

Status of the Kelp Beds in 2023: Orange and San Diego Counties

Prepared for the Region Nine Kelp Survey Consortium (RNKSC)

Prepared by MBC Aquatic Sciences

July 31, 2024

KELP DATA COLLECTION

Kelp bed overflights of Region Nine were conducted on April 20, 2023 (First Quarter), June 20, 2023 (Second Quarter), October 12, 2023 (Third Quarter) and December 23, 2023 (Fourth Quarter). Ten of the kelp beds in Region Nine peaked during the fourth quarter and two kelp beds peaked during the second quarter (Table 1).

The six designated kelp beds in the northernmost portion of Region Nine (from North Laguna Beach to San Clemente) increased in size from 2022 to 2023 (Table 2). No surface canopy was observed in 2023 in the 11 kelp beds from San Mateo Point to Carlsbad State Beach (as was also the case in 2022). Three kelp beds reappeared in the southern portion of Region Nine (Leucadia, Encinitas, and Solana Beach). The two largest beds in Region Nine decreased considerably in size from 2022 to 2023 (the La Jolla kelp bed was 85% smaller and the Point Loma kelp bed was 77% smaller). The total amount of surface kelp canopy in 2023 was 57% lower than the 2022 level, and was the lowest total recorded since 1998 (Figure 1). Kelp canopy in Region Nine has decreased every year since 2018. Surface canopy was observed at 11 of the designated kelp beds in Region Nine in 2023; this was an increase compared to the six kelp beds with surface canopy in 2022. Surface canopy was greater than 20% of the historical maximum size at only four kelp beds in 2023 (100% of maximum at North Laguna Beach, 23.6% of maximum at South Laguna Beach, 48.1% of maximum at South Laguna, and 32.4% of maximum at Capistrano Beach (Figure 2). Of the remaining eight kelp beds with visible surface canopy in 2023, all were less than 5% of their historical maximum (Salt Creek/Dana Point, San Clemente, Leucadia, Encinitas, Cardiff, Solana Beach, La Jolla, and Point Loma).

MONITORING QUESTIONS

One of the objectives of the RNKSC program is to answer several basic monitoring questions regarding the status of kelp beds within Region Nine:

1. What is the maximum areal extent of the coastal kelp bed canopies each year?
 - maximum total kelp canopy covered 0.824 km² in 2023.
2. What is the variability of the coastal kelp bed canopy over time?
 - maximum total kelp canopy decreased in size in 2023 by 57% (from 1.911 km² to 0.824 km²);

- nine kelp beds increased in size (by 200 to 2,200%), including five kelp beds that reappeared in 2023;
 - two kelp beds decreased in size (by 77 to 85%).
3. Are coastal kelp beds disappearing? If yes, what are the factors that could contribute to the disappearance?
- no kelp beds disappeared in 2023
 - no kelp canopy was observed in 17 kelp beds in either 2022 or 2023, including 14 designated kelp beds and three non-designated kelp beds (Dana Harbor, Pendleton Reefs, and Oceanside Harbor).
4. Are new kelp beds forming?
- five kelp beds reappeared in 2023 (Capistrano Beach, San Clemente, Leucadia, Encinitas, and Solana Beach).
 - sea surface temperatures were mostly below average from February through June and nutrient availability was high from January through April, which probably produced favorable conditions for kelp growth.

Table 1. Rankings assigned to kelp beds from aerial photographs from 2023 Region Nine surveys between Corona del Mar and Imperial Beach.

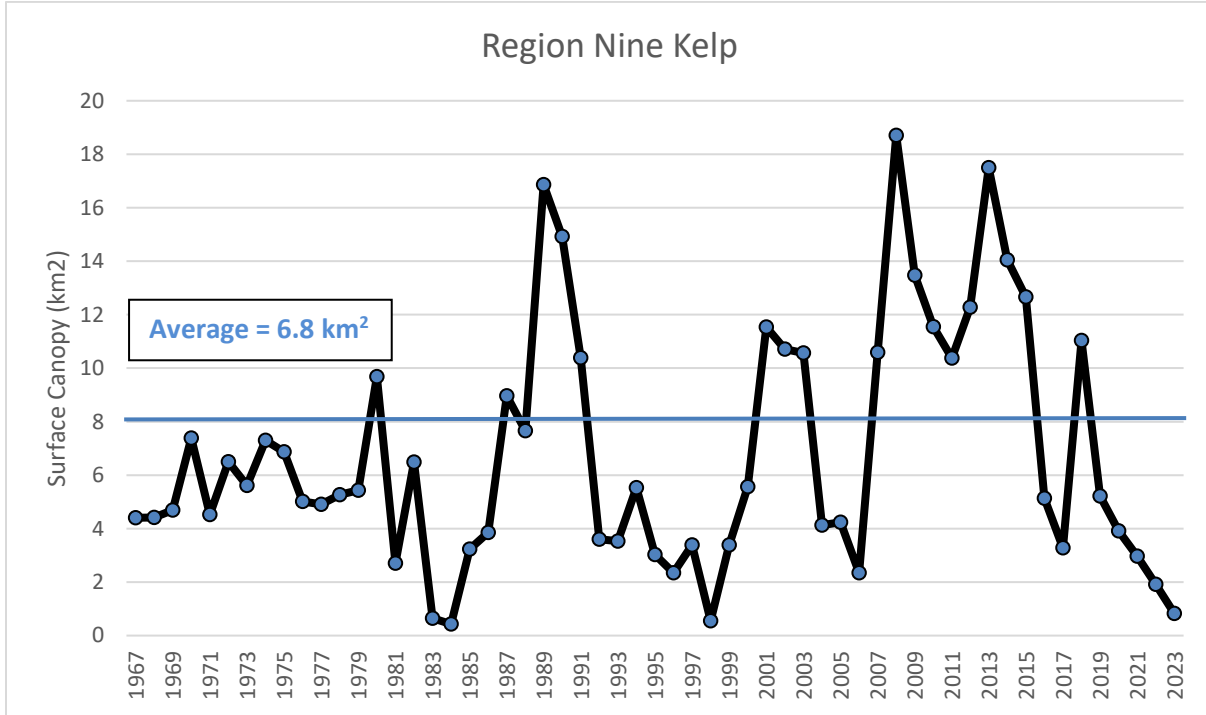
Kelp Beds	2023 Surveys			
	April 20, 2023	June 20, 2023	October 12, 2023	December 23, 2023
North Laguna Beach	1.5	3.0	2.5	4.0
South Laguna Beach	0.5	1.0	0.5	0.5
South Laguna	–	1.0	0.5	3.0
Salt Creek-Dana Point	–	0.5	–	1.0
Dana Marina*	–	–	–	–
Capistrano Beach	–	3.0	1.5	2.5
San Clemente	–	–	–	0.5
San Mateo Point	–	–	–	–
San Onofre	–	–	–	–
Pendleton Reefs*	–	–	–	–
Horno Canyon	–	–	–	–
Barn Kelp	–	–	–	–
Santa Margarita	–	–	–	–
Oceanside Harbor*	–	–	–	–
North Carlsbad	–	–	–	–
Agua Hedionda	–	–	–	–
Encina Power Plant	–	–	–	–
Carlsbad State Beach	–	–	–	–
Leucadia (North, Central, South)	–	–	–	0.5
Encinitas	–	–	–	1.0
Cardiff	–	0.5	3.0	3.0
Solana Beach	–	–	–	0.5
Del Mar	–	–	–	–
Torrey Pines	–	–	NI	–
La Jolla Upper	–	–	NI	0.5
La Jolla Lower	–	–	NI	0.5
Point Loma Upper	–	0.5	1.5	1.5
Point Loma Lower	–	0.5	1.5	1.5
Imperial Beach	–	–	–	–

Ranking values: 0.5 = trace or very small amount of kelp present; 1 = well below average; 1.5 = somewhat below average; 2 = below average; 2.5 = average; 3 = above average; 3.5 = somewhat above average; and 4 = well above average.
 * = not a designated kelp bed
 NI = No Image; X=no overflight conducted in Central Region
 “–” = no kelp present
 Red highlight = survey utilized to quantify surface canopy area

Table 2. Comparison of canopy coverage of Region Nine kelp beds from North Laguna Beach to Imperial Beach (kelp beds listed north to south) during 2022 and 2023.

Kelp Bed	2022 (km²)	2023 (km²)	Percentage Difference
North Laguna Beach	0.040	0.219	+448
South Laguna Beach	0.005	0.064	+1,180
South Laguna	0.001	0.023	+2,200
Dana Point-Salt Creek	0.002	0.006	+200
Dana Marina *	-	-	no change
Capistrano Beach	-	0.075	reappeared
San Clemente	-	0.001	reappeared
San Mateo Point	-	-	no change
San Onofre	-	-	no change
Pendleton Reefs *	-	-	no change
Horno Canyon	-	-	no change
Barn Kelp	-	-	no change
Santa Margarita	-	-	no change
Oceanside Harbor *	-	-	no change
North Carlsbad	-	-	no change
Agua Hedionda	-	-	no change
Encina Power Plant	-	-	no change
Carlsbad State Beach	-	-	no change
Leucadia (North, Central, South)	-	0.002	reappeared
Encinitas	-	0.010	reappeared
Cardiff	-	-	no change
Solana Beach	-	0.006	reappeared
Del Mar	-	-	no change
Torrey Pines	-	-	no change
La Jolla	0.446	0.067	-85
Point Loma	1.417	0.324	-77
Imperial Beach	-	-	no change
TOTAL	1.911	0.824	-57%

Figure 1. Combined canopy coverage of all kelp beds in Region Nine from North Laguna Beach to Imperial Beach from 1967 to 2023. (Blue line=average total canopy area from 1967 through 2023)



