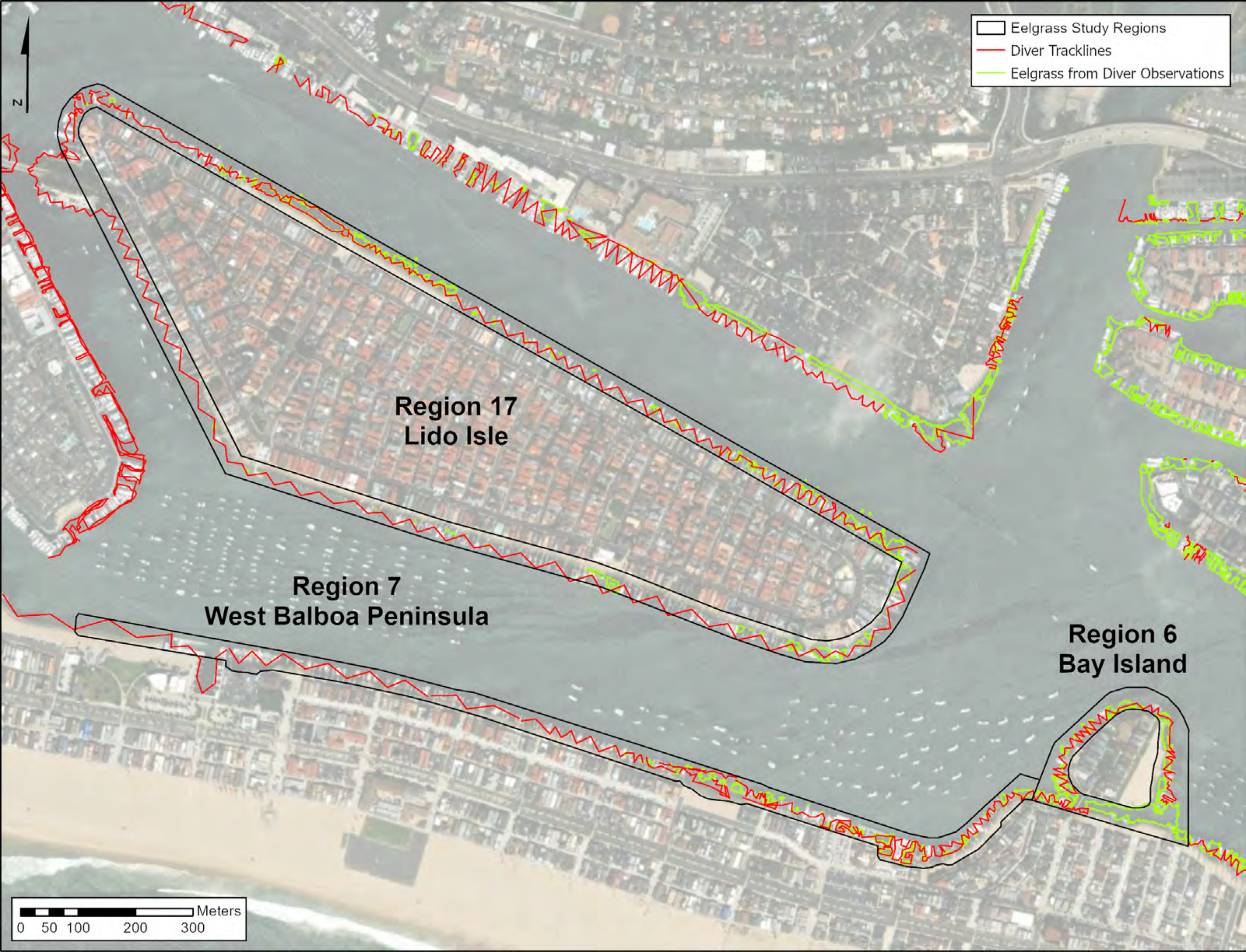
Appendix B: Visual Diver Coverage for *Caulerpa* spp.


