July 1, 2013
(20252)

Russell Boudreau, P.E.
Moffatt and Nichol Engineers
3780 Kilroy Airport Way, Suite 600
Long Beach, CA 90806

SUBJECT: SUMMER MAPPING OF EELGRASS OFF BROAD BEACH IN MALIBU FOR THE BROAD BEACH RESTORATION PROJECT

Dear Mr. Boudreau:

Broad Beach in Malibu (Figure 1) has suffered damage due to wave action. The Broad Beach Geologic Hazard Abatement District is proposing to nourish the beach and dunes with sand to provide protection against wave damage and to permit and retain the emergency revetment. Since the 1970s Broad Beach has gradually narrowed, exposing beachfront property to flooding and damage during winter storms and high tides (Moffatt & Nichol 2012). The public benefit of the historically wide beach also has diminished. In Broad Beach's current condition, only a narrow strip of sand to walk on at low tide is available to recreational users. The proposed Broad Beach Restoration Project would include validation and permitting of the existing emergency revetment, beach nourishment, and sand dune restoration. If approved, the revetment would remain in place and would be buried beneath a new system of sand dunes located at the landward edge of the widened, nourished beach. The revetment would serve as a last line of defense against future severe erosion during extreme storm events. The proposed project would place 600,000 cubic yards of sand on Broad Beach to create a wide, sandy beach backed by a system of sand dunes. The sand for beach nourishment would be trucked from an inland site in Moorpark.

Marine resources at Broad Beach include rocky intertidal habitat with surfgrass in the low intertidal, intertidal, and subtidal sand habitat and offshore kelp and eelgrass beds. These resources were previously described in A Survey of Marine Biological Resources of Broad Beach, Malibu, California (Chambers Group 2012a).

Eelgrass (*Zostera* spp.) is a flowering plant that enhances biological value where it grows. Eelgrass beds provide food, attachment sites, structure, and shelter for a variety of marine animals and also help to stabilize the sediment. Eelgrass (*Z. marina*) is relatively common in bays and harbors but is relatively uncommon off the open coast. The eelgrass bed (thought to be *Z.pacifica*) at Broad Beach has been known since the 1970s (Egstrom 1974; Morin and Harrington 1978; N. Davis, personal observations). On September 29, 2010, Chambers Group, Inc. (Chambers Group) performed a reconnaissance survey of shallow subtidal habitats off Broad Beach (Chambers Group 2012a). The survey consisted of six transects swum perpendicular to shore from about 30-foot water depth to just beyond the surf line. Based on that survey and information from Egstrom (1974) and Noel Davis's dive logs, the approximate location of the eelgrass bed at Broad Beach was mapped. On October 23 and November 1, 2012, the boundary of the eelgrass bed was mapped more precisely by divers swimming the perimeter of the bed towing a buoy

(Chambers Group 2012b). The purpose of the survey described in this report was to map the bed during the summer growing conditions.

METHODOLOGY

Field Survey

The mapping of the eelgrass at Broad Beach was done on two days, June 11 and 12, 2013. The survey vessel on both days was a 21-foot-long Carolina skiff owned and operated by Rick Ware of Coastal Resources Management (CRM). The sonar mapping was done on June 11 by Rick Ware and Tom Gerlinger of CRM. Conditions were fair. Swell was 2 to 3 feet, and winds were 5 to 15 knots.

CRM's Lowrance HDS-12 Gen2 Touch 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 (WAAS)-corrected global positioning system (GPS) position. In addition, a 455/800 kHz transducer and power module with dual channels (sidescan and down-looking) provided a 180 degree view of the seafloor (data were logged on the 800-kHz channel). Data analyses were performed using cloud-based software models and statistical algorithms incorporated into *ciBioBase* developed by Contour Innovations, LLC, St. Paul, Minnesota (Contour Innovations LLC 2013; http://www.cibiobase.com).

The survey was conducted within a 1,355 foot-long by 590-foot-wide (18.6-acre) rectangular zone centered on the eelgrass meadow mapped by biologists in September 2012 (Chambers Group 2012b). Within this zone, data were collected along 67 shore-parallel and shore-perpendicular transects spaced between 10 and 50 feet apart **(**Figure 2**).** Transect lengths were longer and extended farther inshore and offshore than the known eelgrass bed to insure full coverage. The CRM vessel was operated at spends between 3 and 6 knots.