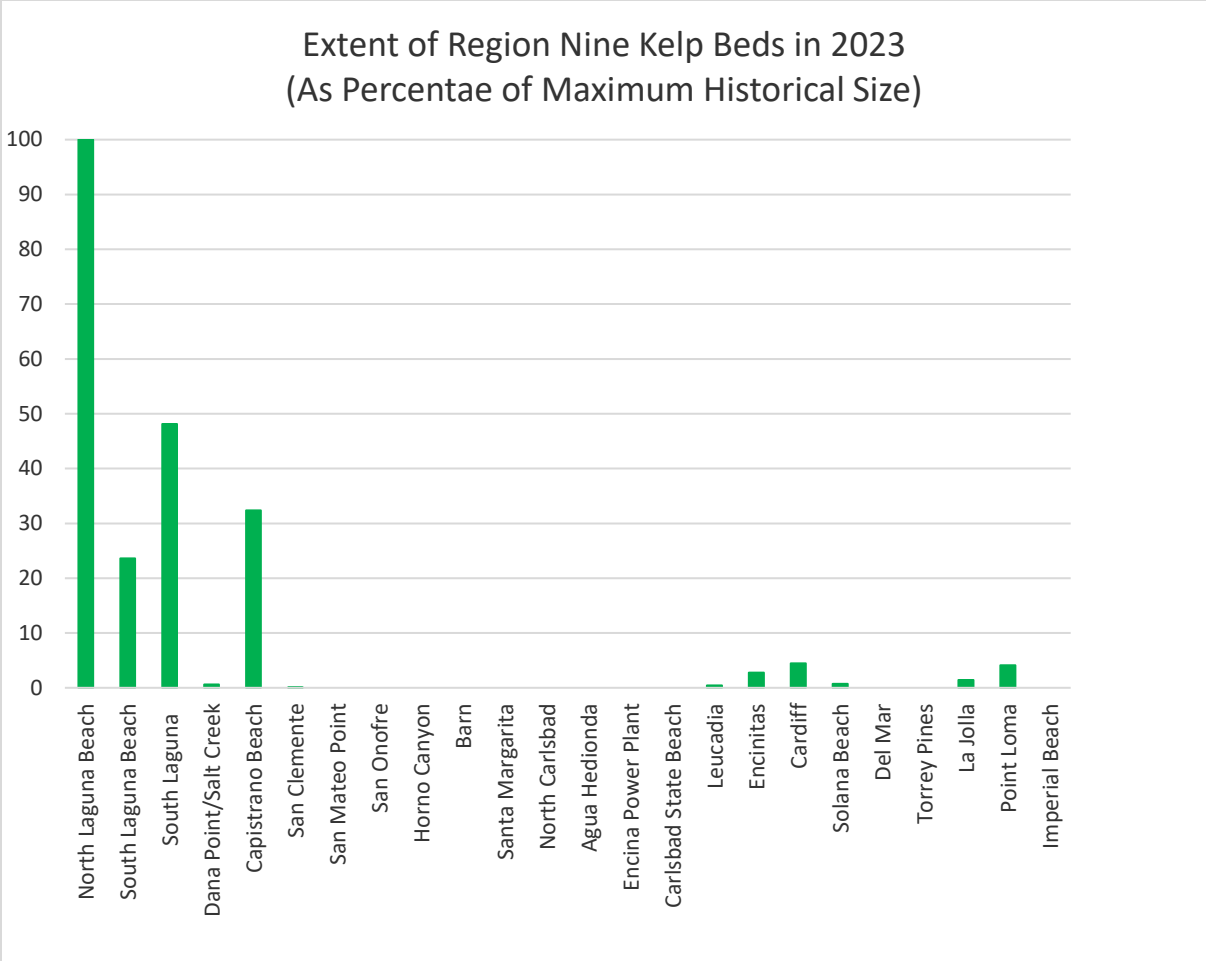


Figure 2. Extent of kelp bed canopy coverage in Region Nine from North Laguna Beach to Imperial Beach in 2023 (as a percentage compared to the historical maximum size of each kelp bed).

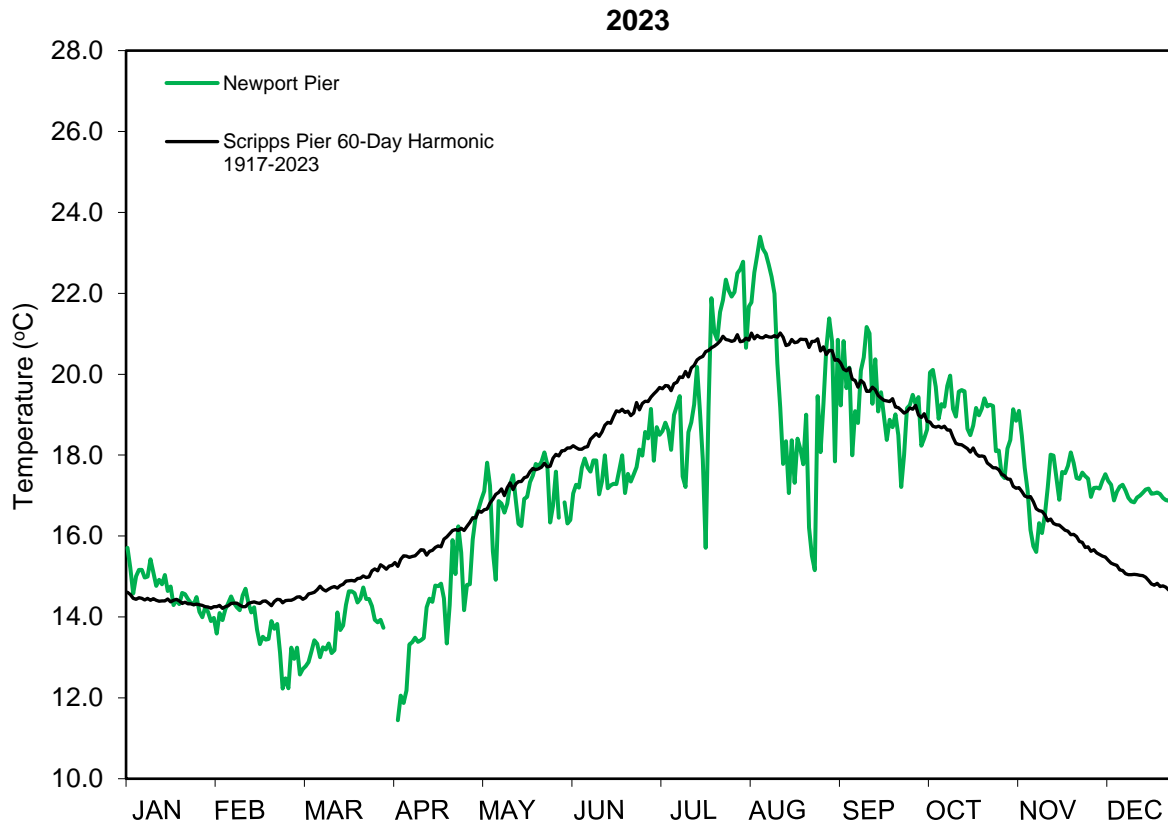


Figure 3. Sea surface temperatures at Newport Pier in 2023 compared to the long-term (1917 to 2023) 60-day harmonic curve for Scripps Pier.

Sea surface temperatures were recorded in 2023 by automatic shore stations located at Newport Pier and at Scripps Pier, and by nearshore buoys located near Oceanside and Point Loma South.

At Newport Pier, sea surface temperatures were usually lower than the long-term values for Scripps Pier from February through March, and from mid-July to mid-August. Surface water temperatures in January, October, November, and December were higher than average (Figure 3). A similar pattern was observed at Oceanside, usually with lower than average sea surface temperatures from February to June and in late August. Sea surface temperatures at Oceanside were usually above average in January, for most of July and early August, and from September through December (Figure 4). A similar pattern was also observed at Scripps Pier, usually with lower than average sea surface temperatures from February to June. Although sea surface temperatures at Scripps Pier were usually above average in January and from July through December, periods of below average temperatures were observed each month from July to November (Figure 5). The sea surface temperature pattern at Point Loma South (Figure 6) was similar to Scripps Pier, with mostly below average temperatures from February until early July,

and mostly above average temperatures in January and from early July through December (except for below average temperatures for a few days in August).

Peak surface canopy for 2023 was recorded in December for most kelp beds (except for South Laguna Beach and Capistrano Beach, which peaked in June). Sea surface temperatures throughout Region Nine were often below average during the first half of 2023 and nutrient availability was high from January through April (Table 3), which should have produced favorable conditions for kelp growth. However, sea surface temperatures were often higher than average during the second half of 2023 and nutrient availability was low (Table 3), so it is unclear why most kelp beds displayed peak canopy in December.

