2022 Eelgrass Monitoring in Newport Bay, Newport Beach, California

February 24, 2023

Revised (April 7, 2023)

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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
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 2022 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 eighth SWEH survey and fifth 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), and 2020 (MTS and CRM 2020). Typically, DWEH surveys are performed every other survey (every 4 years) with SWEH surveys performed every two years. This DWEH survey was performed outside of that historical sequence due to planned dredging of federal channels (FC) in spring 2023. The DWEH mapping during this survey provides a baseline for future monitoring associated with the federal dredging.

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 incorporated the efforts into this report.

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 by their 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 (USACE 2020), the California Coastal Commission (CDP 5-19-1296), 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.

<u>2003-2004 Survey Summary</u>
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).

<u>2006-2008 Survey Summary</u>
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).

<u>2009-2010 Survey Summary</u>
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 acers of DWEH to depths of -28ft MLLW.

<u>2012-2014 Survey Summary</u>
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).

As a result of the surveys performed between 2003 and 2014 three eelgrass stability zones were identified in the Bay. The first zone is the stable eelgrass zone, where eelgrass distribution and density have been relatively constant and underwater light levels were highest. The second zone is the transitional eelgrass zone where eelgrass acreage has been 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).

<u>2016 Survey Summary</u>

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).

<u>2018 Survey Summary</u>

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).

<u>2020 Survey Summary</u>

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 a total of 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 RCM 2020).

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).

Zostera japonica, dwarf eelgrass, is an introduced seagrass found along the west-coast, originally from Asia (Posey, 1988). *Z. japonica* has been known to inhabit the waters of the Pacific Northwest since the early 1900s (Phillips, 1985). Its presence in California has only been known for a short time (Shafer et al. 2008). In Newport Bay, *Z. japonica* is not known to occur. 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, and sea lions utilize eelgrass beds as foraging grounds. Green sea turtles also utilize eelgrass beds. Green sea turtle occurrence in Newport Bay is not well documented. However, MTS made three separate observations of green sea turtles in Upper Newport Bay between May and October 2020.

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 greatly 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 and that facilitates both the City's and resource and 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) was approved (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, 2022, diver survey efforts conducted by MTS. Integral staff for this survey included Dr. Robert Mooney (Principal Investigator), Grace Teller (Biologist, M.Sc.), Erik Mahan (Dive Technician, M.A.Sc.), Jason Carroll (Dive Technician, B.Sc.), Hamza Mahmoud (Dive Technician). Dr. Mooney contributed to project oversight, client communication, and report review. Grace acted as the field team project manager responsible for training staff, scheduling, and ensuring the quality of work conducted daily. Erik, Jason, and Hamza acted as the field team divers and topside support. Additionally, Grace was responsible for drafting the 2022 report summary. CRM staff, Rick Ware and Tom Gerlinger, supported the 2022 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, 2022, and December 15, 2022. 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 paralleled 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 23 SWEH mapping regions and 1 DWEH mapping region (Figure 2).

2-3 Eelgrass Survey Methods

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.

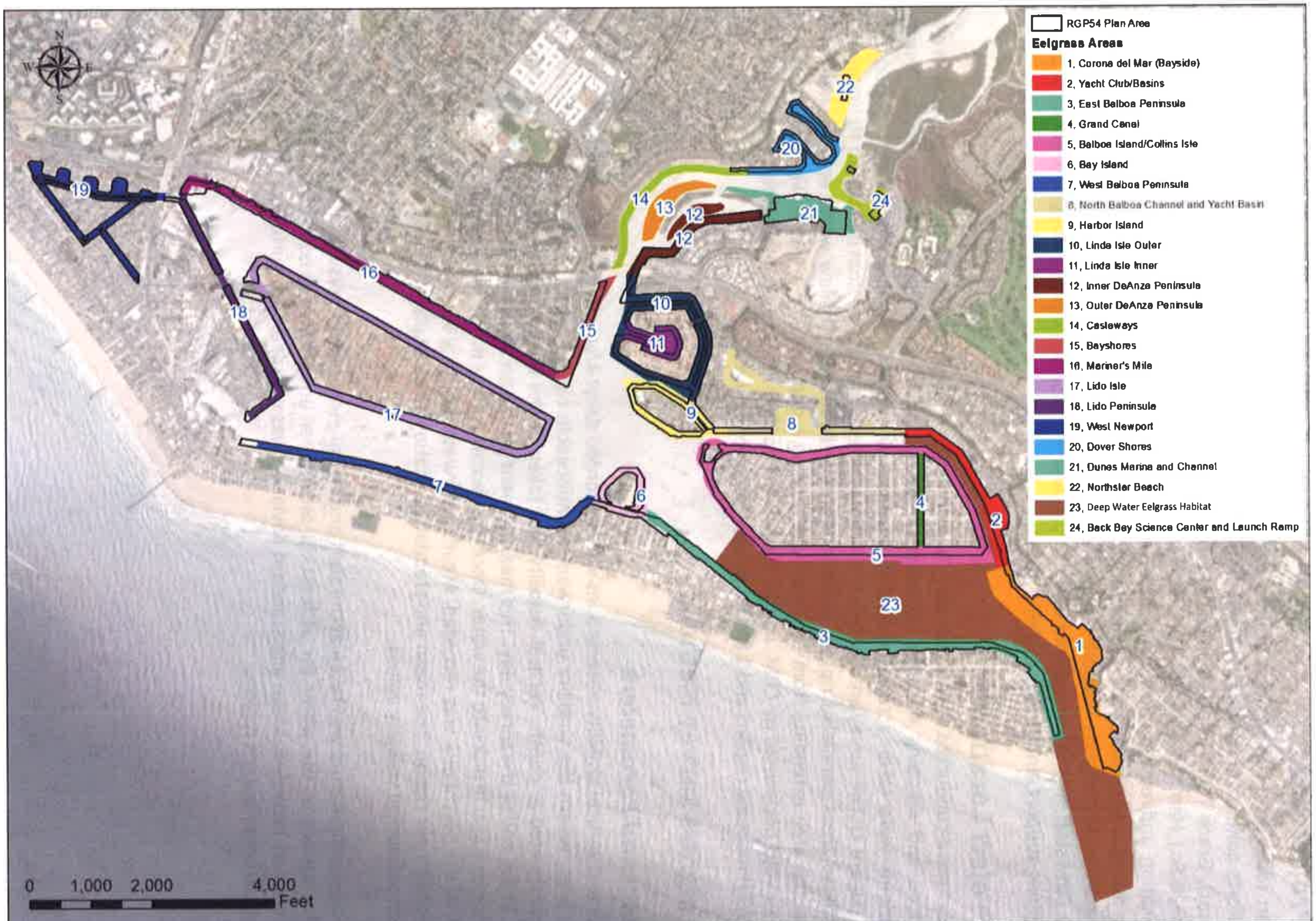

Figure 2. Map of Newport Bay showing 23 shallow water eelgrass habitat mapping regions and the deep-water eelgrass habitat mapping region.

Sonar Survey

CRM used remote sensing techniques, (traditional sonar and down-looking sonar) to supplement the diver eelgrass survey. The traditional sonar and down-looking sonar systems were used to survey areas within -28-ft to -15-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 diver mapping surveys in the larger SWEH areas and/or in SWEH navigational areas considered a risk to divers (Regions 1, 2, 5, 8, 11, 12, 13, 14, 20, 21, 22, and 24). On occasion sonar was utilized to collect data to confirm the offshore extent of SWEH around regions 5, 9, and 10. CRM's Lowrance HDS-12 Gen2 Touch Chartplotter/Ecosounder was used to acoustically collect data on bottom depth and plant height from the 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 180-degree view and a down-looking view of the seafloor (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" the seafloor. Ping rates were set at 15 per second. Pulse width was dynamic and varied depending on depth, which varied between 2-ft 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-ft and 30-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 Navico BioBase 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. Seafloor typically registers 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. In the study area, depth profile and vegetation information were collected on soft-bottom features.

Plant height data included for analysis was limited to a minimum detection limit of 1% of bottom depth. Thus, at a three-foot depth, the minimum plant height detection was 0.4 inches whereas along the offshore track lines at 20-ft depths, minimum plant height was approximately 2.4 inches. Thus, the ability to detect SAV, including eelgrass was good.

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. On sandy and mud bottom habitats echo returns may register eelgrass and the red algae such as *Acrosorium* sp, *Gracilaria* spp. and *Ulva* spp. These species are generally shorter than eelgrass. To minimize the potential for other species to be included in the mapping effort, SAV plant height data used in the data reduction process were limited to between 0.3 ft and 3.5 ft. to maximize the probability of occurrence for *Zostera*. Eelgrass polygons were then traced around the perimeter of the eelgrass point data using ArcMap to illustrate the distribution of eelgrass quantified by these acoustical data collection methods.

Combined with remote underwater camera target verification, this data reduction step reduced the potential for other species of SAV to be included in the mapping process.

Sidescan sonar methods were used to document the DWEH within the deeper channels of Newport Bay in the Entrance Channel, Balboa Reach, and the East Balboa Channel. Designated as Region 23. The DWEH data collection occurred on August 3, 4, and 5, 2020. The following sidescan sonar equipment was used during the survey:

- Hemisphere VS330 Global Positioning System (GPS) Receiver,
- Edgetech 4125D Sidescan Sonar System with 400/900 kHz Towfish,
- Odom Hydrographic Hydrocrack II Depth Sounder,
- Digibar Pro Sound Velocity Recorder, and
- Hypack Max Hydrographic Data Acquisition and Processing Software.

Horizontal positioning for the survey was achieved using a real time DGPS positioning system. Differential Corrections, broadcast by US Coast Guard were used to correct the raw GPS data. The horizontal datum was North American Datum of 1983 (NAD83), epoch 2011.0, the projection was California State Plane Coordinate System Zone VI, and the units were US Survey feet. The vertical datum was Mean Lower Low Water (MLLW), epoch 83-01 based on recorded water level data from the National Oceanic and Atmospheric Administration (NOAA) Outer Los Angeles Harbor tide gauge and corrected for Newport Bay).

To minimize turns during data collection, the survey area was divided in three overlapping sub-regions that were covered with straight line segments. Using the navigation display of the Hypack online software, the vessel was steered along pre-planned shore-parallel track lines spaced 100 ft apart. Vessel track lines are shown in Appendix A.

The Edgetech 4215D Sidescan Sonar System with the 400/900 kHz towfish was operated at the 30-meter (100 ft) range (each channel) providing 100% data overlap. Sidescan sonar and DGPS data were recorded using the Edgetech Discover software and processed using Chesapeake SonarWiz 7 software to produce a compilation of rectilinear corrected composite image mosaics.

The position of the towfish was determined by applying an offset to the vessel's position based on a layback as resolved from the vessel's heading and the amount of sonar tow cable laid out. Towfish altitude above the seabed was recorded continuously and used for data slant range correction. Sounding data were obtained at the same time as the sidescan sonar data.

While the DWEH sidescan and downlooking sonar survey lines were being run, GPS waypoints were marked at locations that depicted the potential presence of SAV based on the real-time downlooking sonar views. These waypoints were then used to conduct follow-up video target surveys.

The target verification survey was conducted by remote underwater video. An Ocean Systems Deep Blue "Splash Cam" was used to view the seafloor in real time using the Lowrance navigation unit's display, for target verification of waypoints collected during the sidescan and downlooking sonar survey. The unit was deployed from the vessel's davit. Run times were standardized to approximate 30 second bottom times. A total of 40 waypoint targets were evaluated by this method to verify the presence or absence of eelgrass vegetation. This visual analysis was then used to go back into the sidescan and downlooking sonar data and refine the final DWEH maps.