Acoustic beam angle for the 200-kHz signal on the 83/200-kHz dual frequency transducer (standard transducer on HDS units) was 20 degrees; the beam coverage for the 455/800 dual frequency transducer was 180 degrees with side lobe angles of 0.9 degree and the down-looking lobe of 1.1 degrees. This narrow elliptical beam essentially "scans" seafloor bottoms. Ping rates were set at 15 per second. Pulse width was dynamic and varied depending on depth, which varied between 20 and 50 feet. 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 20 to 50 feet).

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.

The intention was to refine the sonar map by having divers swim the perimeter of the bed on June 12. Noel Davis and Mike Anghera were the divers. The swell was 2 to 4 feet, and winds were light; however, underwater visibility was too poor to accurately map eelgrass. A silt layer suspended over the bottom made it possible to see the bottom only occasionally. Underwater visibility was only 1 foot. Therefore, the June 2013 map relies on the sonar data.

Data Analysis

Acoustic (traditional, down-looking, and sidescan) and GPS signals were logged to data storage cards (.sl2 format). In the office, the data were uploaded to Contour Innovations' LLC centralized cloud servers for analysis.

Seafloor Bathymetry

Echosounder-generated depth data were standardized to Mean Lower Low Water (MLLW) based on the NOAA tidal reference station at Mugu Lagoon (Ocean Pier). Data were checked for consistency, and the ciBioBase kriging algorithm was used to develop bathymetric contours. Data were then outputted to generate a bathymetric chart of the study area with 3-foot contour intervals.

Seafloor Hardness Factor

Seafloor hardness was determined by the strength of the return echo, with sharp returns representing a hard bottom of rock, sand, gravel, or hard clay. Softer bottoms such as silt typically absorb more acoustic energy. Accordingly, each signal is evaluated for bounce or absorption. CiBioBase hardness values are on a relative scale ranging in values of 0 to 0.2 representing soft bottoms, 0.2 to 0.4 medium hardness bottoms, and 0.4 to 0.5 representing hard bottoms. A Seafloor Hardness Factor graphic was generated from the data analysis that displayed the relative seafloor hardness within the survey area.

Vegetation Detection

Acoustic signals from HDS 200-kHz transducers travel through submerged aquatic vegetation (SUV) on their way to bottom. Seafloors typically register a sharper echo return than the vegetation above. The distance between the seafloor acoustic signature and top of the plant canopy was recorded as the *plant height* for each ping. In the study area, depth profile and vegetation information were collected on both reef and soft-bottom features. Consequently, the echosounder will collect acoustical data on both the reef macrophytic community, including large overstory kelp and canopy (*Macrocystis*, *Egregia*, *Sargassum*, *Phyllospadix*), and understory red, brown, and green turf and upright algal forms. On sandy and mud bottom habitats both echo returns may register eelgrass and the red algae such as *Gracilaria* spp.

Since the 200-kHz sonar data included acoustic signal returns from both hard and soft bottom habitats, the data had to be filtered in order to focus solely on the presence and abundance of eelgrass within the survey area. CRM implemented the following data limits and filters:

1. Known reef areas outside the perimeter of the 2012 eelgrass survey zone were excluded for eelgrass bed mapping. Bathymetry and seafloor hardness factors were not excluded. This eliminated reef-associated algae around the perimeter of the unconsolidated sediment zone, with the potential exception of reef patches within the eelgrass meadow.

2. Plant height data included for analysis was limited to a range between 0.5 foot and 3.5 feet is the approximate range of *Zostera* plant height based on field observations at the Broad Beach site and offshore forms of eelgrass offshore southern California (R. Ware personal observations). Any vegetation detections within this range were considered "present" in percent area calculations/modeling.

Processed acoustical signal depth and vegetation point features were uploaded to the ciBioBase ordinary point kriging[2] algorithm that predicted values in unsampled locations based on the geostatistical relationship of the input points. The kriging algorithm is an "exact" interpolator in locations where sample points are close in proximity and do not vary widely. Kriging smooths bottom feature values where the variability of neighborhood points is high. Using this technique, a kriging-generated map was produced to provide a map of eelgrass probability distribution based on detected acoustical eelgrass returns and secondly, to estimate percent cover of eelgrass in the area. Percent cover was estimated from the kriging-generated probability of occurrence raster map where 1-meter grid cells greater than or equal to 0.5 probability were considered areas where eelgrass was more than likely present. These areas were summed in ArcGIS.