Eelgrass Study Regions
Diver Tracklines
Eelgrass from Diver Observations
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Meters
0 200 400 800 1,200

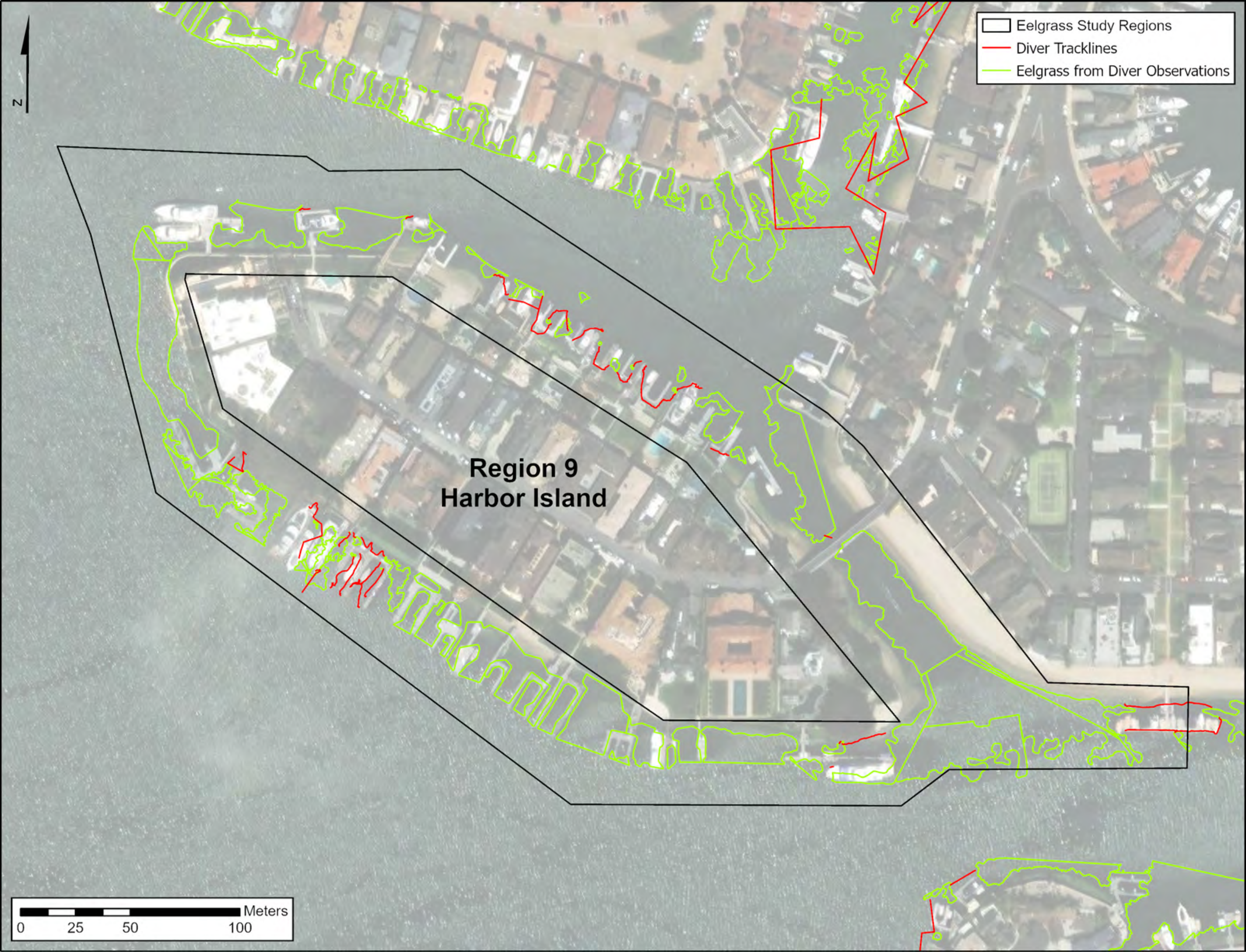
Eelgrass Study Regions
Diver Tracklines
Eelgrass from Diver Observations
Region 1
Corona Del Mar (Bayside)
Region 3
East Balboa Peninsula
Meters
0 50 100 200
N

Eelgrass Study Regions
Diver Tracklines
Eelgrass from Diver Observations
Region 2
Yacht Club/Basins
Region 4
Grand Canal
Region 5
Balboa Island/Collins Isle
Meters
0 50 100 200
N