The DWEH and a portion of neighboring SWEH that was mapped by side scan sonar was broadly mapped as eelgrass although there were gaps present within the interior of the mapped eelgrass beds. The mapping was performed by the same staff at CRM that have mapped all DWEH in the past. The CRM team noted that eelgrass cover in the DWEH has expanded to the point where the beds are functionally contiguous. However, to provide an accurate estimate of the seafloor that is vegetated, an area adjustment based on the percent eelgrass cover was performed. The methods to produce the adjustment consisted of randomly sampling the sonar record and is described in Appendix C. The percent cover data were stratified by 4 areas within the DWEH in Region 23: Balboa Mooring Field, Balboa Peninsula Mooring Field, East Balboa Channel, and Newport Harbor Entrance Channel. Each of these areas was given a percent cover value based on the analysis as provided in Appendix C. The percentages were applied to the areas noted above and some adjacent areas. The adjacent areas included the portion of Region 5 from the RGP 54 boundary to the Region 23 DWEH boundary and the portions of Region 1 between the RGP 54 boundary and the Region 23 DWEH boundary. In the case of Region 1, the area and adjustment was split between portions that were adjacent to the Balboa Mooring Field and the Entrance Channel.

2-4 SCUBA Diver Survey

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 differential global positioning system (dGPS). The topside personnel connected to the diver-towed dGPS using a computer tablet for mapping eelgrass polygons and patches, marking waypoints, and taking notes. A Juniper Systems Geode dGPS was used for the entirety of the survey. The estimated global positioning system (GPS) error of the Geode GPS is less 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 dGPS in use was connected to the tablet via Bluetooth. Once the tablet and dGPS were connected an application, mapitGIS, was opened on the tablet and used to collect waypoints from the dGPS 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 mapitGIS application to begin mapping a new polygon. GPS signals were collected every 2 seconds via the mapitGIS 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 mapitGIS App. 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 KML 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.

Additionally, 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; no Caulerpa was observed at any time within the surveyed areas in Newport Bay

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 26 stations throughout the study area. The 26 stations included all surveyed regions. Regions 5 and 8 had two sampling locations. Region 5 had two sampling locations to account for the difference in sun angel around balboa Island. Region 8 had two sampling locations since the eelgrass beds mapped within that region were small and required more than one location for collection to reach the necessary 10 measurements. Additionally, only a single measurement was collected in Region 19 because no additional eelgrass was mapped such that additional density measurements could be collected without oversampling. The diver counted the number of live, green turions at the sediment/shoot interface, within replicated $1/16^{th}$ 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 26 surveyed sites are provided within 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.

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 mouth. In cloudy sky conditions, less light penetration occurred at depth resulting in overall lower visibility conditions. Additionally, storm events in November and December 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 0.3-ft to 10.4-ft (Figure 3). 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, Western portions of Lido Isle, and West Newport. In these areas, visibility was generally moderate at the more stagnant water reduced sediment suspension. Horizontal visibility ranged between 1-ft and 12-ft (Figure 4). On average horizontal visibility ranged between 1-ft and 7-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 is the lowest average reported visibility compared to previous surveys (Figure 5).

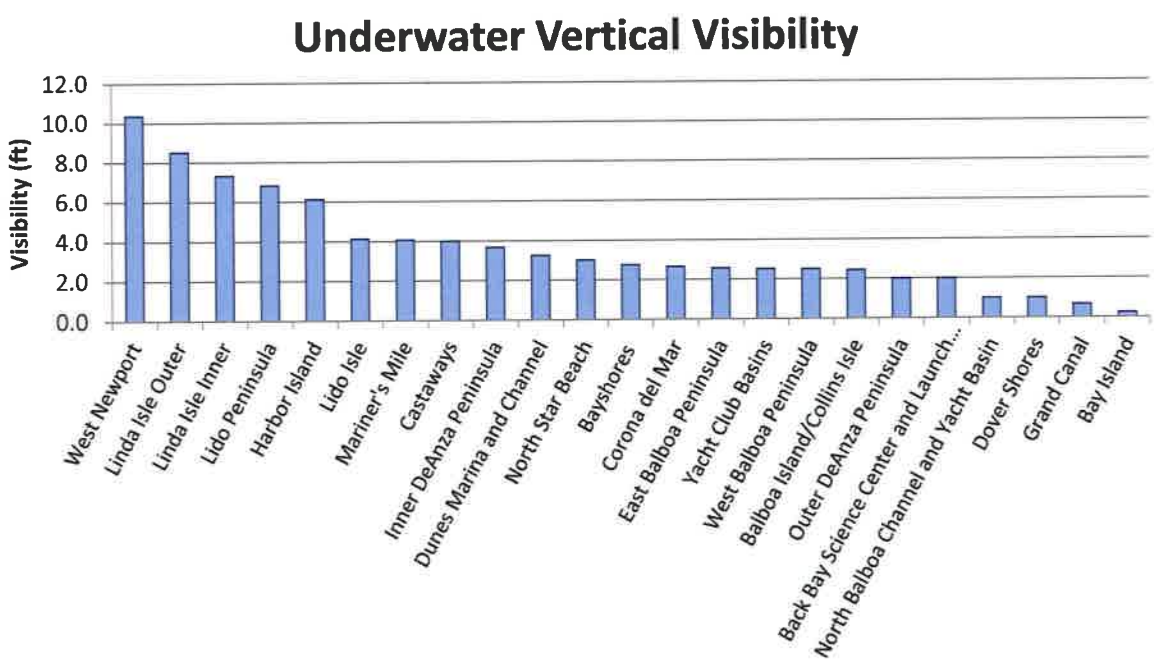

Figure 3. Underwater vertical visibility in feet at survey areas throughout Newport Bay in 2022. Note that vertical visibility is a function of conditions at the time of the survey and does not necessarily indicate a consistent poor water quality condition at any given location.

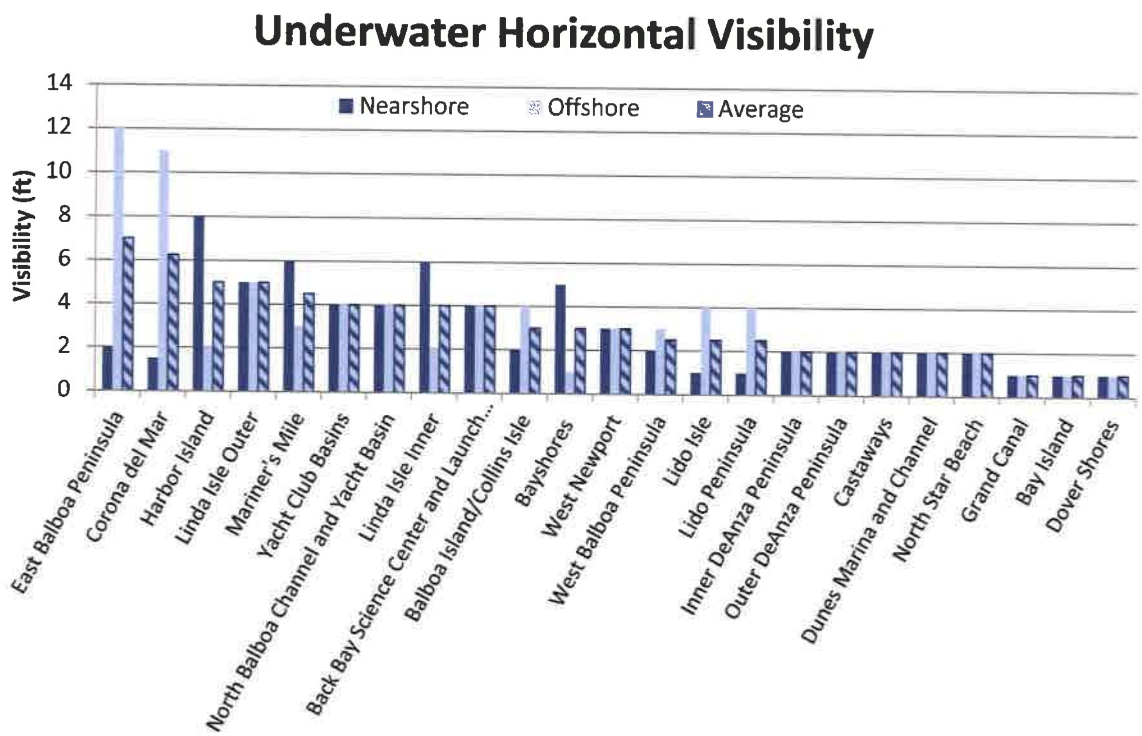

Figure 4. Underwater horizontal visibility in feet at survey areas throughout Newport Bay in 2022. Note that horizontal visibility is a function of conditions at the time of the survey and does not necessarily indicate a consistent poor water quality condition at any given location.

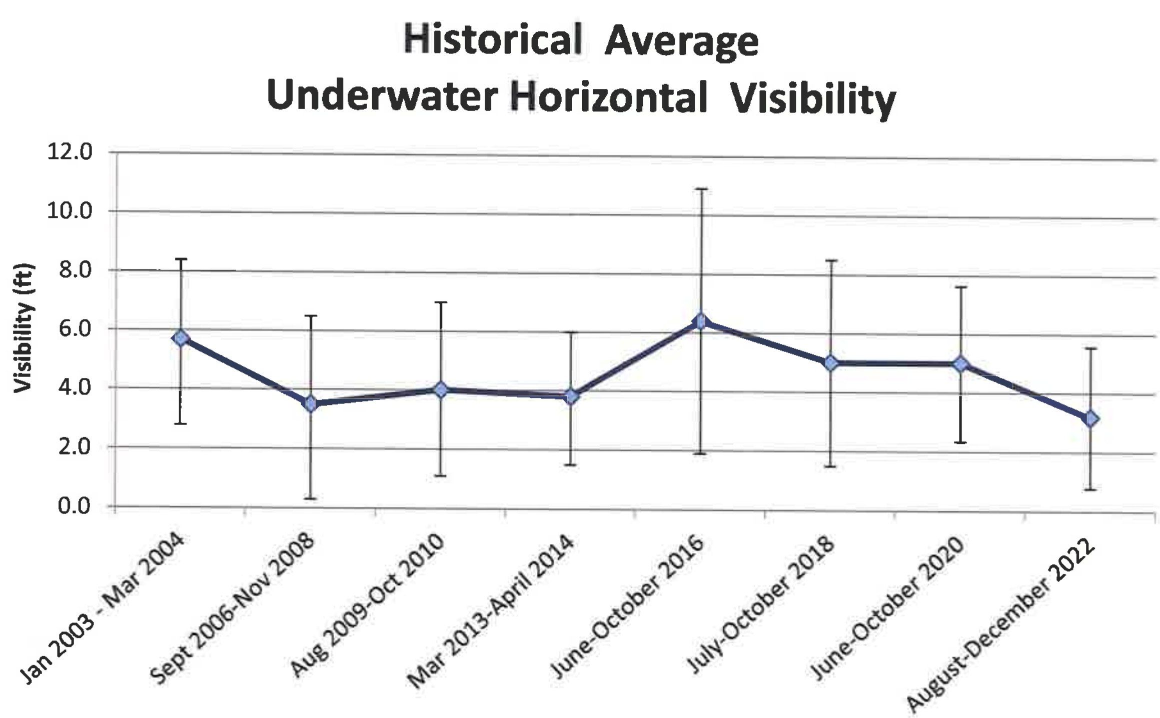

Figure 5. Historical averages of underwater horizontal visibility from 2003 through 2022. Error bars are one standard deviation.

Water Temperature

Location within the Bay and time of the year affect the surface temperature readings collected. Surface water temperature ranged from a low of 51 degrees Fahrenheit (°F) in Regions 8 (North Balboa Channel and Yacht Basin) and 16 (Mariner's Mile), during early December, to a high of 75 °F in Region 7 (West Balboa Peninsula), near the middle of September (Figure 6). In general, average surface water temperature was warmer in regions surveyed in summer/early fall months (August-October) and cooler in late fall/winter mons (November-December) (Figure 7).