To compare the results of the Chambers 2012 survey with the current 2013 survey, CRM overlaid the CRM-generated September 2012 eelgrass bed perimeter map and the 5-meter-wide band eelgrass patch zone with the June 2013 eelgrass bed perimeter using ArcMap 10.1.

All map outputs were projected with the GCS WGS 84 coordinate system and WGS 84 datum (decimal degrees).

RESULTS

Figure 3 shows the eelgrass bed that was mapped off Broad Beach in June. The bed is approximately 8.75 acres in size and extends from a water depth of about 21 feet Mean Lower Low Water (MLLW) to about 40 feet MLLW. It is approximately 1,104 feet long by about 456 feet wide. The sonar shows the patchiness of the bed, a feature that could not be mapped by the divers in November. Eelgrass cover in the bed was calculated at 11.7 percent. Based on the previous dives, the bed contains large patches of sand. In addition, reefs are scattered within the bed. Figure 4 shows the bottom hardness detected by the sonar. Hard substrate is most pronounced at the western end of the bed near Lechuza Point, and hard bottom is indicated elsewhere in the bed as well.

Figure 4 compares the outline of the bed mapped in November 2012 by divers with the outline of the bed mapped by sonar in June 2013. The November survey estimated the size of the bed as 6.9 acres compared to the June estimate of 8.75 acres. The footprints are similar, but the June survey shows greater width throughout the bed, particularly on the offshore edge. Some of the difference may be due to the fact that the sonar detected eelgrass patches, while the divers in November did not attempt to map all the patches. However, it is likely that the bed did expand during the spring growing season following a calm, dry winter. The divers observed new growth of eelgrass in June. The bed depths mapped in June of 21 feet to 40 feet were slightly different than the November estimate of the bed as occurring between 24 feet and 42 feet. The depth difference may be a result of the greater accuracy of the depth measurement using sonar compared to diver depth gauges.

If you have any questions or need any additional information, please contact me at (949) 261-5414, ext. 7208.

Sincerely,

CHAMBERS GROUP, INC.

Noel Davis, Ph.D.
Vice President, Marine Biology

Attachment 1 – **Figure 1: Project Location**

Attachment 2 – **Figure 2: Sonar Survey Track Lines**

Attachment 3 – **Figure 3: Summer 2013 Eelgrass Map**

Attachment 4 – **Figure 4: Comparison of October 2012 and June 2013 Eelgrass Maps**

Attachment 5 – **Figure 5: Bottom Hardness**

REFERENCES

Chambers Group, Inc. (Chambers Group)
2012a Survey of Marine Biological Resources of Broad Beach, Malibu, California. Prepared for Moffatt and Nichol Engineers.

2012b Mapping of Eelgrass off Broad Beach in Malibu for the Broad Beach Restoration Project. Prepared for Moffatt and Nichol Engineers.

Contour Innovations, LLC
2013 ciBioBase User Reference Guide Version 5.2.

Egstrom, G.H.
1974 The Los Angeles County Underwater Resource Inventory. University of California Sea Grant Program.

Moffatt and Nichol Engineers (Moffatt and Nichol)
2012 Broad Beach Restoration Project Public Trust Resource Environmental Impact Analysis Coastal Engineering Appendix Prepared for Broad Beach Geologic Hazard Abatement District.

Morin, J.G. and A. Harrington
1978 Reconnaissance Survey of the Mugu-Malibu Area of Special Biological Significance. A report to the California Department of Fish and Game and State Water Resources Control Board.