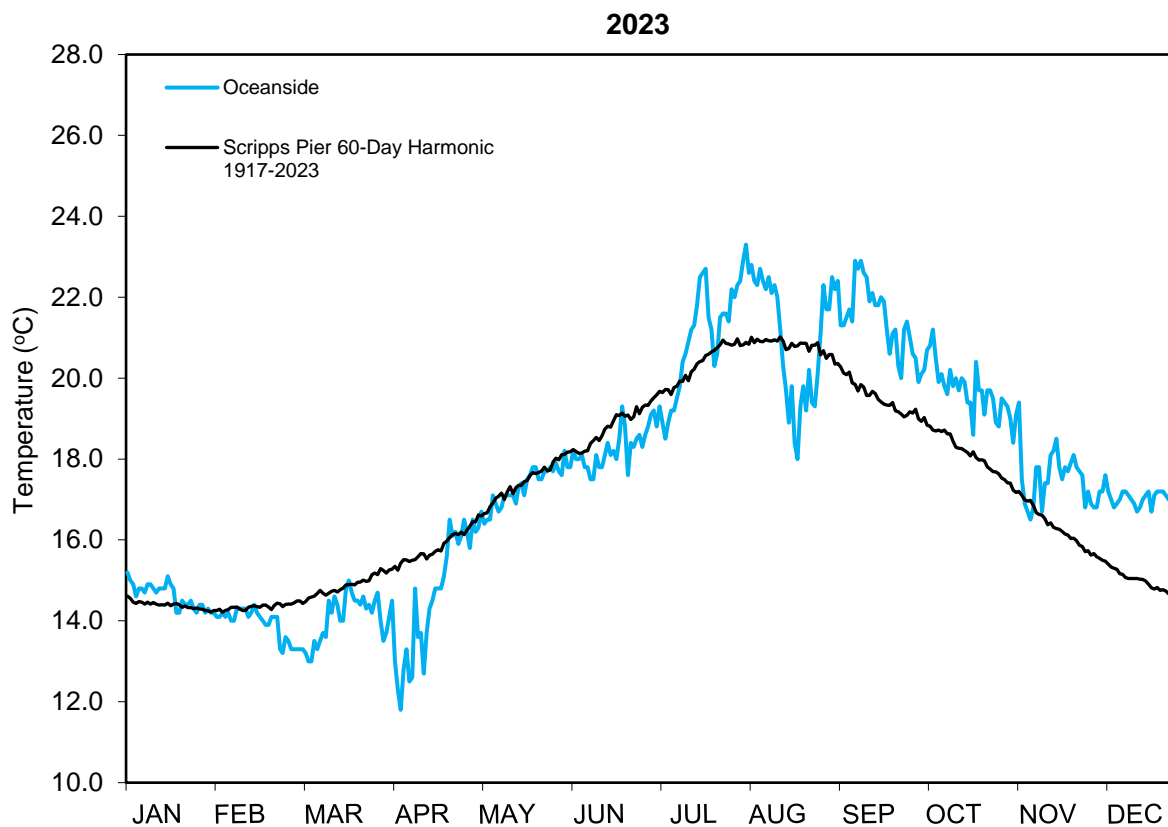


Figure 4. Sea surface temperatures at Oceanside in 2023 compared to the long-term (1917 to 2023) 60-day harmonic curve for Scripps Pier.

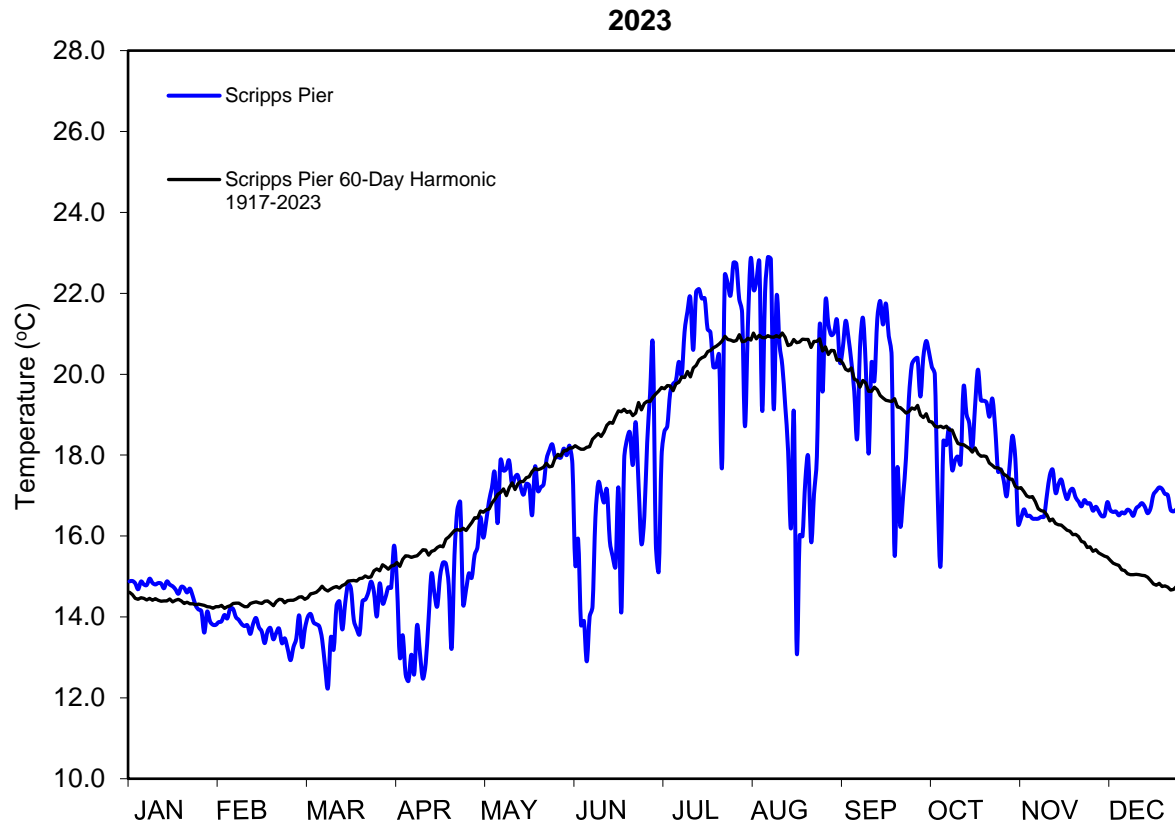


Figure 5. Sea surface temperatures at Scripps Pier in 2023 compared to the long-term (1917 to 2023) 60-day harmonic curve for Scripps Pier.

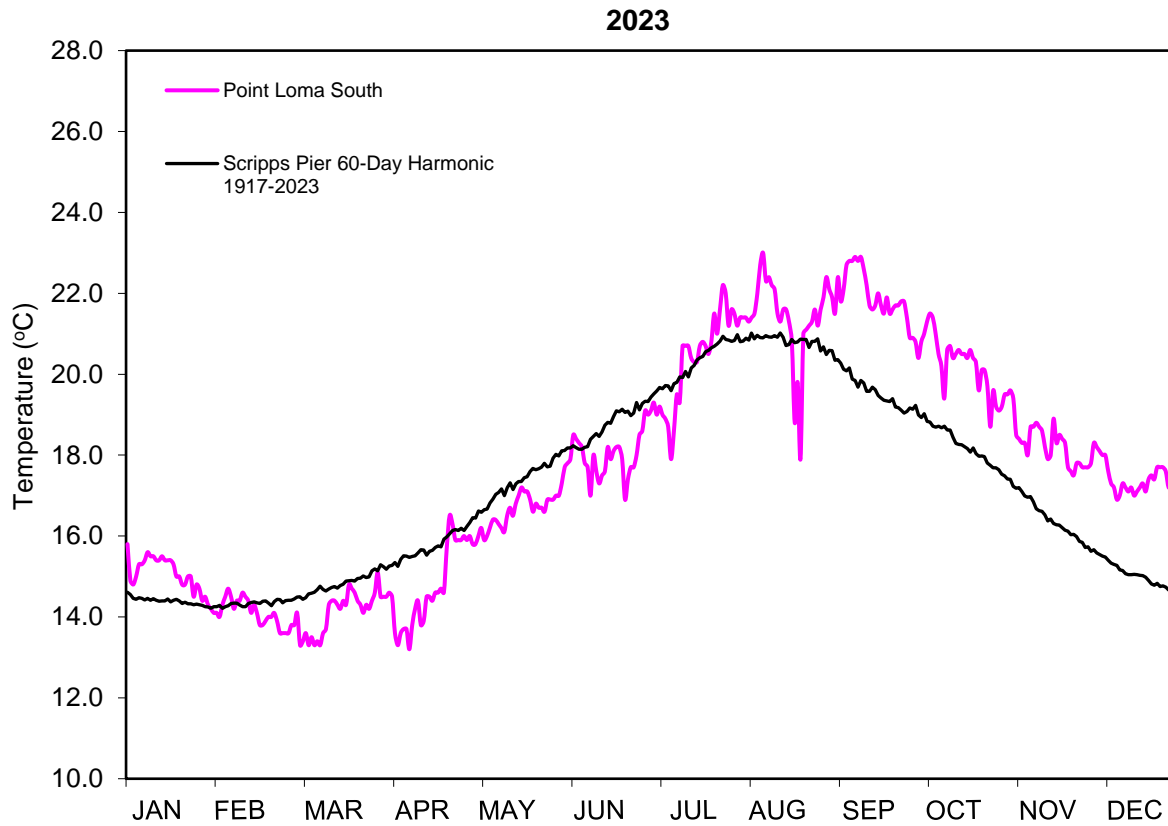


Figure 6. Sea surface temperatures at Point Loma in 2021 compared to the long-term (1917 to 2021) 60-day harmonic curve for Scripps Pier.

Table 3. Monthly Nutrient Index Scores for Newport Pier, Oceanside, Scripps Pier, and Point Loma in 2023.