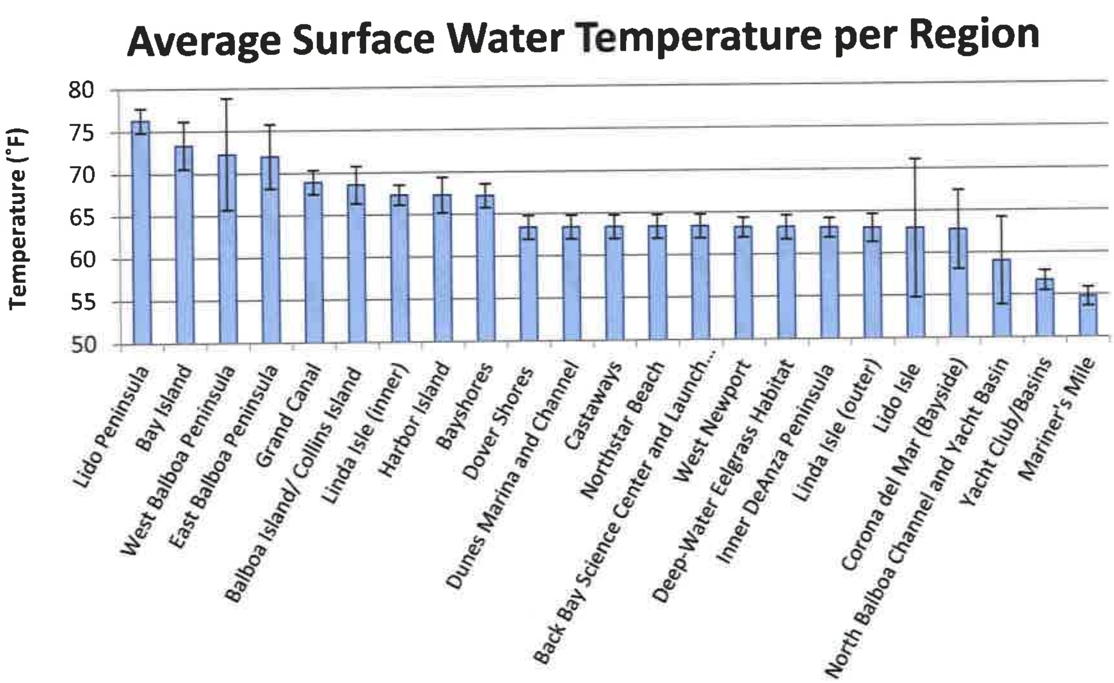

Figure 6. Average surface water temperature by region during the 2022 eelgrass mapping survey. Error bars are one standard deviation.

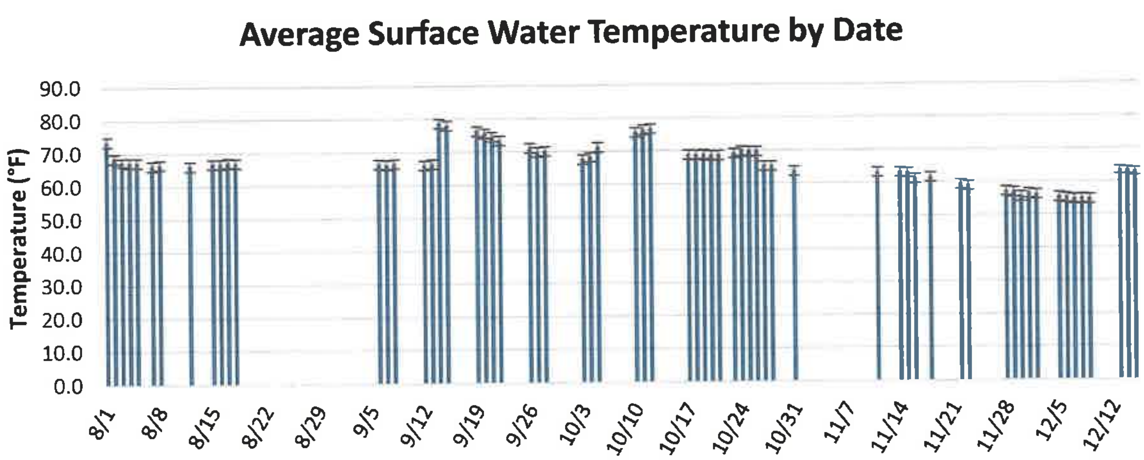

Figure 7. Average surface water temperature by date during the 2022 eelgrass mapping survey. Error bars are one standard deviation.

3-2 Eelgrass Distribution and Abundance

A total area of 205.4 ac was mapped depicting eelgrass beds in Newport Bay during this 2022 survey. This included 109.01 acres of SWEH and 96.4 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 8.

The DWEH and a portion of neighboring SWEH that was mapped by side scan sonar was broadly mapped as eelgrass although there were gaps present within the interior of the mapped eelgrass beds. The mapping was performed by the same staff at CRM that have mapped all DWEH in the past. The CRM team noted that eelgrass cover in the DWEH has expanded to the point where the beds are functionally contiguous. However, to provide an accurate estimate of the seafloor that is vegetated, an area adjustment based on the percent eelgrass cover was performed. The methods to produce the adjustment consisted of randomly sampling the sonar record and is described in Appendix C. The percent cover data were stratified by 4 areas within the DWEH in Region 23: Balboa Mooring Field, Balboa Peninsula Mooring Field, East Balboa Channel, and Newport Harbor Entrance Channel. Each of these areas was given a percent cover value based on the analysis as provided in Appendix C. The percentages were applied to the areas noted above and some adjacent areas. The adjacent areas included the portion of Region 5 from the RGP 54 boundary to the Region 23 DWEH boundary and the portions of Region 1 between the RGP 54 boundary and the Region 23 DWEH boundary. In the case of Region 1, the area and adjustment was split between portions that were adjacent to the Balboa Mooring Field and the Entrance Channel. The percent cover adjusted areas are provided in Table 1 where adjustments were made. The adjustments reduce the total eelgrass vegetated area to 164.3 acres. The adjusted DWEH and SWEH totals are 62.2 and 102.1, respectively.

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 24 survey regions.

ID	Region	Acres	Adjusted Acres	% of Total
1	Corona del Mar (Bayside)	23.73	18.68	11.36%
2	Yacht Club/Basins	4.23		2.57%
3	East Balboa Peninsula	5.91		3.60%
4	Grand Canal	1.27		0.77%
5	Balboa Island/Collins Isle	19.18	16.86	10.25%
6	Bay Island	1.96		1.19%
7	West Balboa Peninsula	0.81		0.49%
8	North Balboa Channel and Yacht Club	1.21		0.74%
9	Harbor Island	3.41		2.07%
10	Linda Isle Outer	5.17		3.19%
11	Linda Isle Inner	5.24		3.19%
12	Inner DeAnza Peninsula	10.17		6.19%
13	Outer DeAnza Peninsula	6.77		4.12%
14	Castaways	4.97		3.02%
15	Bayshores	1.25		0.76%
16	Mariner's MIle	1.41		0.86%
17	Lido Isle	1.28		0.78%
18	Lido Peninsula	0.02		0.01%
19	West Newport	0.00		0.00%
20	Dover Shores	6.07		3.69%
21	Dunes Marina and Channel	2.63		1.60%
22	Northstar Beach	0.06		0.04%
23	Deep Water Sonar	96.43	62.20	37.83%
24	Back Bay Science Center and Launch Ramp	2.74		1.67%

Figure 8. Map of eelgrass coverage observed during the 2022 survey.

MTS

3-3 Deep Water Eelgrass Distribution

Region 23. Deep Water Eelgrass Habitat (62.20)

The results of the detailed sidescan and downlooking sonar surveys identified 62.2 ac of DWEH within the Newport Bay Entrance Channel and Balboa Reach (Figure 9). 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 7.74% of the Newport Bay soft bottom habitat during the 2022 survey.

Figure 9. 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 18.68 ac and accounted for 18.29% 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.

Three shallow water regions accounted for 44.75% of total SWEH mapped:

- Corona del Mar (Bayside) (18.68 ac)
- Balboa Island/Collins Isle (16.86 ac)
- DeAnza Peninsula – Inner (10.17 ac)

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

ID	Region	Acres	Adjusted Acres	% of Total
1	Corona del Mar (Bayside)	23.73	18.68	18.28%
2	Yacht Club/Basins	4.23		4.14%
3	East Balboa Peninsula	5.91		5.79%
4	Grand Canal	1.27		1.24%
5	Balboa Island/Collins Isle	19.18	16.86	16.50%
6	Bay Island	1.96		1.91%
7	West Balboa Peninsula	0.81		0.79%
8	North Balboa Channel and Yacht Club	1.21		1.18%
9	Harbor Island	3.41		3.34%
10	Linda Isle Outer	4.67		5.13%
11	Linda Isle Inner	5.24		5.13%
12	Inner DeAnza Peninsula	10.17		9.95%
13	Outer DeAnza Peninsula	6.77		6.62%
14	Castaways	4.97		4.86%
15	Bayshores	1.25		1.23%
16	Mariner's MIle	1.41		1.38%
17	Lido Isle	1.28		1.25%
18	Lido Peninsula	0.02		0.02%
19	West Newport	0.00		0.00%
20	Dover Shores	6.07		5.94%
21	Dunes Marina and Channel	2.63		2.57%
22	Northstar Beach	0.06		0.06%
24	Back Bay Science Center and Launch Ramp	2.74		2.69%

Region 1. Corona del Mar (18.68 ac)

The most expansive SWEH was mapped in Region 1 (Figure 10).

The 2022 mapping results indicate an increase in eelgrass coverage since the previous mapping effort in 2020 (MTS and CRM 2020). Currently more eelgrass is mapped within Region 1 than has been mapped during any previous eelgrass survey (CRM 2005, 2008, 2010, 2012, 2015, 2017). A total of 4.8 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.

Most of the eelgrass expansion occurred within deeper water portions in the northern and western areas of Region 1. Many of the polygons beyond the RGP54 Plan Area became more filled in forming a continuous bed compared to more discrete eelgrass beds reported in MTS and CRM 2020. Eelgrass meadows covered 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 10. 2022 Eelgrass Habitat Map. Region 1 (Corona del Mar/Bayside) and Region 3 (Balboa Peninsula-East of Bay Island, Partial). See Figure 12 for remainder of Region 3.

Region 2. Yacht Club Basins and Marinas (4.23 ac)

Region 2 supported eelgrass throughout much of the area, extending from the Balboa Yacht Club to the Balboa Island Bridge (Figure 11). Eelgrass in this area occurred at depths extending from 0.50-ft to -12.5-ft MLLW. Region 2 was ranked 10th for eelgrass acreage, containing 4.23 ac. Eelgrass in this area covers 4.14% 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 within the navigation channel outside of the RGP54 area was notable. Eelgrass in this Region has continued to increase since the 2009-2010 survey (CMR 2011) and is 1.45 ac greater than reported during the previous 2020 survey (MTS and CRM 2020).

Region 3. Balboa Peninsula – East (5.91 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 10 and Figure 12). Region 3 was ranked 6th for eelgrass acreage, containing 5.91 ac. Acreage increases occurred from eelgrass expanding within the RGP54 area. However, connectivity of eelgrass beds outside the RGP54 area mapped during the 2020 survey also contributed to eelgrass increases in this Region. Eelgrass coverage in Region 3 has increased by 2.52 ac since the 2020 survey (MTS and CRM 2020). Eelgrass in this Region occurred at depths between 0.1-ft and -15.4-ft MLLW. Eelgrass here constitutes 5.79% of total reported SWEH.

Region 4. Grand Canal (1.27 ac)

The Grand Canal, Region 4, separating "Little Balboa" and "Balboa Island" was almost completely covered by eelgrass (Figure 11). Eelgrass beds extend between depths of 1.3-ft to -7.8-ft MLLW. Region 4 ranked 17th for SWEH coverage and accounted for 1.24% of total SWEH reported. Eelgrass here has been consistent with little fluctuation among the survey years. The 1.27 ac of eelgrass mapped here represents a decrease of 0.02 ac since the 2020 survey (MTS and CRM 2020). The small decline in eelgrass coverage may be caused by changes in overwater coverage from vessels moored within the channel.

Region 5. Balboa Island and Collins Isle (16.86 ac)

Region 5 extends around the perimeter of Balboa Island and Collins Isle (Figure 11). Eelgrass in this area ranked 2nd, covering 16.86 ac, and accounted for 16.50% of SWEH reported. Eelgrass beds extended between depths of 1.86-ft to -15.3-ft MLLW. Eelgrass has continued to increase since the 2009-2010 survey (CRM 2011, 2015, 2017, MTS 2018, MTS and CRM 2020). Since the 2020 survey, eelgrass has increased by 6.74 ac. Overall, eelgrass coverage underwent bed expansion throughout the region, but most notably in the more offshore eastern and southern areas if the region.