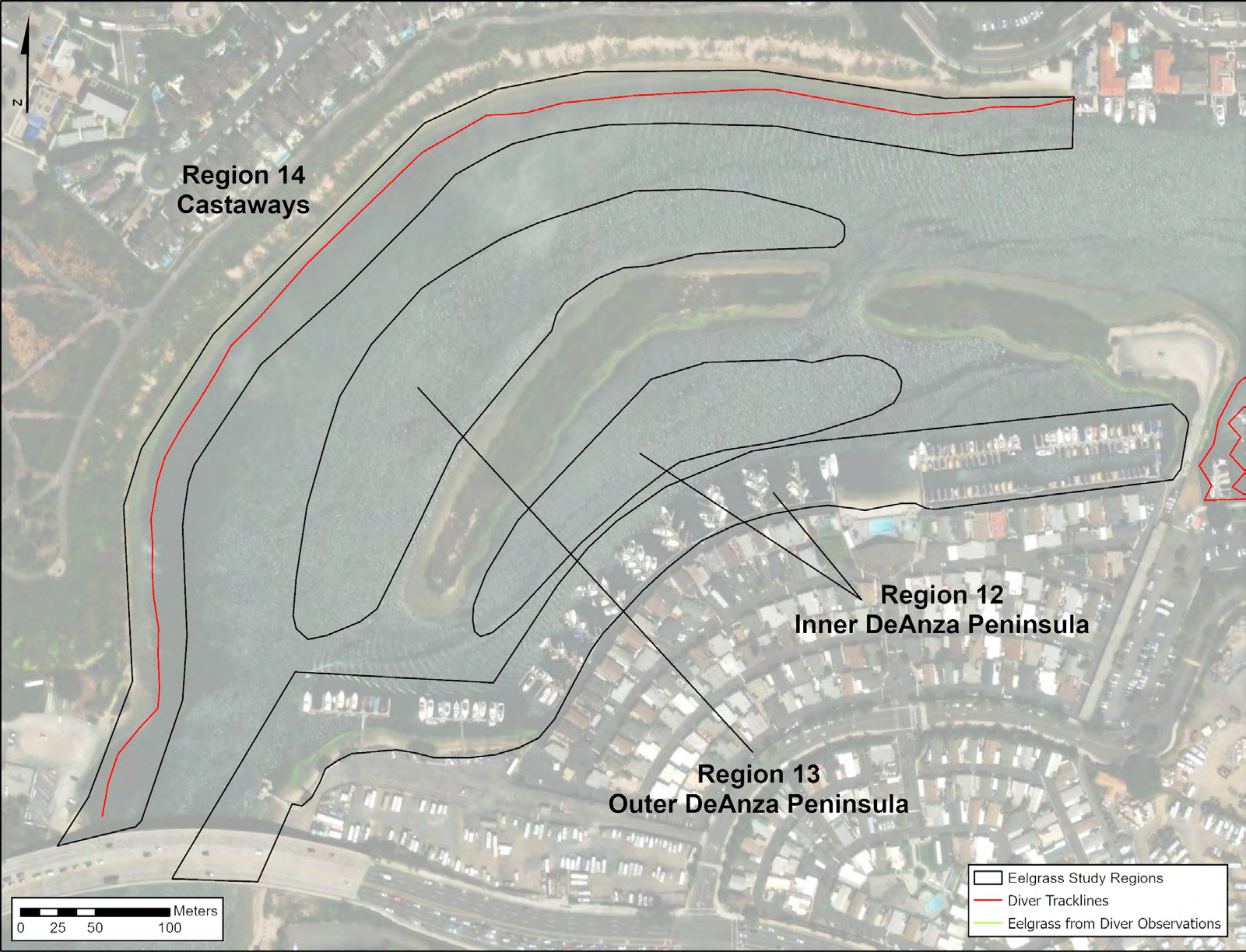
Eelgrass Study Regions
Diver Tracklines
Eelgrass from Diver Observations
Region 3
East Balboa Peninsula
Meters
0 50 100 200
N