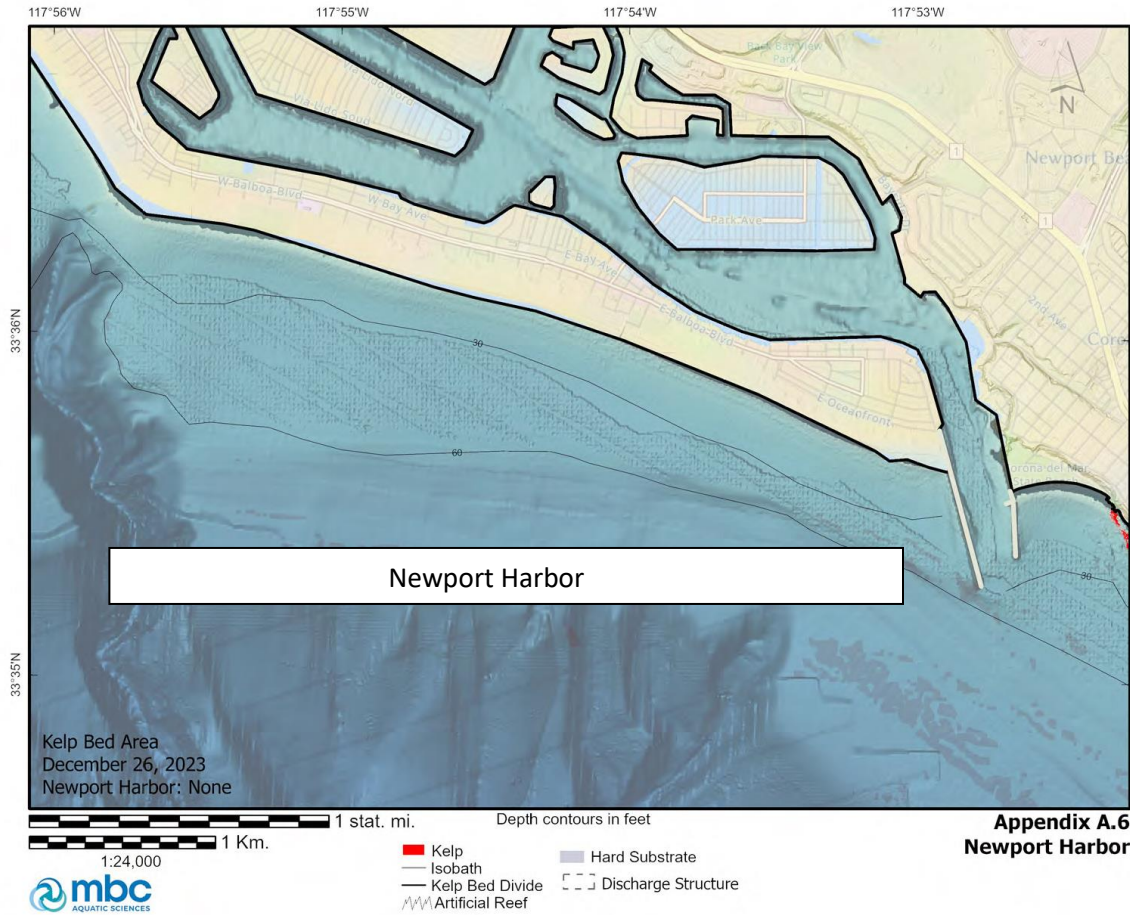
Month	Nutrient Index Scores			
	Newport Pier	Oceanside	Scripps Pier	Point Loma
January	4	4	4	2
February	8	8	8	4
March	8	8	8	4
April	4	4	4	4
May	1	0	0	1
June	0	0	1	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	0	0	1	0
December	0	0	1	0

Appendix 1.

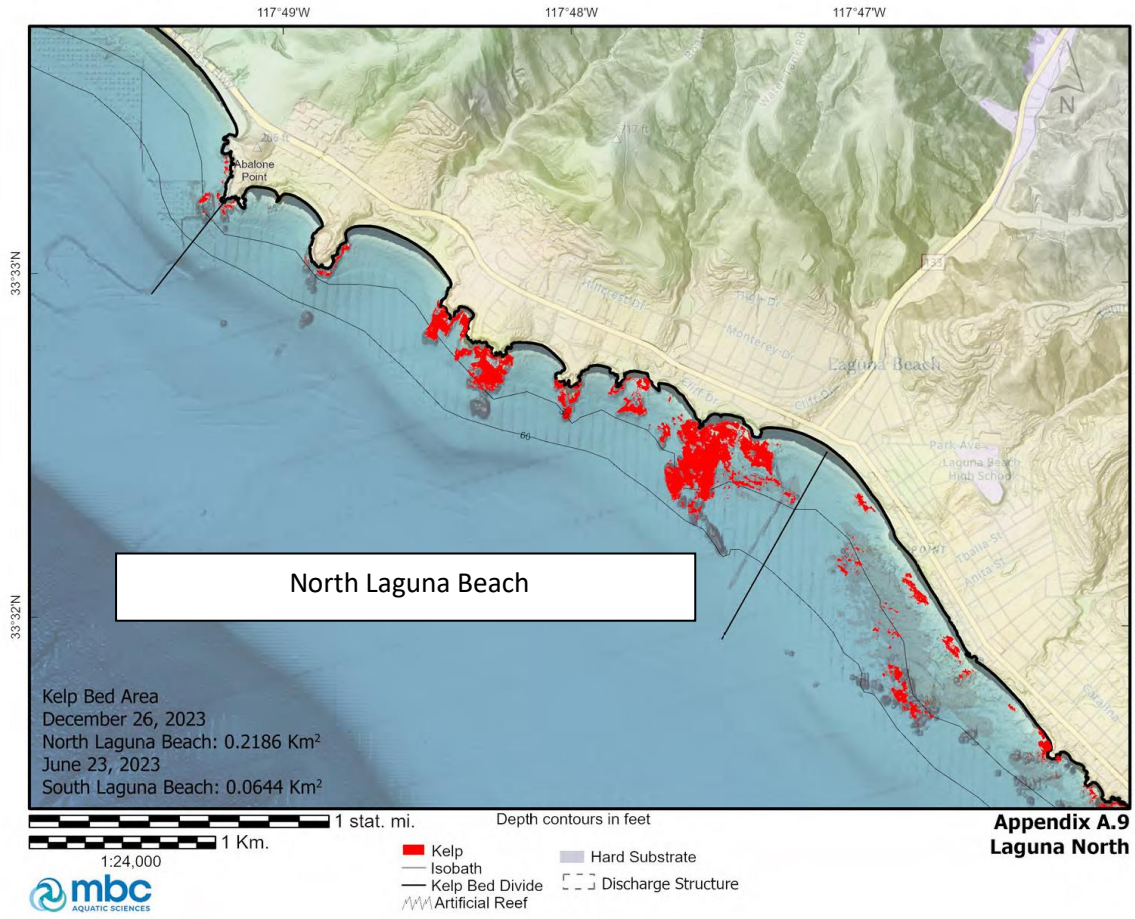
Aerial Photographs of Kelp Beds in Region Nine in 2021

(photographs provided for kelp beds with visible surface canopy in 2021 and for the quarter with the maximum surface canopy for the year)

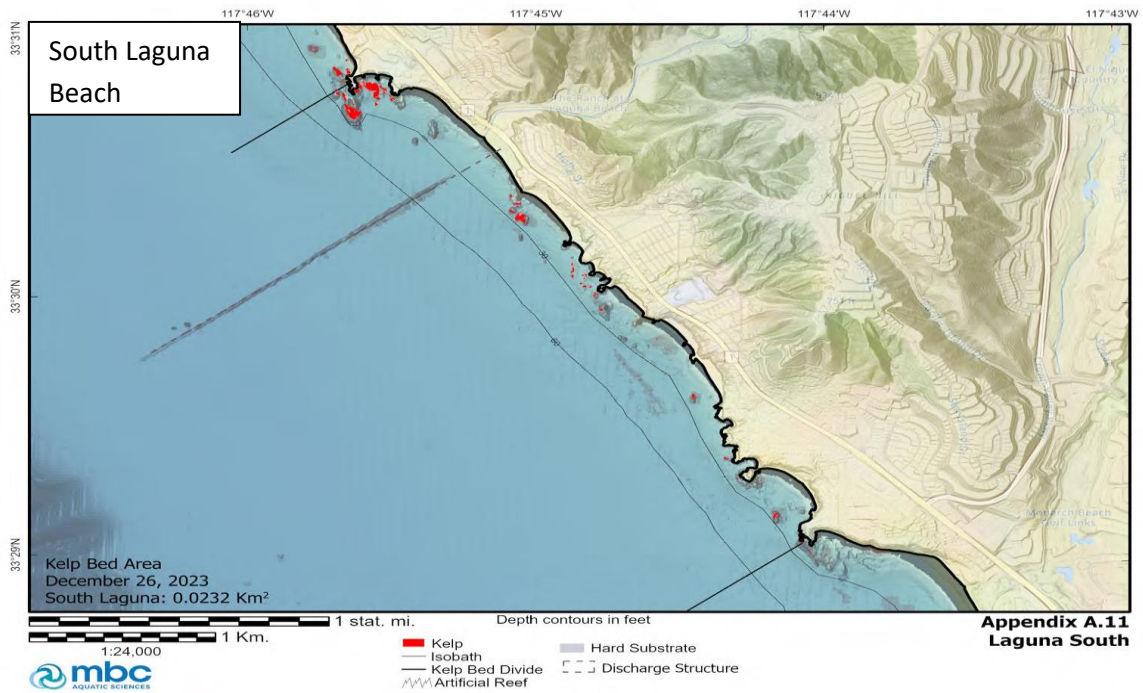
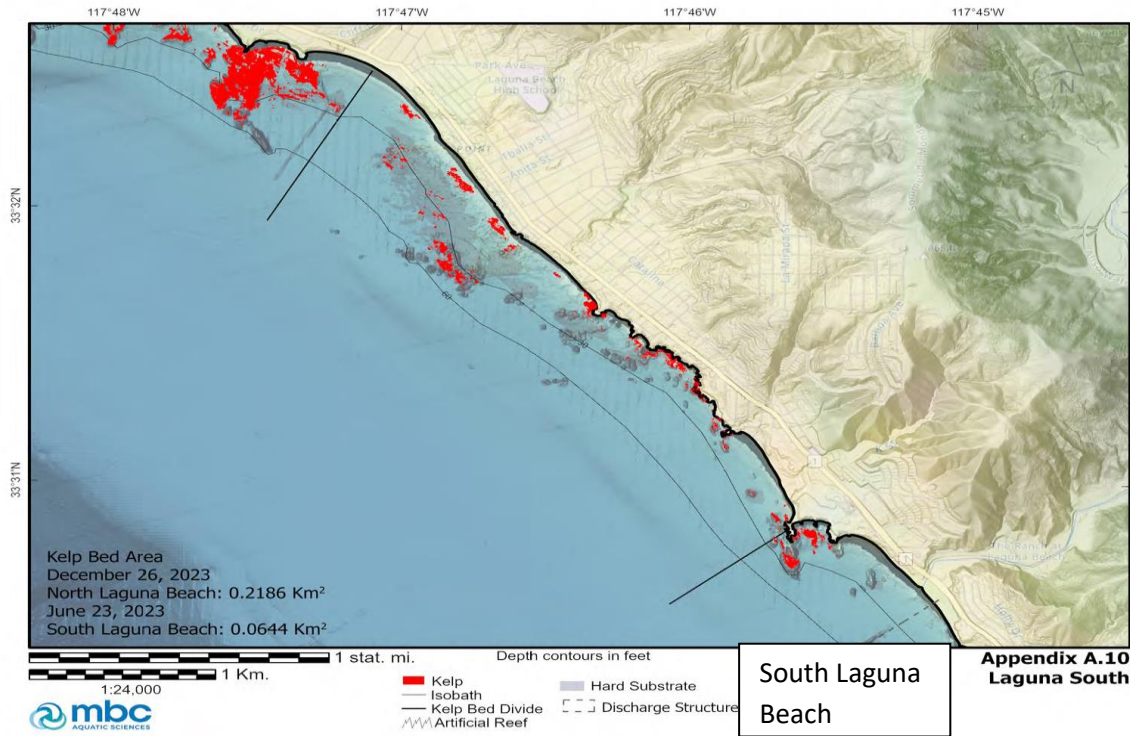
1) Newport Harbor (not a designated kelp bed)