Figure 11. 2022 Eelgrass Habitat Map. Regions 2 (East balboa Channel Yacht Clubs/Basins), 4 (Grand Canal), and 5 (Balboa and Collins Island).

Figure 12. 2022 Eelgrass Habitat Map. Region 3 (Balboa Peninsula – East of Bay Island, Partial).

Region 6. Bay Island (1.96 ac)

Bay Island, Region 6, accounts for a small amount of eelgrass habitat, 1.96 ac (Figure 13). This region is ranked 14th and accounts for 1.91% of total SWEH reported. Eelgrass beds in this area extend from 0.86-ft to -14.9-ft MLLW. Eelgrass around Bay Island has continued to increase since the 2013-2014 survey (CRM 2015). Since the 2020 survey, eelgrass has increased by 0.28 ac (MTS and CRM 2020). In general, new acreage was observed along the western side of the island.

Region 7. Balboa Peninsula – West (0.81 ac)

Region 7 eelgrass extends from the Bay Island Bridge to 11th street, covering 0.81 ac (Figure 13). Region 7 was ranked 20th for eelgrass coverage and accounts for 0.79% of total SWEH reported. Eelgrass extends from 0.77-ft to -9.8-ft MLLW in the region. While the depth of observed eelgrass was shallower eelgrass has continued to increase since the 2013-2014 survey (CRM 2015). Since the 2020 survey, eelgrass coverage has increased by 0.24 ac (MTS and CRM 2020).

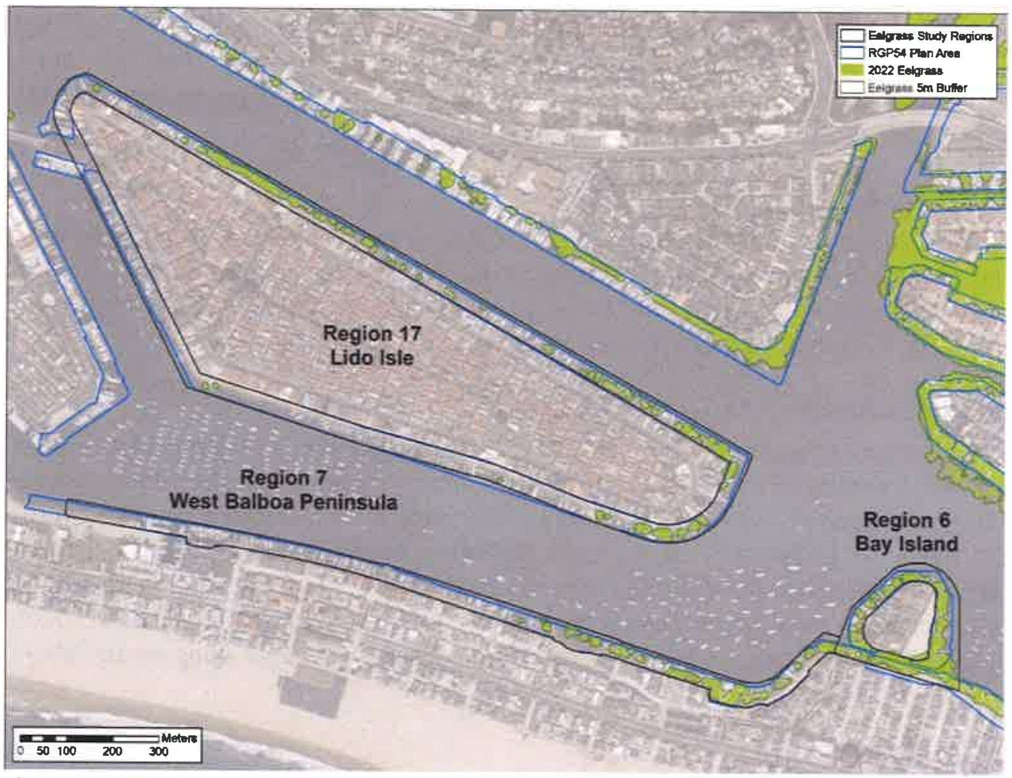

Figure 13. 2022 Eelgrass Habitat Map. West Balboa Peninsula. Region 6 (Bay Island) and Region 7 (Balboa Peninsula – West, Partial).

Region 8. North Balboa Channel and Yacht Basin (1.21 ac)

Region 8 includes eelgrass from the north side of the North Balboa Channel between the Balboa Island Bridge and Beacon Bay, covering 1.21 ac (Figure 14). 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 to 1.18% of total reported SWEH. Since the previous 2020 survey, eelgrass coverage has expanded by 0.31 ac (MTS 2020). Much of the eelgrass growth appears to have occurred in the fairways of Balboa Yacht Basin and in the southwestern portion of the region.

Region 9. Harbor Island (3.41 ac)

Eelgrass around Harbor Island, Region 9, accounted for 3.41 ac of mapped SWEH (Figure 15). Eelgrass extended from 0.88-ft to -12.3-ft MLLW and contributed to 3.34% of total SWEH reported. Similar amounts of eelgrass coverage were observed during this survey compared to the previous years survey in 2020. 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.

Region 10. Linda Isle – Outer (5.24 ac)

Eelgrass in Region 10, Linda Isle – Outer, covered 5.24 ac (Figure 14). Region 10 was ranked 7th and accounted for 5.13% 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 2020 survey, eelgrass coverage in Region 10 has increased by 1.17 ac (MTS 2020).

Region 11. Linda Isle – Inner (5.24 ac)

Region 11, Linda Isle – Inner, eelgrass covers 5.24 ac and accounts for 5.13% of total SWEH reported (Figure 14). 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. However, since the 2020 survey, eelgrass has increased by 0.41 ac (MTS and CRM 2020).

Region 12. DeAnza Peninsula – Inner (10.17 ac)

Region 12, DeAnza Peninsula – Inner, eelgrass covers 10.17 ac (Figure 16). Eelgrass beds occurred from 0.00-ft to -12.8-ft MLLW and account for 9.95% of total reported SWEH. Since the most recent survey in 2020, eelgrass has increased by 1.09 ac (MTS and CRM 2020). Reported increases to SWEH are likely a factor of eelgrass filling in in the eastern part of this region.

Region 13. DeAnza Peninsula – Outer (6.77 ac)

Ranked 4th, Region 13, DeAnza Peninsula – Outer, has 6.77 ac of eelgrass coverage (Figure 16). Eelgrass here accounts for 6.62% 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 five times the area since it was first mapped in 2003-2004 (CRM 2005). Since the 2020 survey, eelgrass coverage decreased by 0.50 ac and follows declines in eelgrass coverage in this region observed in 2020 (MTS and CRM 2020). Reported changes to SWEH may be attributed to minor changes in eelgrass coverage along the periphery of the mapped bed.

Region 14. Castaways (4.97 ac)

Region 14, Castaways, contributes 4.97 ac of eelgrass coverage, accounting for 4.86% of total eelgrass reported. Eelgrass here occurs a depths extending from 0.24-ft to -10.00-ft MLLW. The majority of previous year's survey efforts performed here 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).

Figure 14. 2022 Eelgrass Habitat Map. Regions 8 (North Balboa Channel and Yacht Basins), 10, Linda Isle, Outer), and 11 (Linda Isle, Inner).

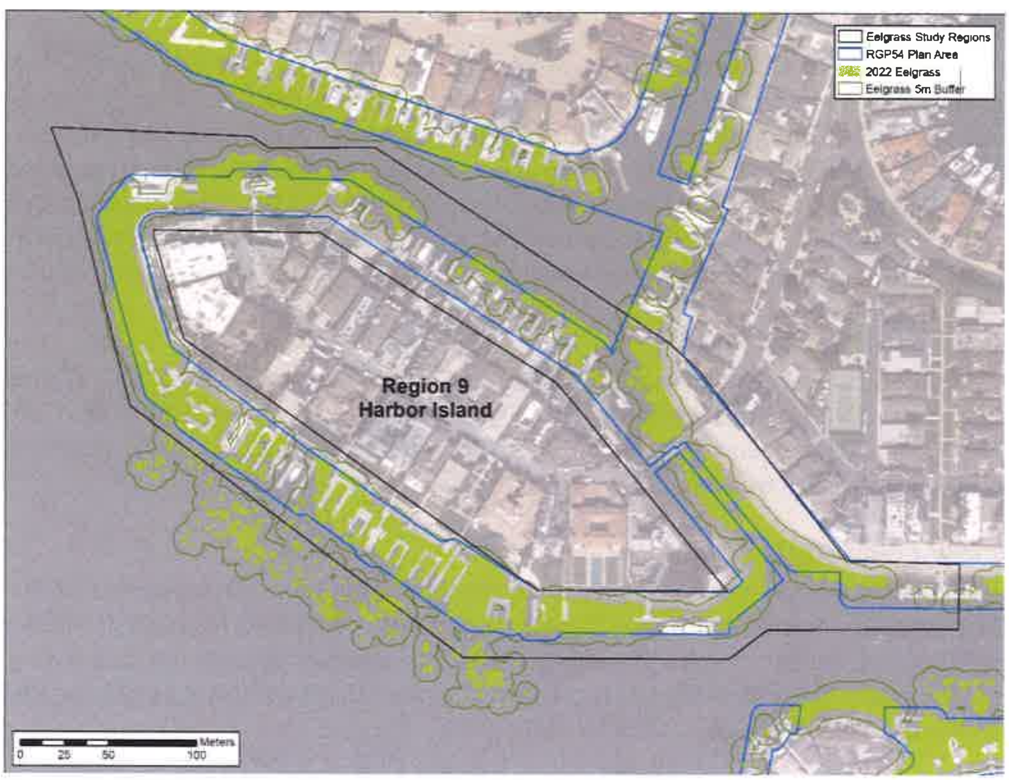

Figure 15. 2022 Eelgrass Habitat Map. Region 9 (Harbor Island).

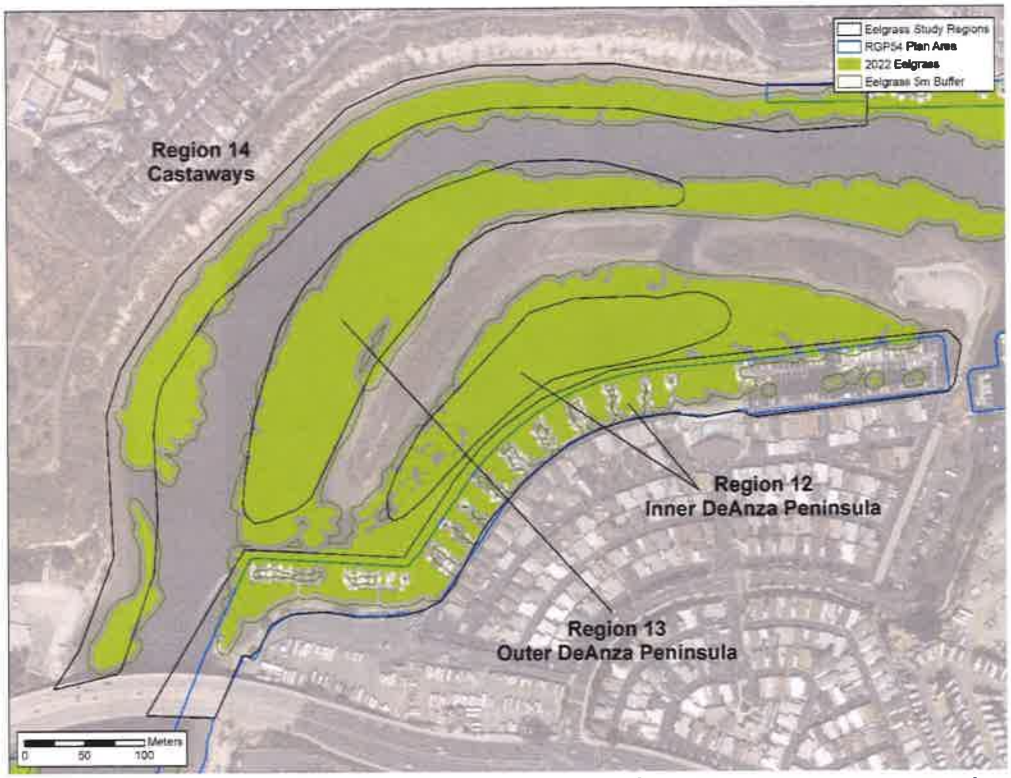

Figure 16. 2022 Eelgrass Habitat Map. Regions 12 (DeAnza/bayside Peninsula, East – Inner), 13 (DeAnza/Bayside Peninsula, West – Outer), and 14 (Castaways to Dover Shores).