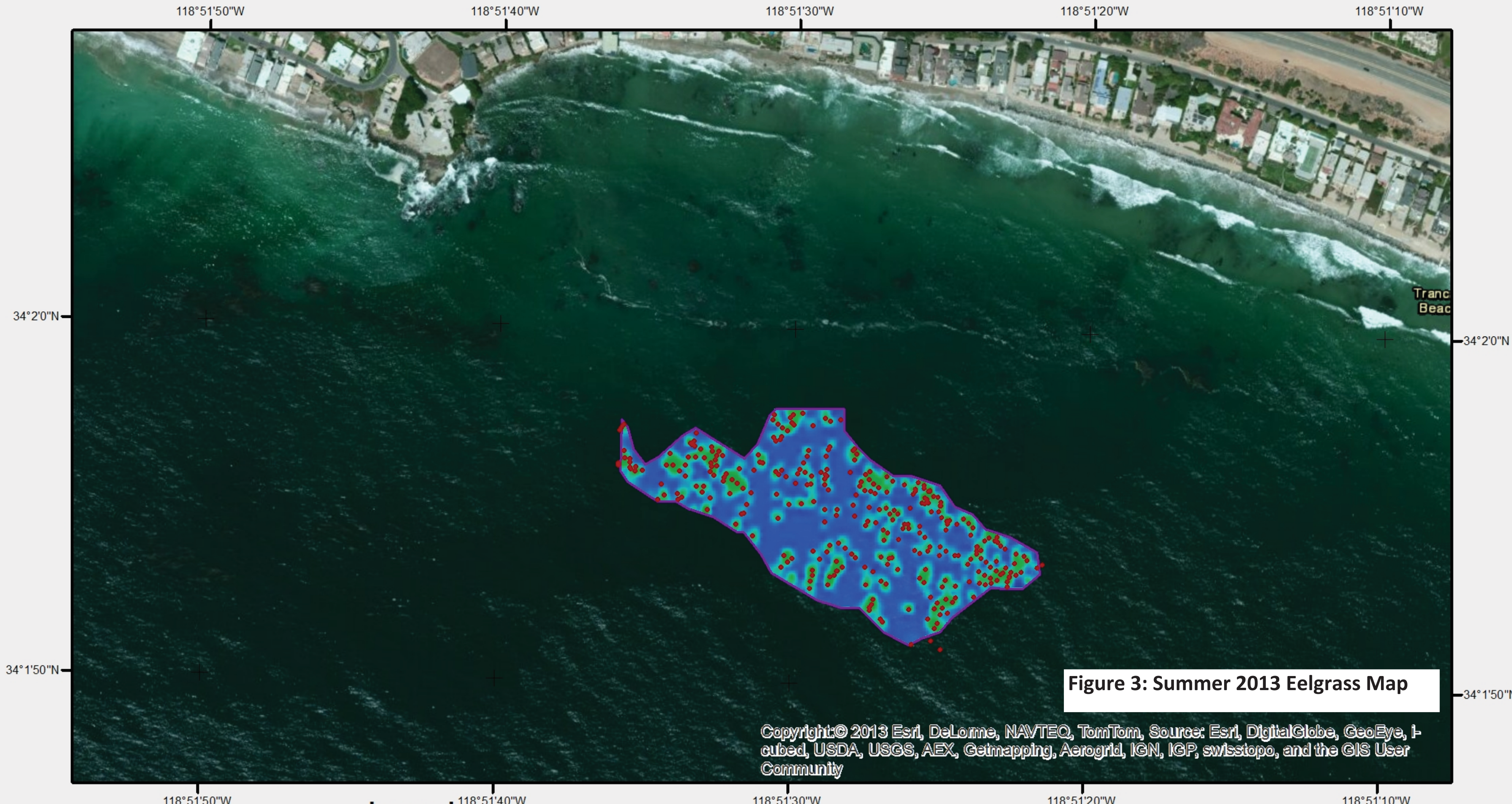
Figure 1
Project Location

Chambers Group Inc.

Image Source

Figure 2: Sonar Survey Track Lines

Acoustically Mapped Eelgrass (Zostera sp.) Offshore Broad Beach
Malibu, California
Coastal Resources Management Inc. June 2013



N
W E
S

Legend

June 2013 Eelgrass Boundary

Within Bed Eelgrass Detects

Eelgrass Coverage

Prob Occurrence (kriging)

1

0

Bed Boundary = 8.75 Acres
Eelgrass Cover = 11.7%

Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree

0 100 200 400 600 800
Feet

COASTAL • RESOURCES • MANAGEMENT

BIOBASE
Aquatic Mapping System

Broad Beach Eelgrass Surveys, October 2012 and June 2013

Figure 4: Comparison of October 2012 and June 2013 Eelgrass Maps

Survey Conducted For: Chambers Group, Inc. By: Coastal Resources Management, Inc. 11 June, 2013