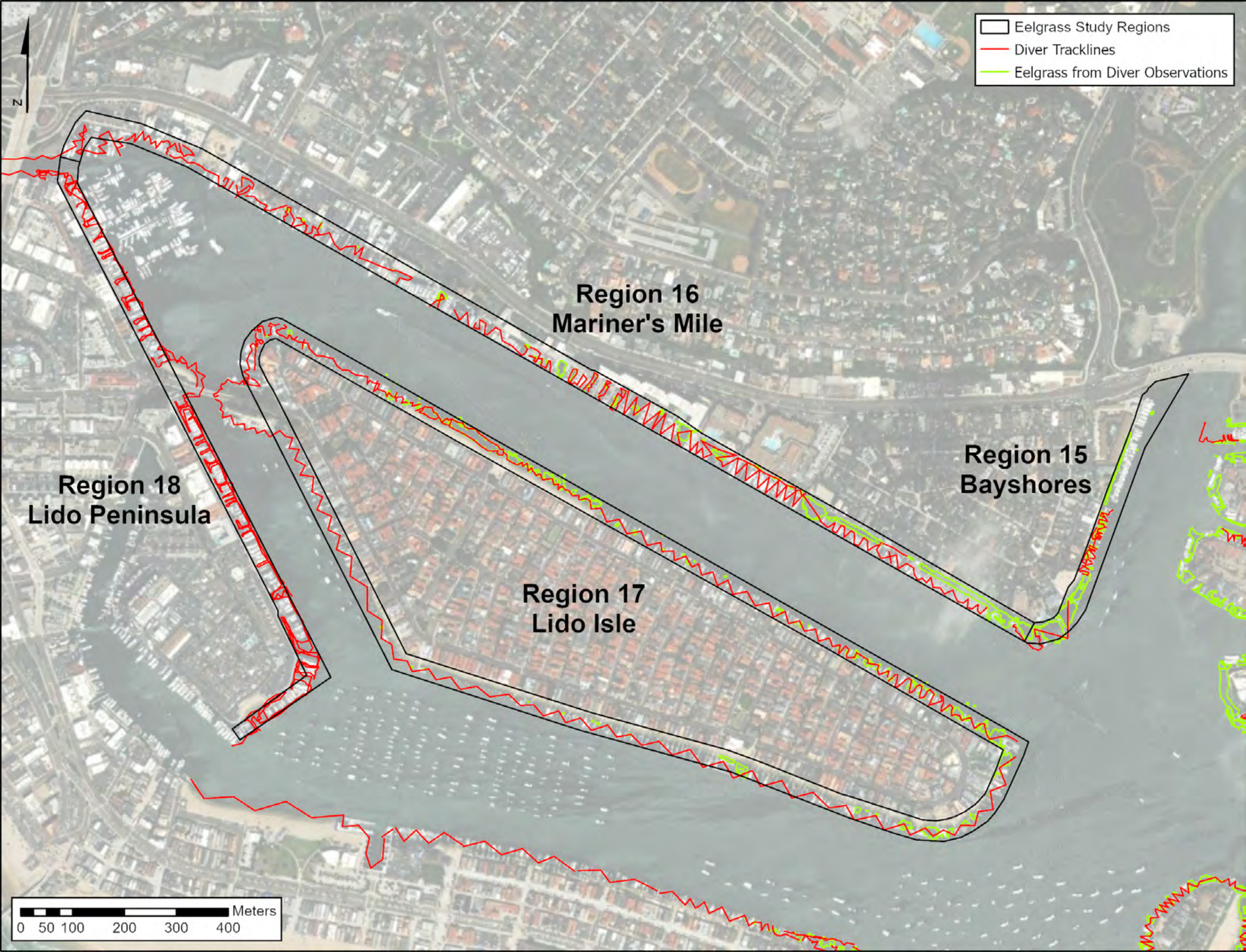

Eelgrass Study Regions
Diver Tracklines
Eelgrass from Diver Observations
N
Region 17
Lido Isle
Region 7
West Balboa Peninsula
Region 6
Bay Island
Meters
0 50 100 200 300


Eelgrass Study Regions
Diver Tracklines
Eelgrass from Diver Observations
N
Region 11
Linda Isle Inner
Region 10
Linda Isle Outer
Region 8
North Balboa Channel and
Yacht Basin
Meters
0 50 100 200