Region 15. Bayshores (1.25 ac)

Region 15 extends from the Coast Highway Bridge to the junction of the Lido reach (Figure 17). The eelgrass in Region 15 covered 1.25 ac and accounted for 1.23% 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 has increased by 0.25 ac (MTS and CRM 2020). Eelgrass within this area generally occurs as moderate size beds between the head wall and dock structures, marina fairways, and open water beach/swim areas.

Region 16. Mariner's Mile (1.41 ac)

Along the southern portion of Bayshores and mariner's Mile, Region 16, eelgrass covered 1.41 ac and accounted for 1.38% of total SWEH reported (Figure 17). 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). Since the recent 2020 survey eelgrass increased by 0.12 ac.

Region 17. Lido Isle (1.28 ac)

Region 17, Lido Isle, eelgrass cover extended primarily along the northern and eastern portions of the island (Figure 17). Eelgrass here was present in water depths ranging between 0.60-ft to -10.00-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 2020 survey, eelgrass has increased by 0.36 ac (MTS and CRM 2020).

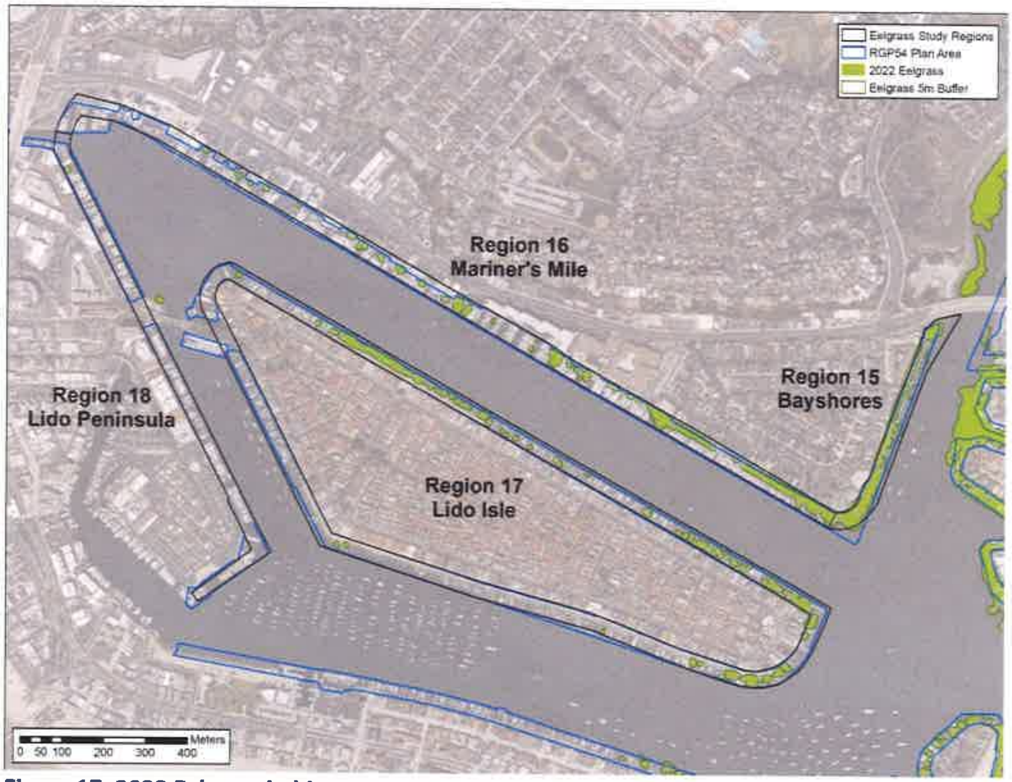

Figure 17. 2022 Eelgrass habitat Map. Regions 7 (Balboa Peninsula – West of Bay Island, Partial), 15 (Bayshores), 16 (Mariner's Mile), 17 (Lido Isle), and 18 (Lido Peninsula).

Region 18. Lido Peninsula (0.02 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 occurs between -3.1-ft to -10.8-ft MLLW. This same eelgrass was mapped in 2020 and during this survey (MTS and CRM 2020). Eelgrass in this region continues to decline and has decreased by 0.04 ac since 2020.

Region 19. West Newport (0.0024 ac)

No eelgrass has been reported in Region 19, West Newport, during any survey performed prior to 2022. This survey marked the first time where SWEH was found in Region 19 (Figure 18). A total of 0.0024 acres of eelgrass was mapped in the northwestern corner of Region 19 between -5.2-ft and -5.3-ft MLLW.

Figure 18. 2022 Eelgrass Habitat Map. Region 19 (West Newport).

Region 20. Dover Shores (6.07 ac)

Region 20, Dover Shores, was first surveyed in 2013-2014 (Figure 19; CRM 2015). Since this 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 6.07 ac, accounting for 5.94% of total reported SWEH, and extends from 0.40-ft to -12.0-ft MLLW. Since the recent 2020 survey eelgrass has increased by 4.69 ac (MTS and CRM 2020).

Region 21 Dunes Marina and Channel (2.63 ac)

Dunes Marina, Region 21, was first surveyed in 2013-2014 (Figure 19; CRM 2015). Since hat 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 this survey effort. Eelgrass here covers 2.63 ac and accounts for 2.57% of SWEH reported. Eelgrass in this region was present between 0.50-ft and -8.5-ft MLLW.

Region 22. Northstar Beach (0.06 ac)

Northstar Beach, Region 22, was first surveyed in 2016 (Figure 19; 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 has continued to increase during this survey accounting for 0.06 ac and 0.06% of reported SWEH. Eelgrass in this region occurred at depths from -2.8-ft to -7.2-ft MLLW.

Region 24. Back Bay Science Center and Launch Ramp (2.74 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 2022 survey, 2.74 ac of SWEH was reported and accounts for 2.69% of reported SWEH. An increase of 2.52 ac since the previous survey in 2020 (MTS and CRM 2020). Eelgrass in this region occurred at depths ranging between -5.5-ft and -11.0-ft MLLW.

Figure 19. 2022 Eelgrass Habitat Map. Regions 20 (Dover Shores), 21 (Dunes Marina and Channel), 22 (Northstar Beach), and 24 (Back Bay Science Center and Launch Ramp).

4 Historical Eelgrass Coverage

In general, eelgrass in the Bay has undergone periods of decrease and increase (Figure 20, 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.

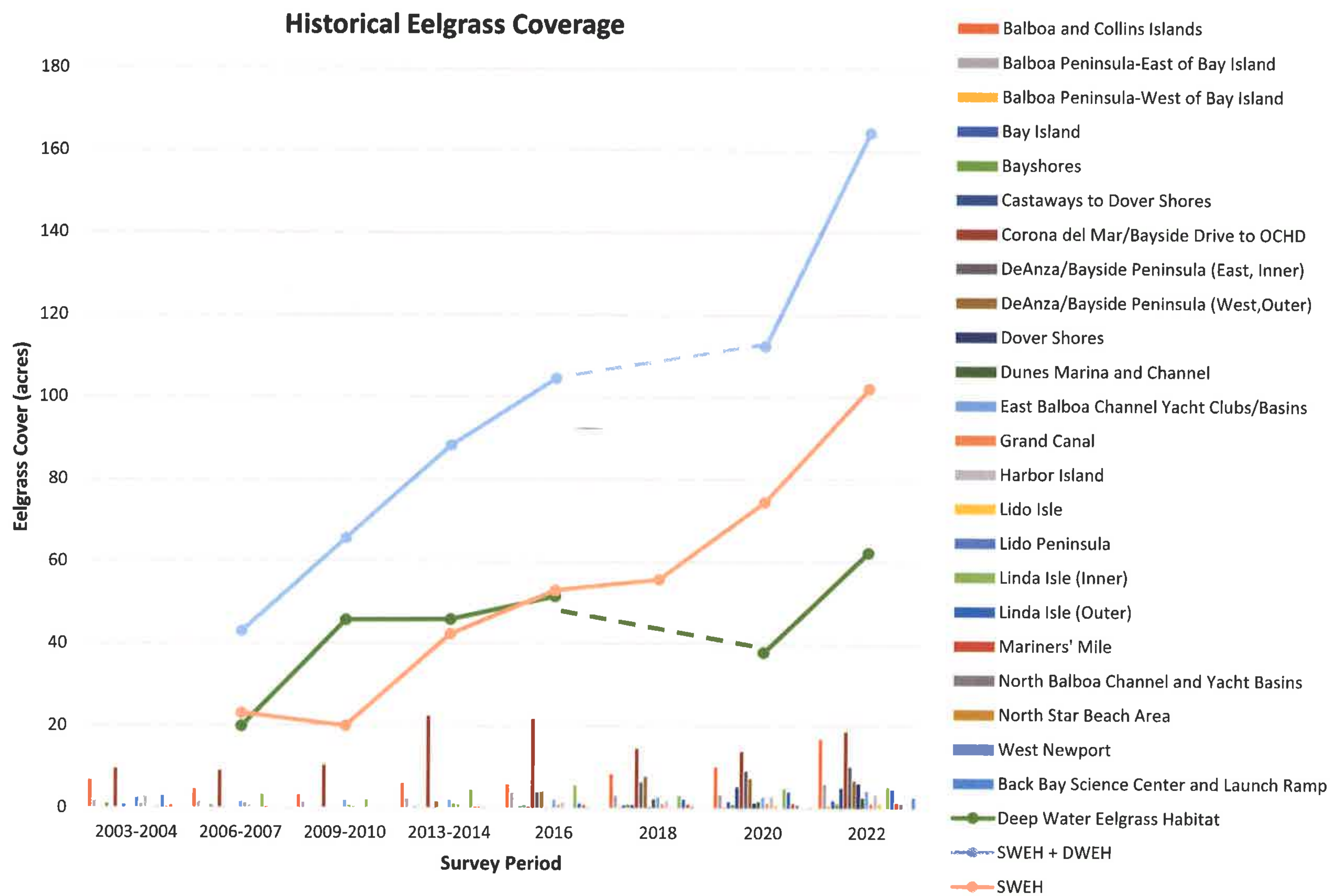

Figure 20. Historical coverage of eelgrass by region and survey period within Newport Bay. Deep water eelgrass habitat (DEH) was not surveyed for in 2018, thus dashed lines represent the overall change observed since the 2016 survey (CRM 2016).