Legend

- Broad Beach Eelgrass 2013 Boundary
- Broad Beach Eelgrass (Main Bed) 2012 Boundary
- Broad Beach 2012 Eelgrass Patch Boundary

Scale:

500 250 0 500 Feet

Horizontal Datum: WGS 84

N W E S

COASTAL • RESOURCES • MANAGEMENT

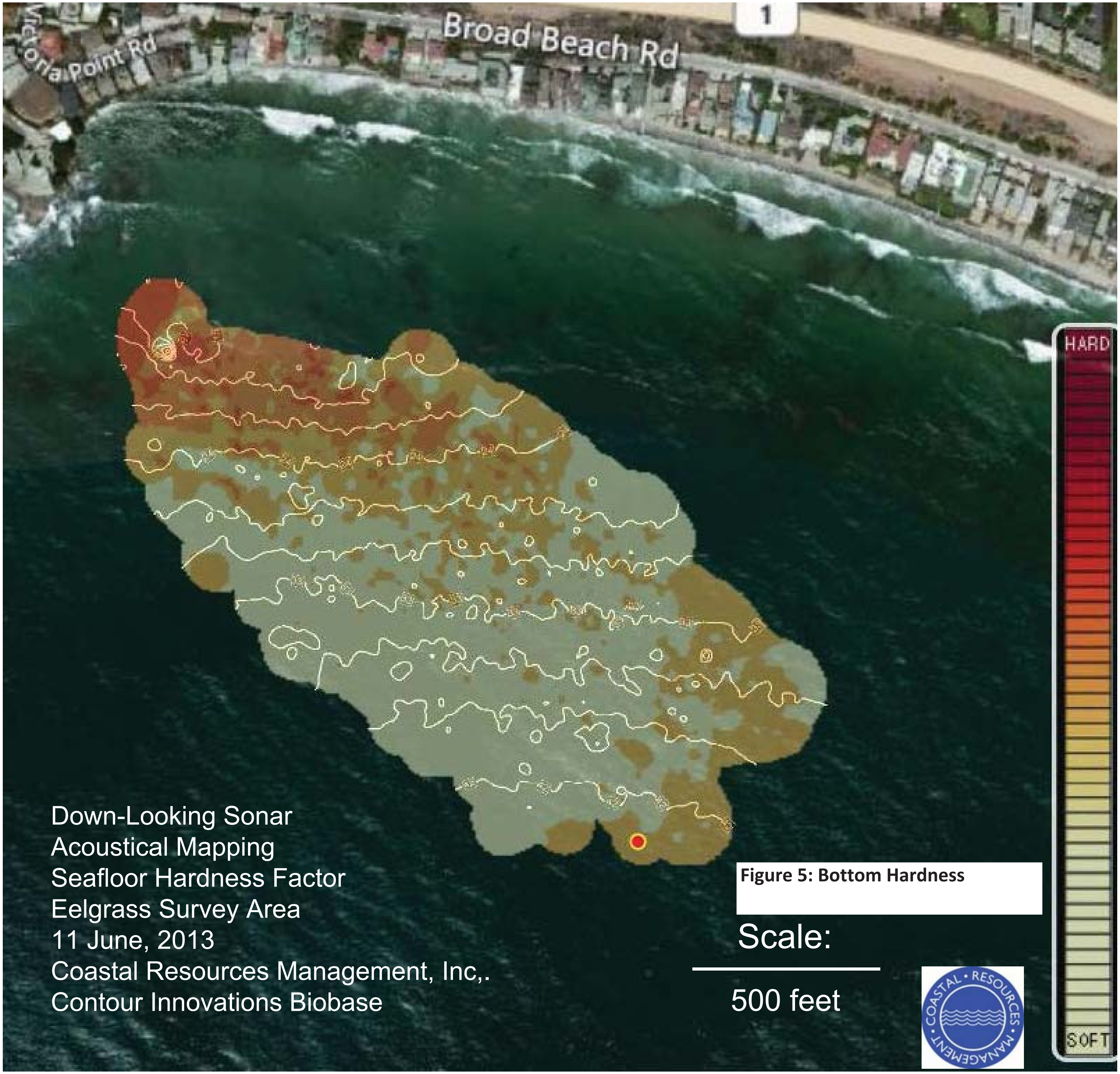


Figure 5: Bottom Hardness