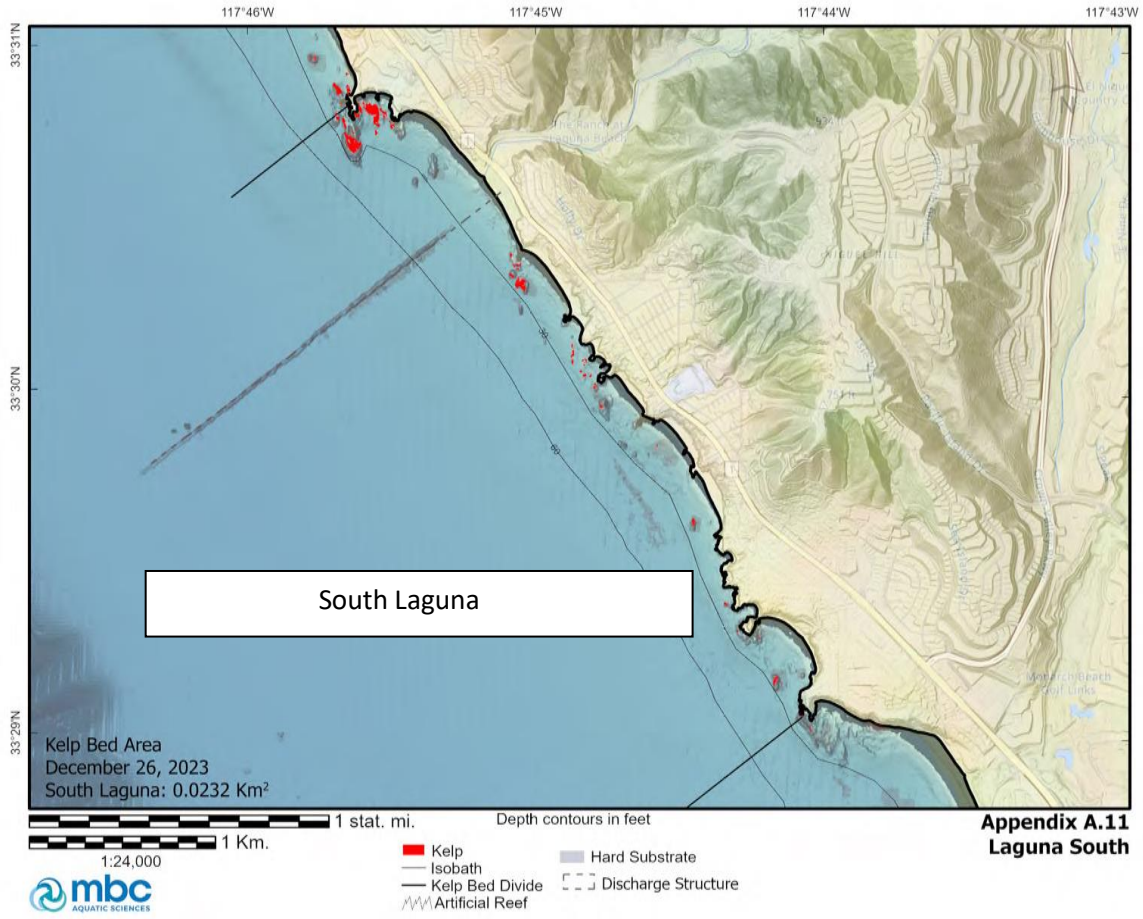
2) North Laguna Beach



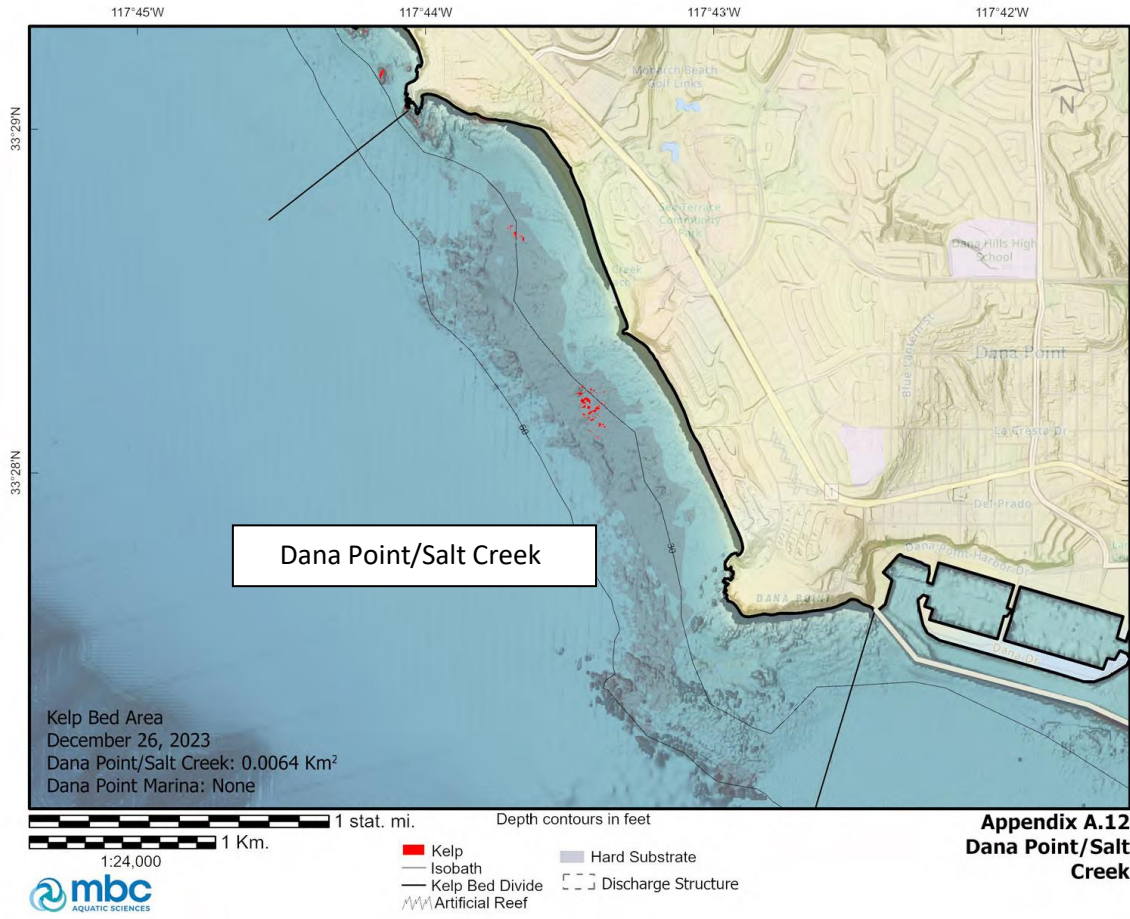
3) South Laguna Beach



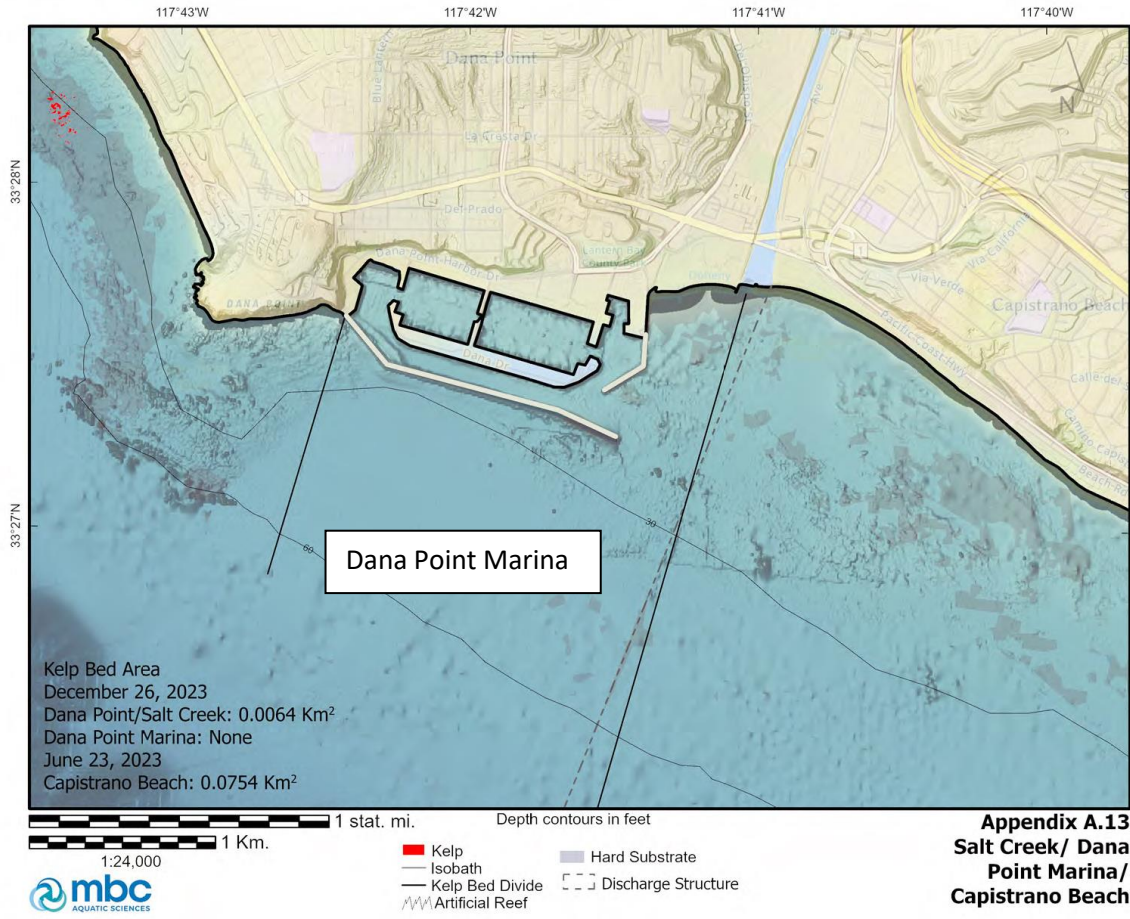