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

Region	Description	Historical Eelgrass Acreage								
		2003-2004	2006-2007	2009-2010	2013-2014	2016	2018	2020	2022	Mean
1	Corona del Mar/Bayside Drive to OCHD	9.52	9.08	10.36	22.37	21.65	14.47	13.85	23.73	15.00
2	East Balboa Channel Yacht Clubs/Basins	2.47	1.54	1.76	2.06	2.02	2.67	2.78	4.23	2.44
3	Balboa Peninsula-East of Bay Island	1.67	1.56	1.39	2.27	3.78	3.08	3.39	5.91	2.88
4	Grand Canal	0.90	1.14	0.62	1.06	0.89	1.13	1.29	1.27	1.04
5	Balboa and Collins Islands	6.69	4.55	3.05	5.98	5.74	8.30	10.11	19.18	7.66
6	Bay Island	0.13	0.05	0.04	0.30	0.50	0.80	1.67	1.96	0.68
7	Balboa Peninsula-West of Bay Island	0.03	0.03	0.01	0.10	0.21	0.35	0.57	0.81	0.26
8	North Balboa Channel and Yacht Basins	0.70	0.12	0.12	0.24	0.25	0.55	0.90	1.21	0.51
9	Harbor Island	2.72	0.71	0.45	0.91	1.35	1.78	2.83	3.41	1.77
10	Linda Isle (Outer)	2.92	0.33	0.07	0.39	1.16	2.23	4.07	5.24	2.05
11	Linda Isle (Inner)	0.28	3.22	1.97	4.50	5.55	3.09	4.84	5.24	3.59
12	DeAnza/Bayside Peninsula (East, Inner)	0.21	0.01	0.00	0.08	3.83	6.32	9.09	10.17	3.71
13	DeAnza/Bayside Peninsula (West,Outer)	0.79	0.00	0.00	1.60	4.01	7.75	7.27	6.77	3.52
14	Castaways to Dover Shores	0.13	0.00	0.00	0.01	0.34	0.84	5.24	4.97	1.44
15	Bayshores	0.99	0.66	0.00	0.16	0.76	0.91	1.01	1.25	0.72
16	Mariners' Mile	0.23	0.07	0.07	0.31	0.71	0.97	1.24	1.41	0.63
17	Lido Isle	0.03	0.00	0.00	0.02	0.07	0.41	0.92	1.28	0.34
18	Lido Peninsula	No Data	0.00	0.00	0.00	0.00	0.13	0.07	0.02	0.03
19	West Newport	No Data	No Data	No Data	0.00	No Data	0.00	0.00	0.00	0.00
20	Dover Shores	No Data	No Data	No Data	0.01	0.18	0.32	1.38	6.07	1.59
21	Dunes Marina and Channel	No Data	No Data	No Data	0.00	0.03	2.23	1.69	2.63	1.32
22	North Star Beach Area	No Data	No Data	No Data	No Data	0.00	0.00	0.01	0.06	0.02
24	Back Bay Science Center and Launch Ramp	No Data	No Data	No Data	No Data	0.00	0.00	0.22	2.74	0.74
	SWEH Subtotal	30.41	23.07	19.92	42.35	53.02	58.18	74.42	102.21	51.94
23	Deep Water Eelgrass Habitat	No Data	19.90	45.70	45.90	51.50	No Data	37.94	62.20	42.07
	SWEH + DWEH Total	30.41	42.97	65.62	88.25	104.52	58.18	112.36	164.41	96.35*

*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 21). Which 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 102.21 ac of SWEH was mapped within the three eelgrass zones (Figure 22). In the Stable Eelgrass Zone 48.31 ac of eelgrass was mapped. The Transition Eelgrass Zone accounted for 53.66 ac of eelgrass, Lastly, the Unvegetated Zone had only 0.24 ac of eelgrass. If DWEH was included in the eelgrass assessment by zones, the Stable Zone eelgrass would total 108.34 ac and the Transitional Zone would total 55.84 ac. Stable Zone eelgrass cover is impacted more by the inclusion of DWEH.

Since the 2020 survey, eelgrass has increased in the Stable and Transitional Zones, increasing by 16.06 ac and 11.64 ac, respectively. Both the Stable and Transitional Zones continue to expand at a high rate and have both contributed to overall increases to SWEH. For the second year SWEH cover within the Transition Zone has surpasses coverage in the Stable Eelgrass Zone. It should be noted that the Transition Zone is larger than the Stable Eelgrass Zone.

Figure 21. Map of three distributional zones within Newport Bay.

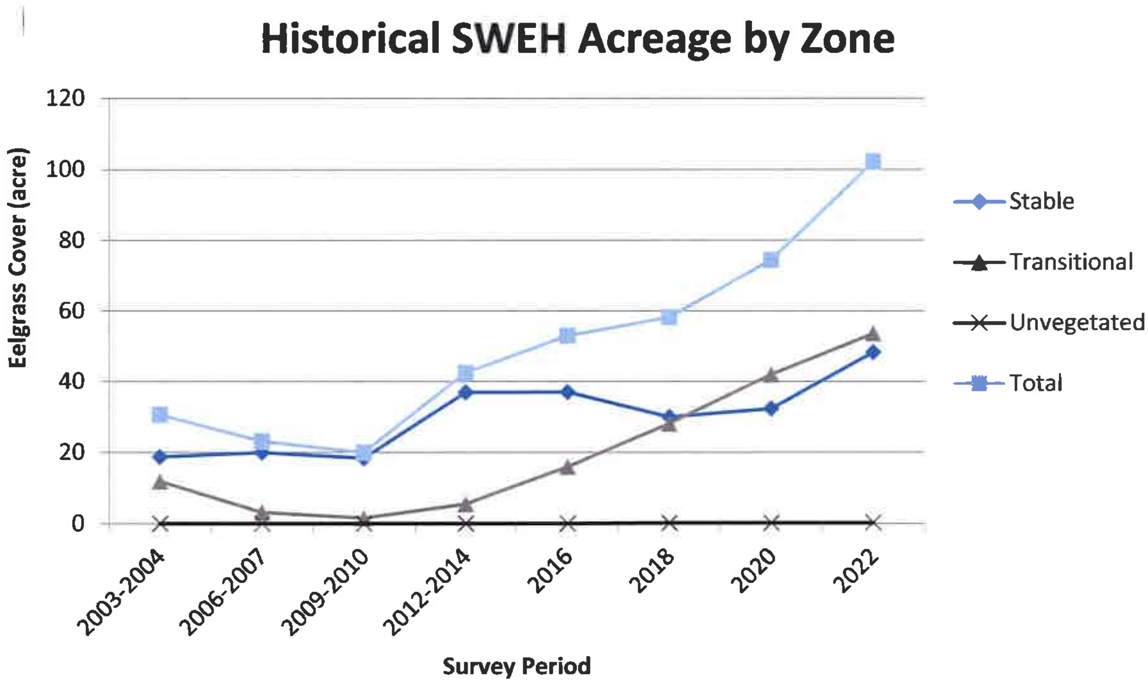

Figure 22. Historical SWEH coverage by zone in Newport Bay.

6 Density

Density measurements were taken at 24 stations throughout the Bay and represent the 24 Regions (Figure 23). Region 1, Corona del Mar, had the highest reported inshore and offshore density. Density measurements were not collected in all Regions, however only a single density measurement was collected in West Newport (Region 19) because eelgrass coverage mapped in that region was too small for any additional measurements to be collected.

The average density for all 24 stations was 109 turions/sq m and ranged between 578 and 1 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 111 turions/sq m and average offshore density was 104 turions/sq m (Figure 24). Region 1 has the highest reported average inshore density at 311 turions/sq m, followed by Regions 5 and 17 where eelgrass density was 218 turions/sq m and 169 turions/sq m, respectively. Offshore eelgrass density was greatest for Region 1, 231 turions/sq m followed by stations 17 and 24 where eelgrass density was 178 turions/sq m and 162 turions/sq m, respectively.

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

Region ID	Coordinates (dd.ddddd°) Latitude	Longitude
1	33.59949	-117.87965
2	33.60598	-117.88527
3	33.60004	-117.88669
4	33.60449	-117.88898
5	33.60412	-117.89262
5	33.60857	-117.89519
6	33.60649	-117.90408
7	33.60548	-117.90928
8	33.61052	-117.89411
8	33.61000	-117.89611
9	33.60972	-117.90226
10	33.61304	-117.90515
11	33.61391	-117.90346
12	33.61846	-117.90198
13	33.61968	-117.90243
14	33.62141	-117.90131
15	33.61214	-117.90807
16	33.61421	-117.91287
18	33.61671	-117.92645
17	33.61016	-117.90923
19	33.62096	-117.93637
20	33.62300	-117.89635
21	33.61951	-117.89332
22	33.62470	-117.89311
23	33.60407	-117.88545
24	33.62003	-117.89276

Over time, eelgrass density had fluctuated (Figure 25). 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, approaching values reported in 2013-2014.

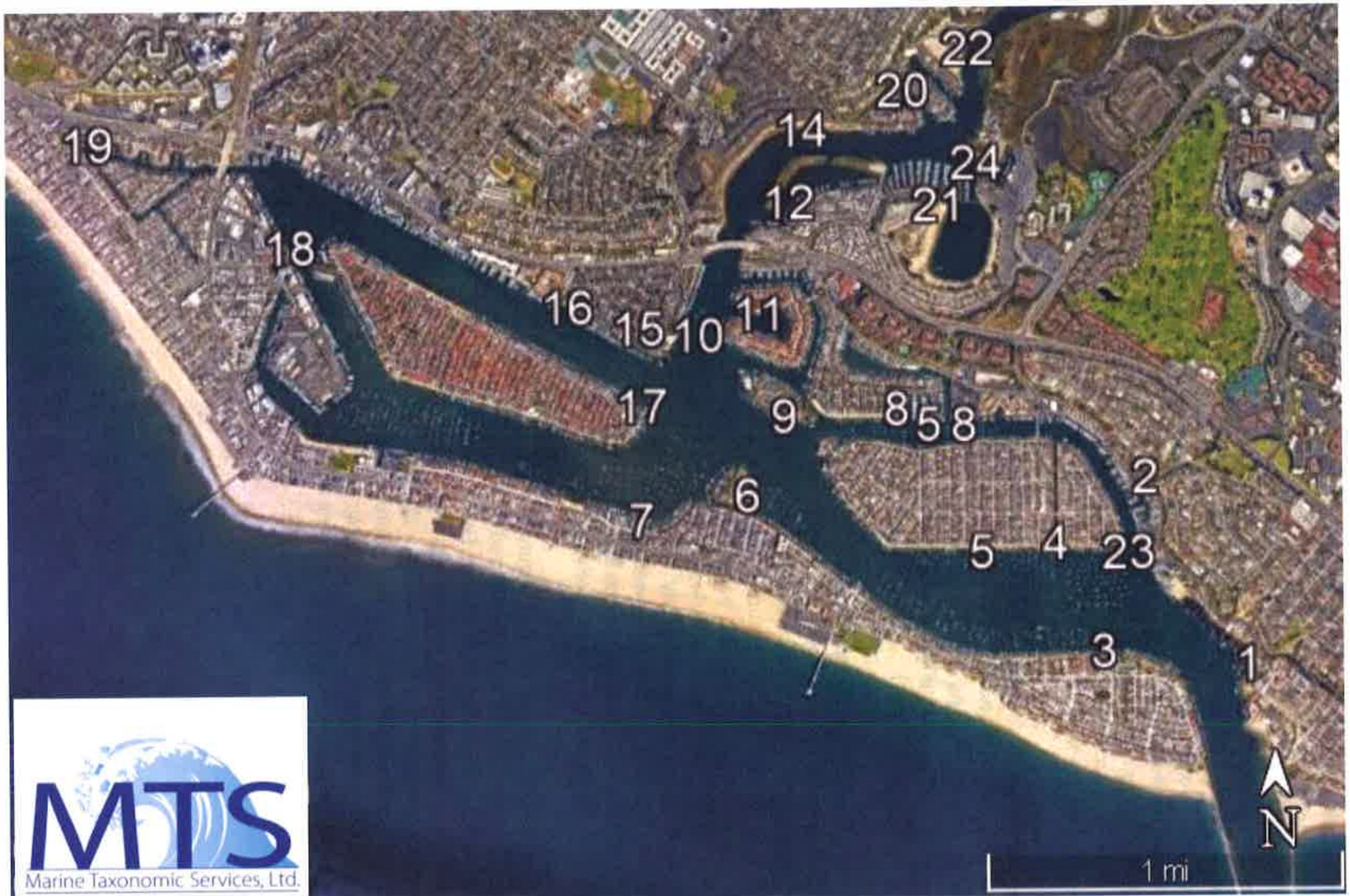

Figure 23. Map of locations where density measurements were taken in Newport Bay during the 2022 survey. The numerical value icons on the map indicate the region and location where density measurements were collected. For some regions more than one location was visited for collection of density.