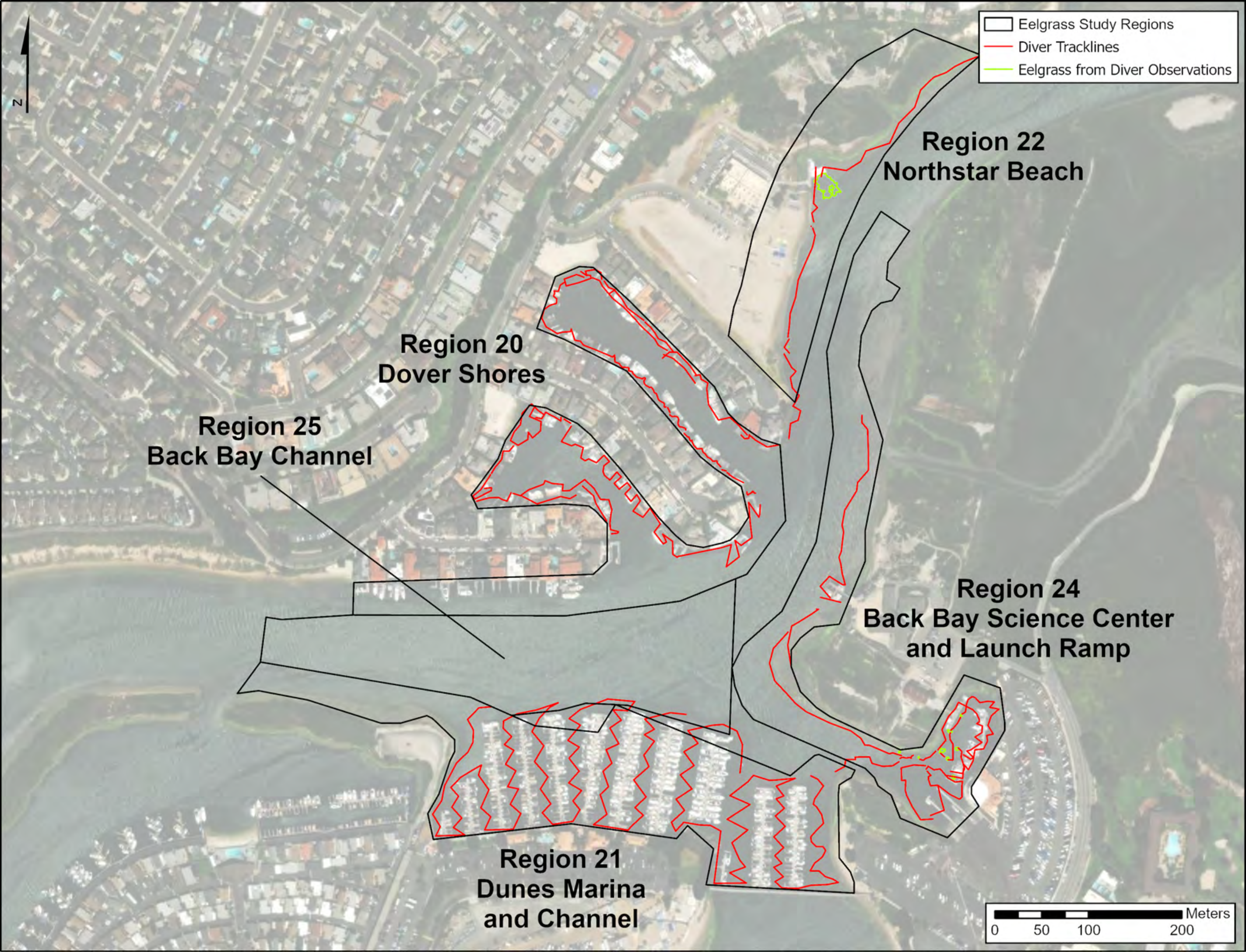


Eelgrass Study Regions
Diver Tracklines
Eelgrass from Diver Observations
N
Region 9
Harbor Island
Meters
0
25
50
100


N
Region 14
Castaways
Region 12
Inner DeAnza Peninsula
Region 13
Outer DeAnza Peninsula
Eelgrass Study Regions
Diver Tracklines
Eelgrass from Diver Observations
Meters
0 25 50 100


Eelgrass Study Regions
Diver Tracklines
Eelgrass from Diver Observations
N
Region 16
Mariner's Mile
Region 15
Bayshores
Region 18
Lido Peninsula
Region 17
Lido Isle
Meters
0 50 100 200 300 400

Eelgrass Study Regions
Diver Tracklines
Eelgrass from Diver Observations
N
Region 19
West Newport
Meters
0 25 50 100 150



Eelgrass Study Regions
Diver Tracklines
Eelgrass from Diver Observations
N
Region 22
Northstar Beach
Region 20
Dover Shores
Region 25
Back Bay Channel
Region 24
Back Bay Science Center
and Launch Ramp
Region 21
Dunes Marina
and Channel
Meters
0
50
100
200

Eelgrass Study Regions
Diver Tracklines
Eelgrass from Diver Observations
N
Region 23
Deep Water Sidescan Sonar
Meters
0 100 200 400