4) South Laguna



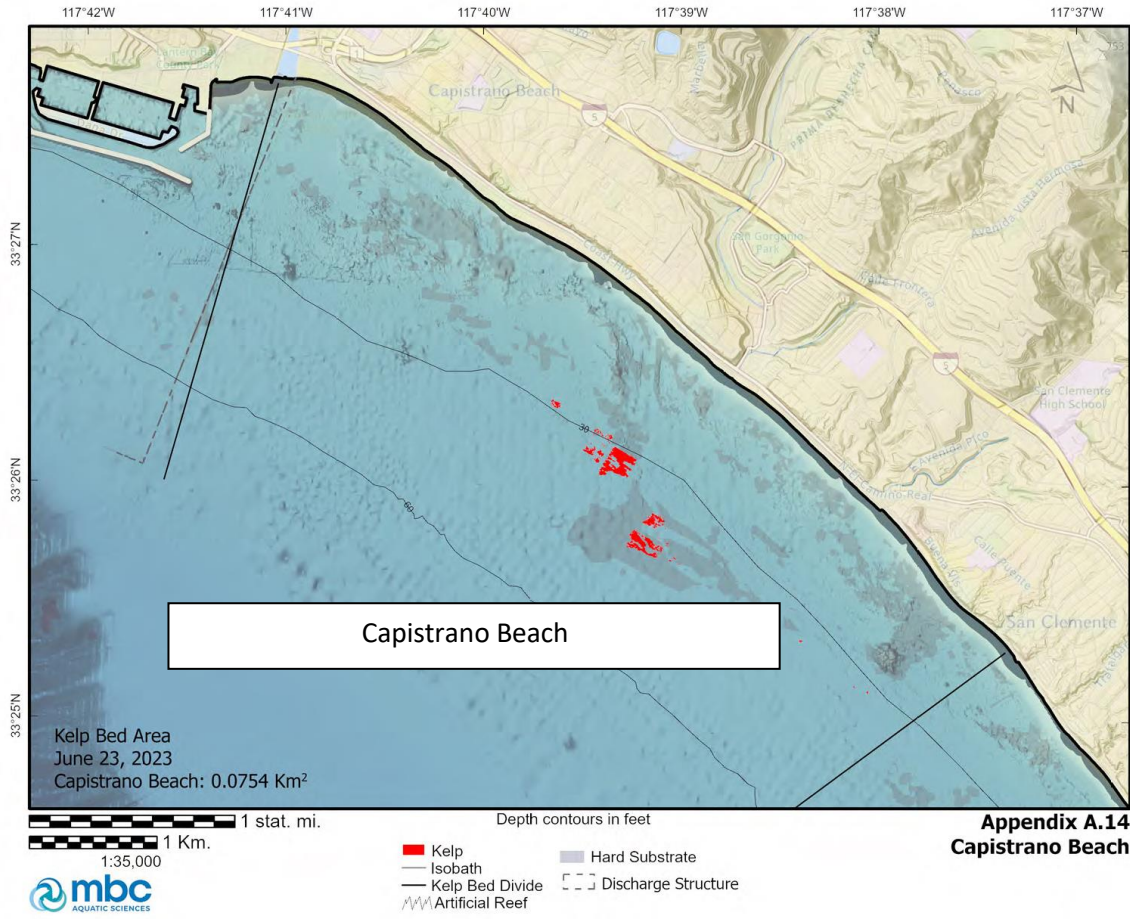
5) Dana Point-Salt Creek



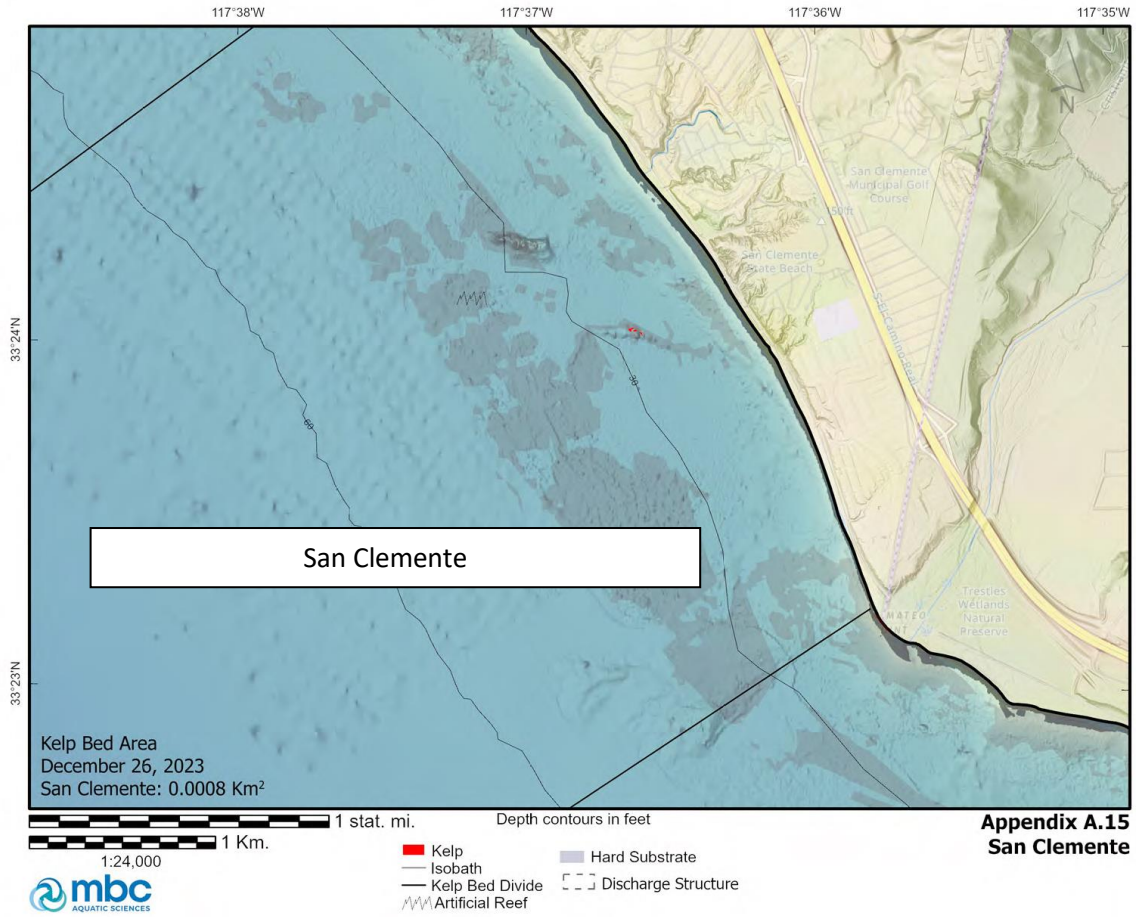
6) Dana Point Marina (not a designated kelp bed)