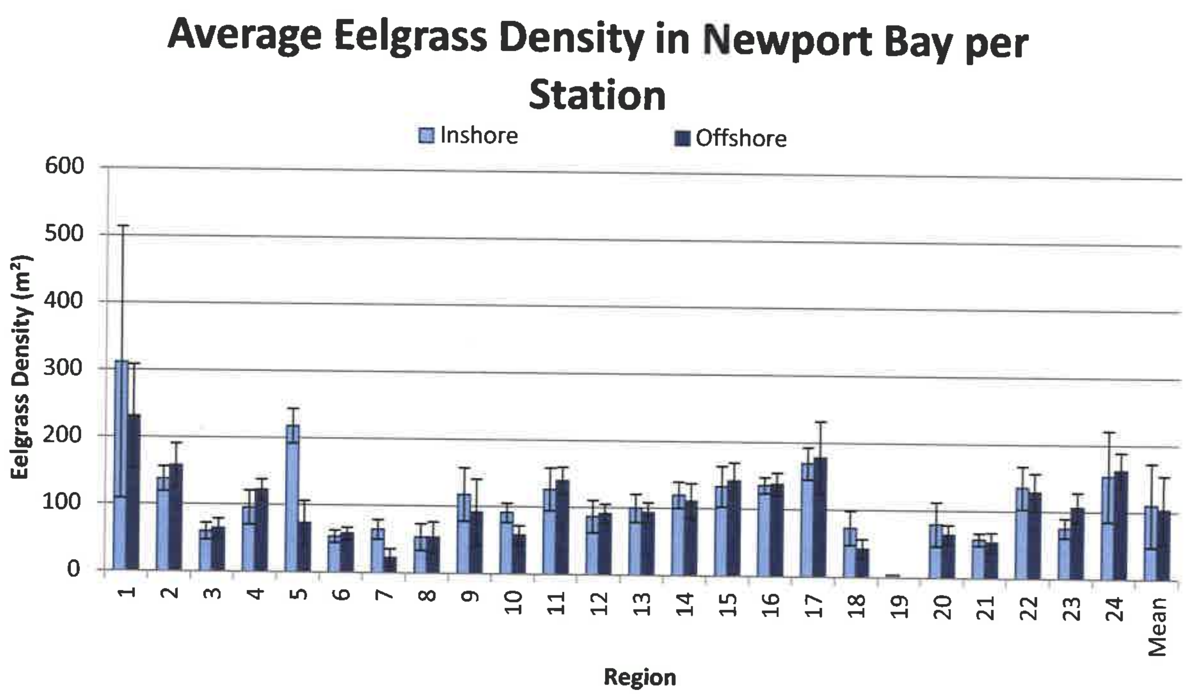

Figure 24. Average eelgrass density per Region in Newport Bay. Error bars are one standard deviation.

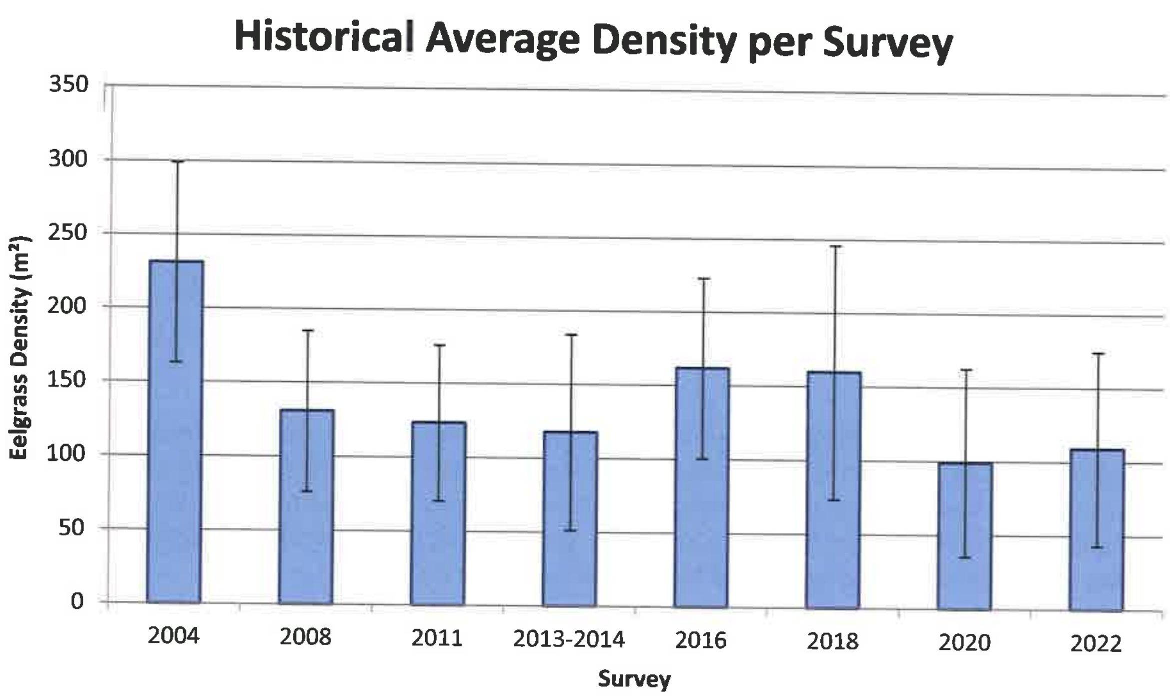

Figure 25. Historical average eelgrass density per survey in Newport Bay. Error bars represent one standard deviation.

7 Marine Life

7-1 Marine Life Observed

Numerous marine species were observed during the 2022 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.

A few species were only observed within Zone 1 at the entrance to the Bay. These species included the California garibaldi (*Hypsypops rubicundus*), rock wrasse (*Halichoeres semicinctus*), chestnut cowrie (*Cypraea spadicea*), and Pacific eelgrass (*Zostera pacifica*). The entrance to the Bay is the only area where two species of eelgrass (*Z. marina* and *Z. paficica*) were observed together.

When moving farther away from the mouth of the Bay the biodiversity appeared to decrease. When moving farther away from the entrance channel fewer fish species were observed. However, some invertebrate and vertebrate species remained present when moving from Zone 2 to Zone 3. Organisms present in abundance away from the entrance channel included round rays (*Urobatis halleri*), California aglaja (*Navanax intermis*), and anemones (*Diadumene* sp. and *Pachyceriathis fimbriatus*).

Two species were only observed along Bay-ward portions of eelgrass beds where water depth was greater than 11-ft MLLW, the sea whip (*Balticina* sp.) and the golden phoronid (*Phoronopsis californica*), reported for the first time in 2018 (MTS 2018). In rocky habitats, as found along Bayshores and western Balboa Island/Collins Isle, East Pacific red octopus (*Octopus rubenscens*) and California two spot octopus (*Octopus bimaculatus*) were common.

On multiple occasions California sea lion (*Zalopphus 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.

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 **not observed** at any time within the bounds of the area surveyed in Newport Bay. Instances where the diver was visually observing the seafloor were recorded and are included as Appendix B.

Table 5. Table of species observed during the 2022 Newport Bay shallow water eelgrass survey (table continues on next page).

Phyla	Genera	Species	All Zones (hard substrate)	All Zones (soft substrate)	Zone 1	Zone 2	Zone 3
Bacteria							
	red/rust bacteria, unID	rust bacteria, unID				X	X
	white sulfer bacteria, unID	sulfer bacteria, unID				X	X
Algae-Phaeophyta							
	green algae	*Codium fragile spp. tomentosoides*	X				
	brown algae	*Colpomenia sinuosa*	X				
	brown algae	*Cystoseira osmundacea*	X				
	brown algae	*Dictyopteris undulata*	X				
	brown algae	*Dictyota flabellata*	X				
	sargassum weed	*Sargassum muticum*	X				
Crustacean-Arthropoda							
	Aorid amphipod	*Grandidierella japonica*	X				
	barnacle	*Balanus glandula*	X				
	buckshot barnacle	*Chthamalus fissus/dalli*	X				
	California spiny lobster	*Panulirus interruptus*			X	X	
	cancer crab	*Cancer* sp.	X				
	lined shore crab	*Pachygrapsus crassipes*	X				
	Mysid shrimp	Mysidacea unID	X				
Fish-Pisces							
	barred sand bass	*Paralabrax nebulifer*		X			
	barred surfperch	*Amphistichus argenteus*		X			
	black croaker	*Cheilotrema saturnum*			X	X	
	black surfperch	*Embiotoca jacksoni*			X	X	
	blacksmith	*Chromis punctipinnis*			X	X	
	California garibaldi	*Hypsypops rubicundus*			X		
	California halibut	*Paralichthys californicus*		X			
	California lizardfish	Synodus lucioceps			X	X	
	California salema	Xenistius californiensis			X	X	
	Claifornia sargo	*Anisotremus davidsonii*		X			
	kelp bass	*Paralabrax clathratus*			X	X	
	kelp surfperch	*Brachyistius frenatus*			X	X	
	mullet	*Mugil cephalus*		X			
	opaleye	*Girella nigricans*	X				
	pile surfperch	*Domalichthys vacca*		X			
	rock wrasse	*Halichoeres semicinctus*			X		

Phyla	Genera	Species	All Zones (hard substrate)	All Zones (soft substrate)	Zone 1	Zone 2	Zone 3
	rockfish, unID	*Scorpaenidaw*, unID	X				
	rock-pool blenny	*Parablennius parvicornis*	X				
	round stingray	*Urobatis halleri*		X			
	rubberlip surfperch	*Rhacochilus toxotes*		X			
	senorita	*Oxyjulis californica*			X	X	
	speckled sanddab	*Citharichthys stigmaeus*		X			
	spotted sand bass	*Paralabrax maculatofasciatus*			X	X	
	topsmelt	*Atherinops affinis*			X	X	
	turbot, unID	Pleuronichthys, unID		X			
	yellowfin croaker	*Umbrina roncador*			X	X	
Flatworms-Platyhelminthes							
	polyclad worm	*Prostheceraeus bellostriatus*				X	X
	polyclad worm, unID	polyclaid worm, unID				X	X
Gorgonians-Cnidaria							
	brown gorgonian	*Muricea fruticosa*	X				
	California golden gorgonian	*Muricea californica*	X				
Green Algae-Chlorophyta							
	green algae	*Ulva intestinalis*	X				
	green algae	*Ulva lactuca*	X				
	green algae	*Bryopsis corticulans*	X				
	green algae	*Chaetomorpha aerea*				X	X
Jellyfish and Anemones-Cnidaria							
	anemone	*Diadumene* sp.	X				
	burrowing anemone	*Pachycerianthis fimbriatus*		X			
	fairy palm hydroid	*Corymorpha palma*			X	X	
	hydroid	*Aglaophenia dispar*	X				
	sea pen	*Styalatula elongata* (> 11ft MLLW only)			X	X	
Marine Worms-Phoronid							
	golden phoronid	*Phoronopsis californica* (>11ft MLLW only)				X	X
Moss Animals-Bryozoa/Ectoprocta							
	bryozoan	*Thalamoporella californica*	X				
	Red"= "chip" bryozoan	*Watersipora subtorquata*	X				
	stoloniferan bryozoan and arborescent bryozoans	*Amathia verticillatum, Bulgula neritina, Bulgula californica*	X	X			
Red Algae-Rhodophyta							
	red algae	*Gelidium* sp.	X	X			
	red algae	*Grateloupia* sp.	X				

Phyla	Genera	Species	All Zones (hard substrate)	All Zones (soft substrate)	Zone 1	Zone 2	Zone 3
	red algae	*Microcladia* sp.	X				
	red algae	*Polysiphonia* sp.	X				
	red algae	*Gracilariopsis sjoestedtii*	X				
	red algae	*Gracilaria* sp.	X				
	red coralline algae	*Corralina* sp.	X				
Seagrasses-Zosteracea							
	ditchgrass	*Ruppia maritima*		X			
	eelgrass	*Zostera pacifica*			X		
	eelgrass	*Zostera marina*		X			
	surf grass	*Phyllospadix torreyi*		X			
Sea stars, urchins, and cucumbers							
	bat star	*Asterina miniata*			X	X	
	sand star	*Astropecten armatus*			X	X	
Snails and Octopus-Mollusca							
	Asian date mussel	*Musculista senhousia*	X				
	bay mussel	*Mytilus galloprovincialis*	X				
	calcarious tube snail	*Serpulorbis squamigerus*		X			
	California horn snail	*Cerithidea californica*		X			
	California two-spot octopus	*Octopus bimaculatus*		X			
	carinate gastropod	*Alia carinata*		X			
	chestnut cowrie	*Cypraea spadicea*			X		
	dorid nudibranch	*Doriopsilla albopunctata*		X			
	East Pacific red octopus	*Octopus rubescens*			X	X	
	giant Pacific oyster	*Crassostrea gigas*	X				
	giant rock scallop	*Crassadoma gigantea*	X				
	Gould's bubble snail	*Bulla gouldiana*		X			
	hermit crab	*Pagurus* sp.		X			
	Kellet's whelk	Kelletia kelletii			X	X	
	kelp scallop	*Leptopecten latiatauratus*		X			
	Lewis' moon snail	*Polinices lewisii*			X	X	
	mossy chiton	*Mopalia muscosa*		X			
	native oyster	*Ostrea lurida*	X				
	predatory sea slug	*navanax inermis*		X			
	rock jingle	*Chama* sp.	X				
	rough limpet	*Lottia limatula*		X			
	speckled scallop	*Argopecten ventricosa*		X			

Phyla	Genera	Species	All Zones (hard substrate)	All Zones (soft substrate)	Zone 1	Zone 2	Zone 3
	wavy chione	*Chione undatella*	X				
	wavy top snail	*Lithopoma undosa*			X	X	
Sponges-Porifera							
	Porifera, unID	Sponge, unID	X		X	X	X
	yellow sponge	*Cliona* sp.	X		X	X	X
	yellow sponge	*Haliclona* sp.	X		X	X	X
Tunicates-Urochordata							
	colonial sea squirt, unID	colonial Ascidiacea, unID	X				
	colonial tunicate	*Botryllus/Botrylloides* complex	X				
	sea squirt, unID	Ascidiacea unID	X				
	solitary tunicate	*Styela montereyensis*	X				
	solitary tunicate	*Styela plicata*	X	X			

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 2022. This was the eighth survey conducted in a series of surveys since 2003.

The Bay was divided into three zones enveloping 23 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 109.0 ac within the SWEH regions and 96.43 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, 48.69%, 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, 13, 14, and 18. In all other regions, eelgrass coverage was greater than values reported in the previous 2020 survey (MTS and CRM 2020). 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 as losses were observed.

Eelgrass density collected at 24 regions indicates that density has increased when compared to the previous 2020 survey (MTS and CRM 2020). Generally, density was greatest along the shallower portions of mapped eelgrass polygons. While density was greatest in these shallow areas, Region1 displayed values far above all other densities collected in other regions. Overall, average density fell within the range of values historically reported. This was the first survey where density was collected in all regions as every region supported some amount of eelgrass.

Many species were observed throughout the survey effort. Species diversity generally decreased moving away from the entrance channel. Uncommon species observed included the golden phoronid (*Phoronopsis califonica*). The noxious alga, *Caulerpa* spp., was not found in Newport Bay during this survey effort.

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Appendix A: DWEH Sonar Track Lines

Sidescan Sonar Vessel Track Lines. August 3rd-4th, 2022.
Coastal Resources Management, Inc./ Nearshore and Wetland Surveys

Horizontal Datum: NAD 83 State Plane California VI FIPS 0406 (survey feet)

1,500 Feet

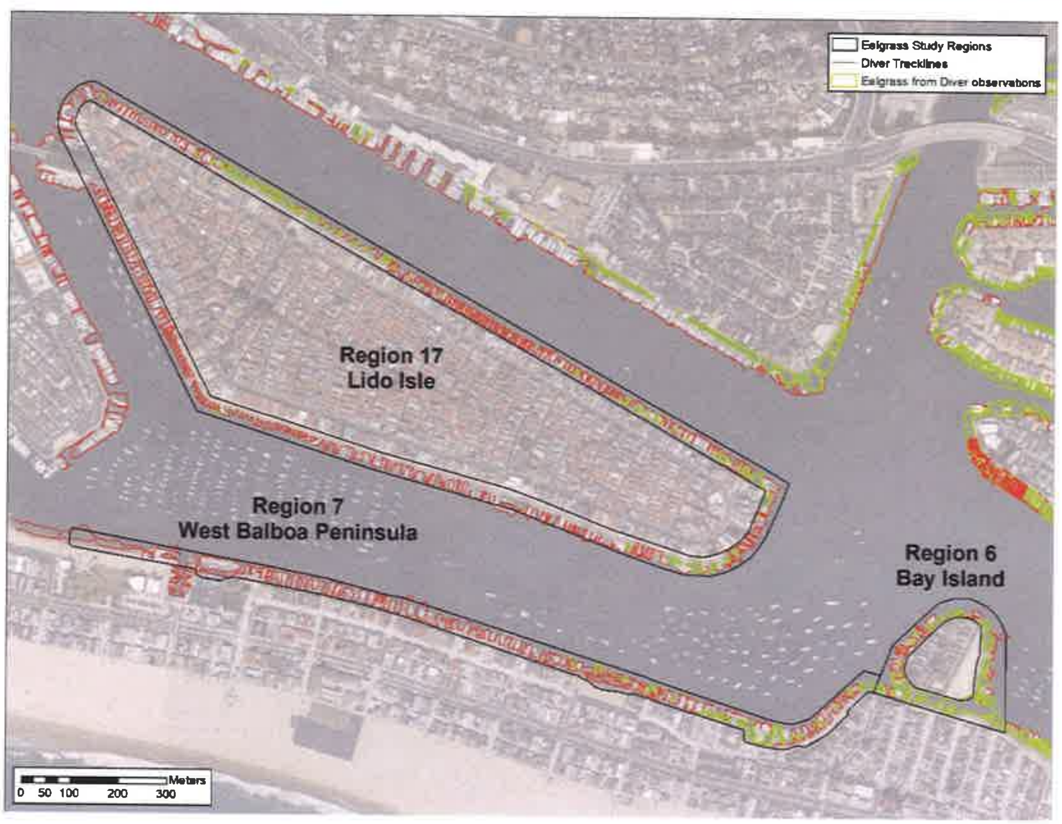
Coastal Resources Management, Inc.

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


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

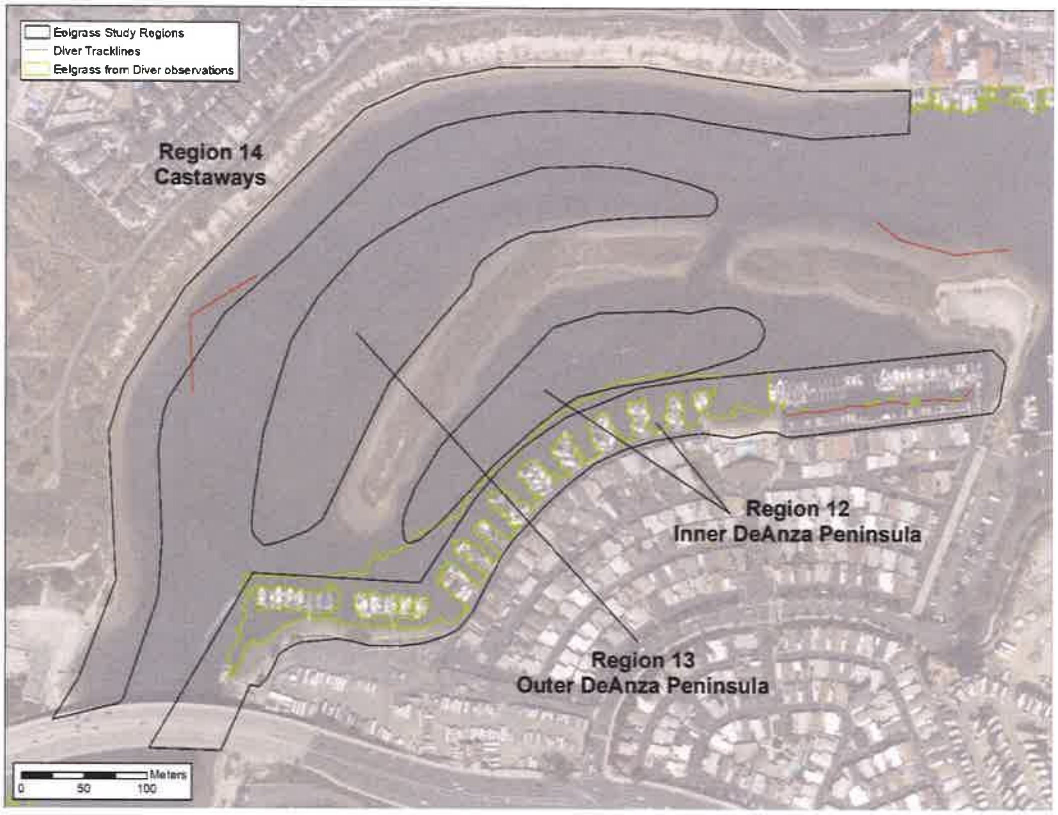

Eelgrass Study Regions
Diver Tracklines
Eelgrass from Diver observations
Region 2
Yacht Club/Basins
Region 4
Grand Canal
Region 5
Balboa Island/Collins Isle
Meters
0 50 100 200

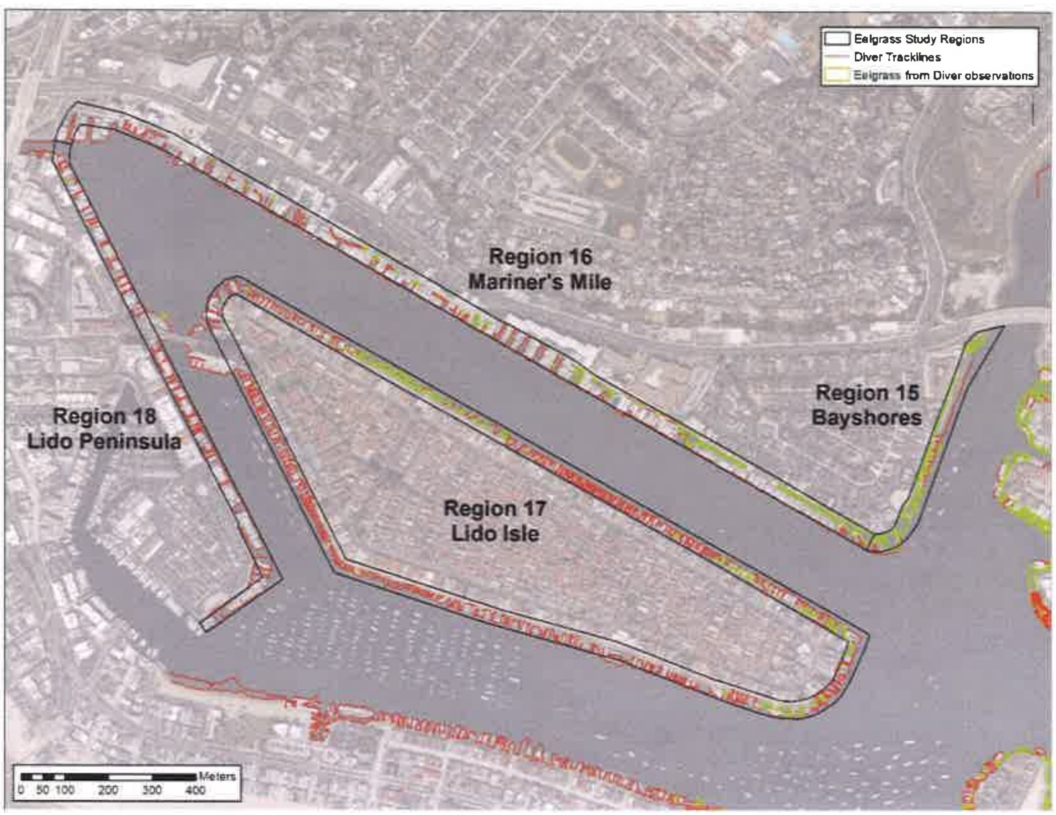

Eelgrass Study Regions
Diver Tracklines
Eelgrass from Diver observations
Region 3
East Balboa Peninsula
Meters
0
100
200


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


Eelgrass Study Regions
Diver Tracklines
Eelgrass from Diver observations
Region 9
Harbor Island
0 25 50 100
Motors


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


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


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


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

Appendix C: DWEH Eelgrass Percent Cover Analysis