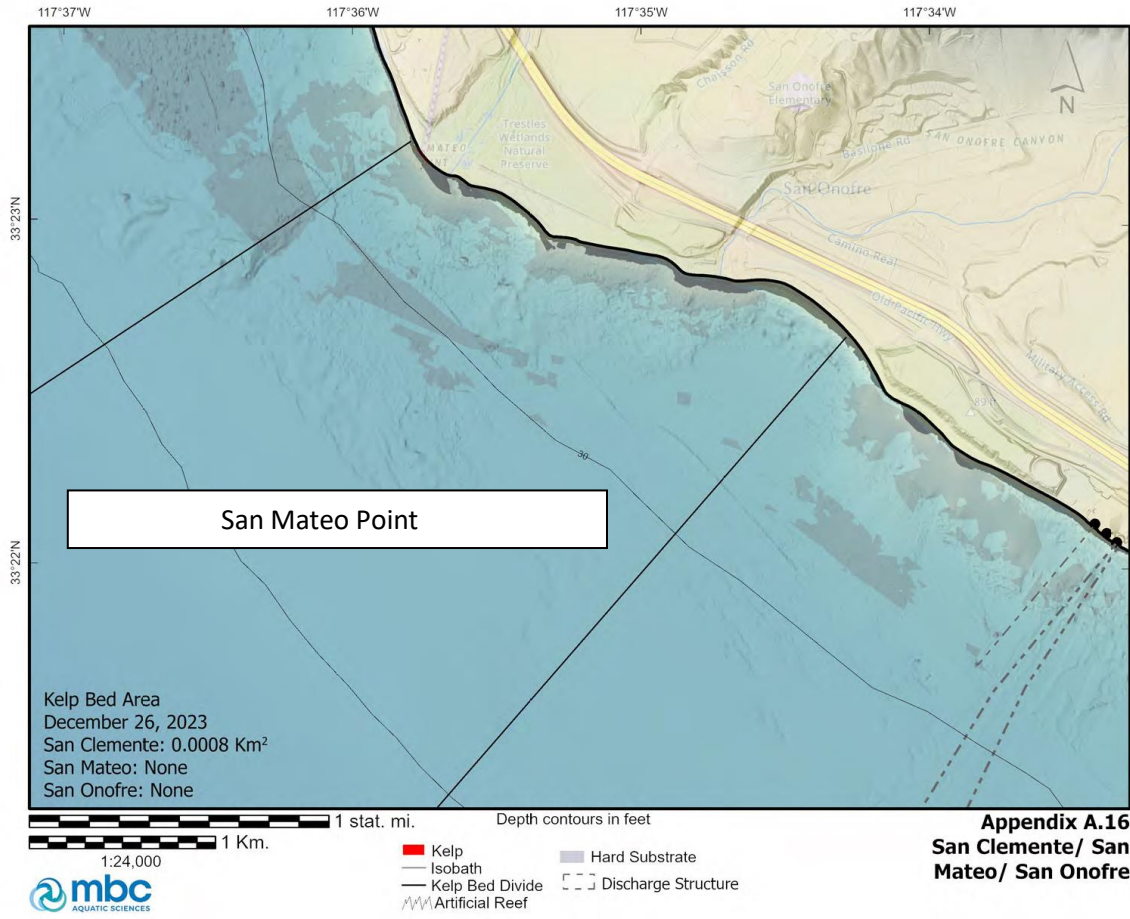
7) Capistrano Beach



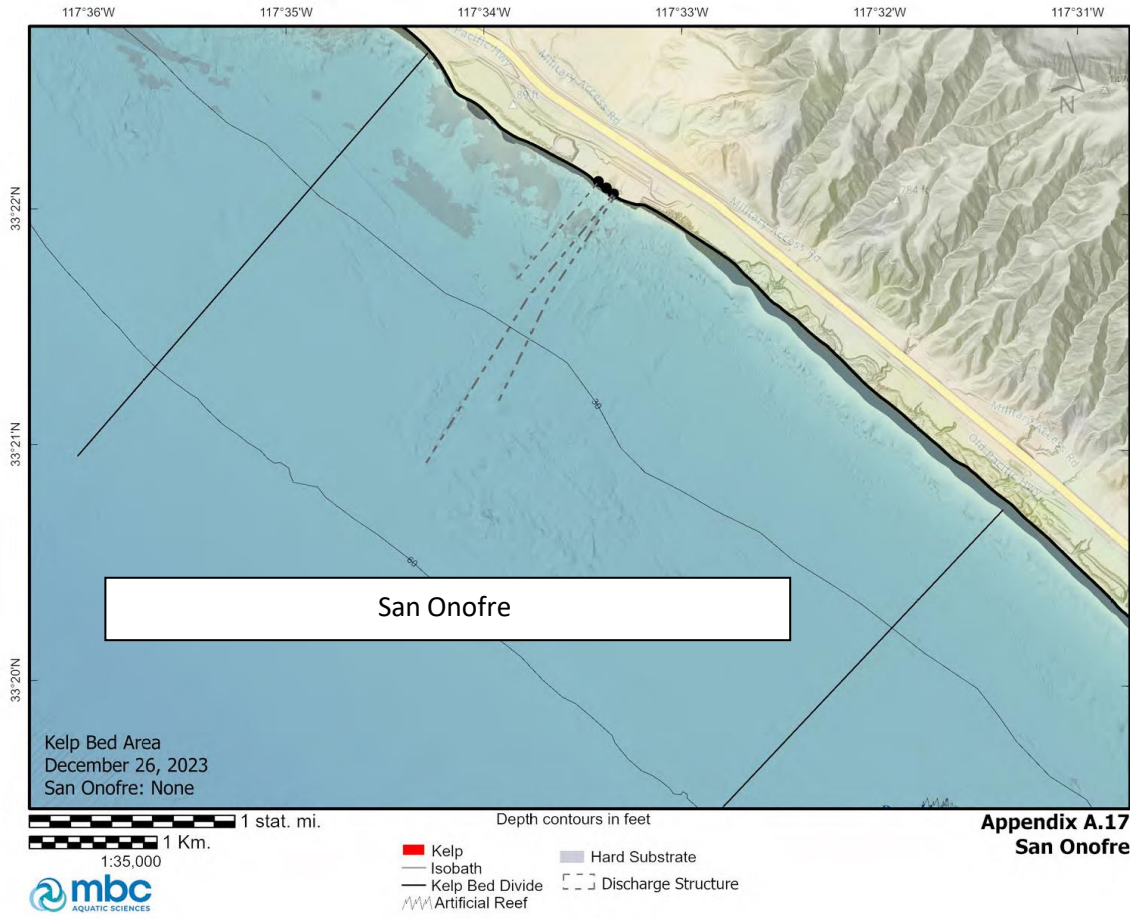
8) San Clemente



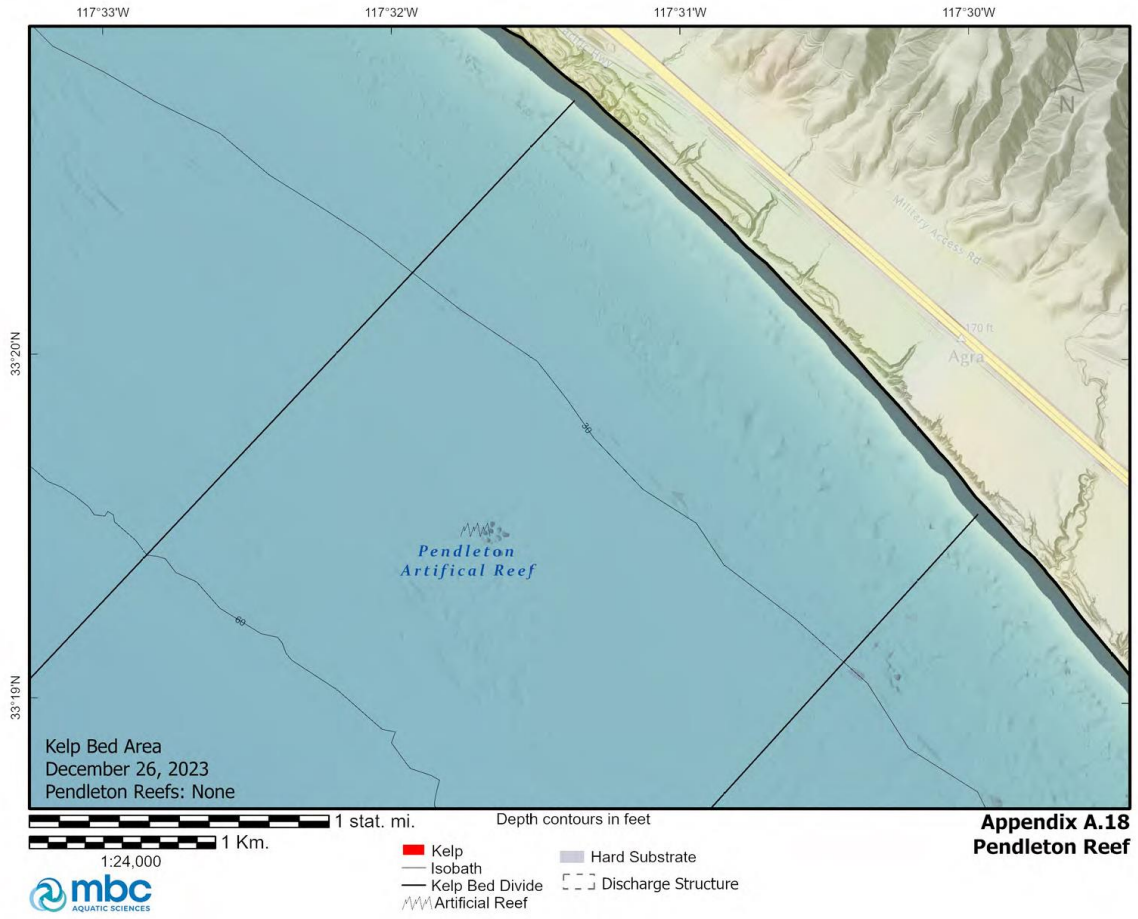
9) San Mateo Point



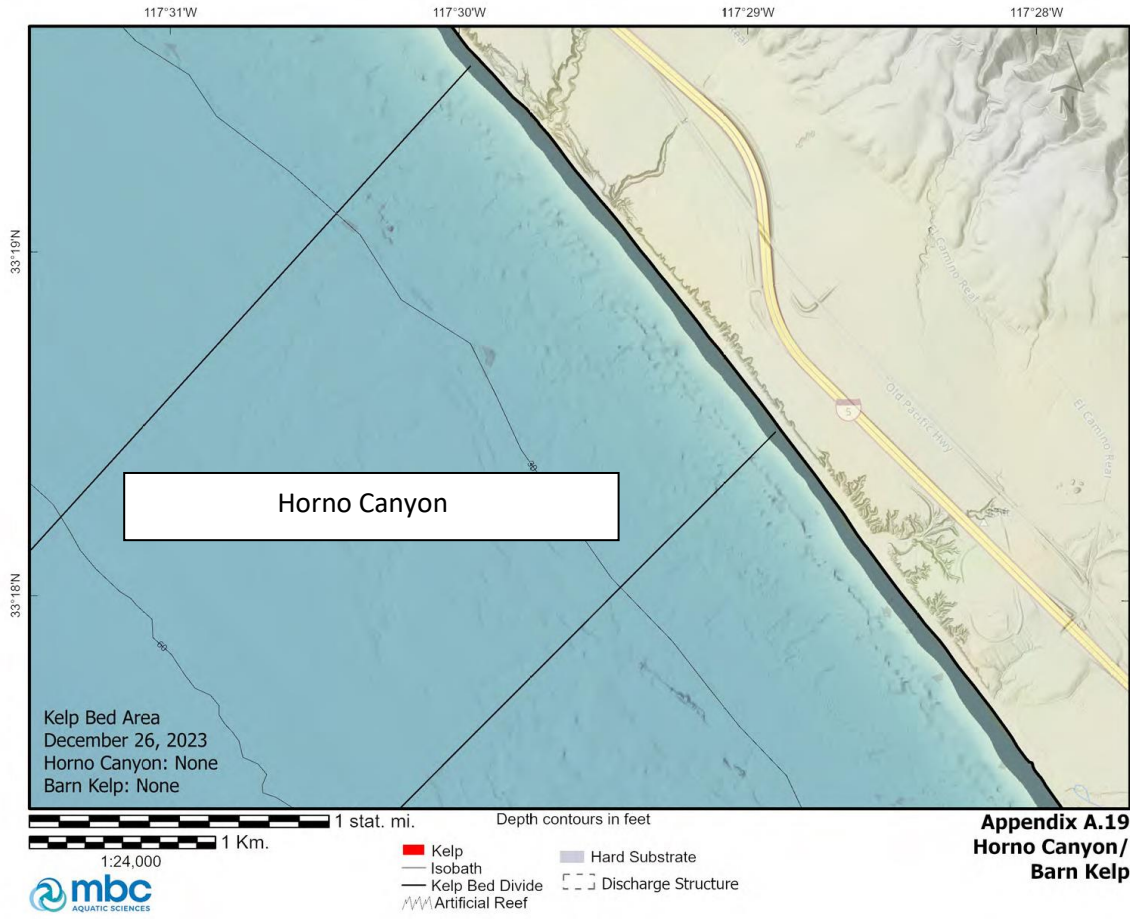
10) San Onofre



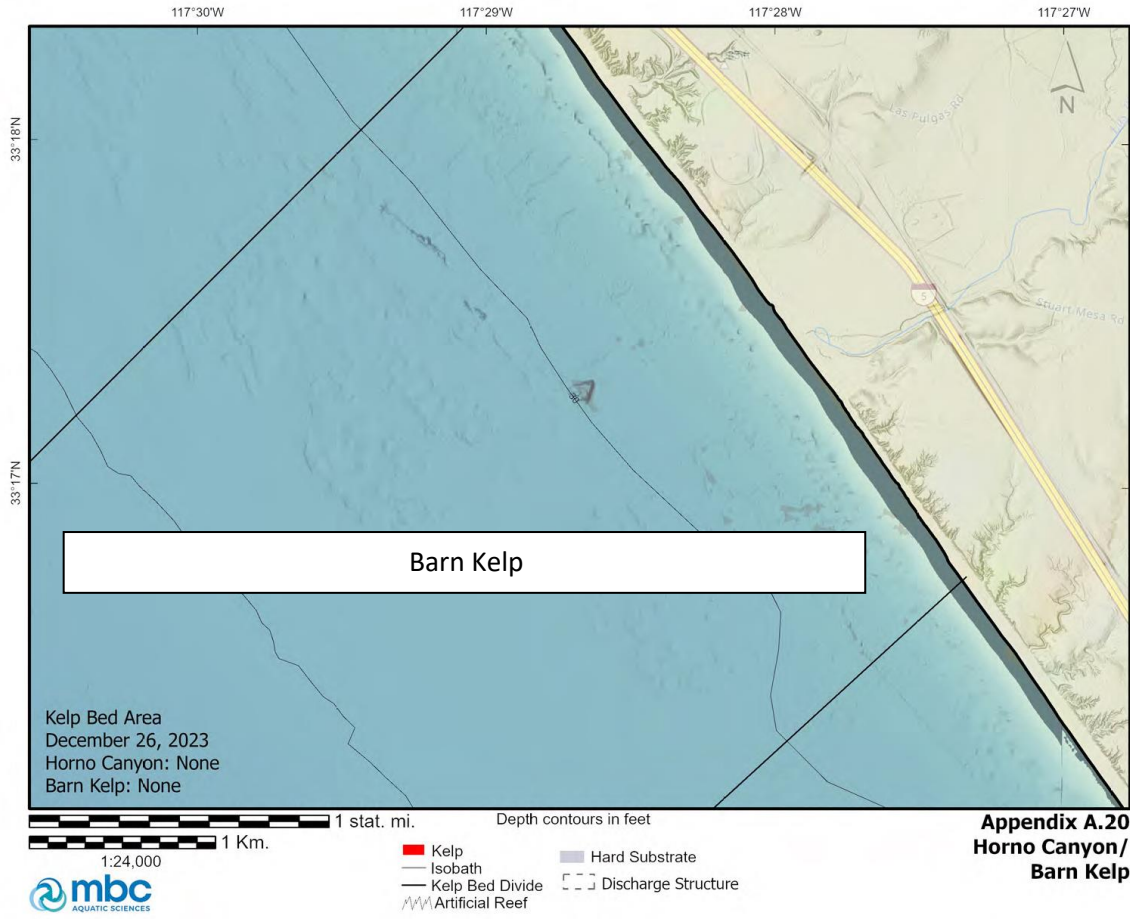
11) Pendleton Reefs (not a designated kelp bed)



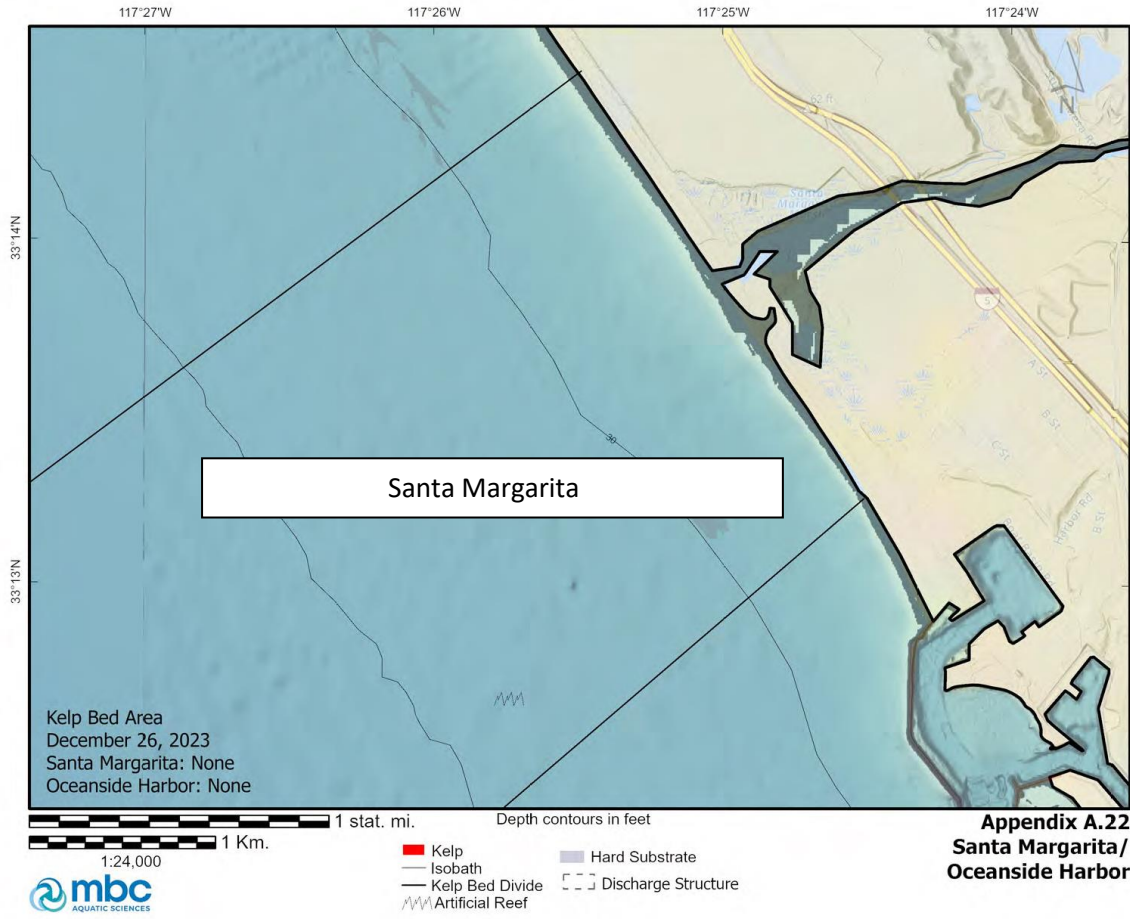
12) Horno Canyon



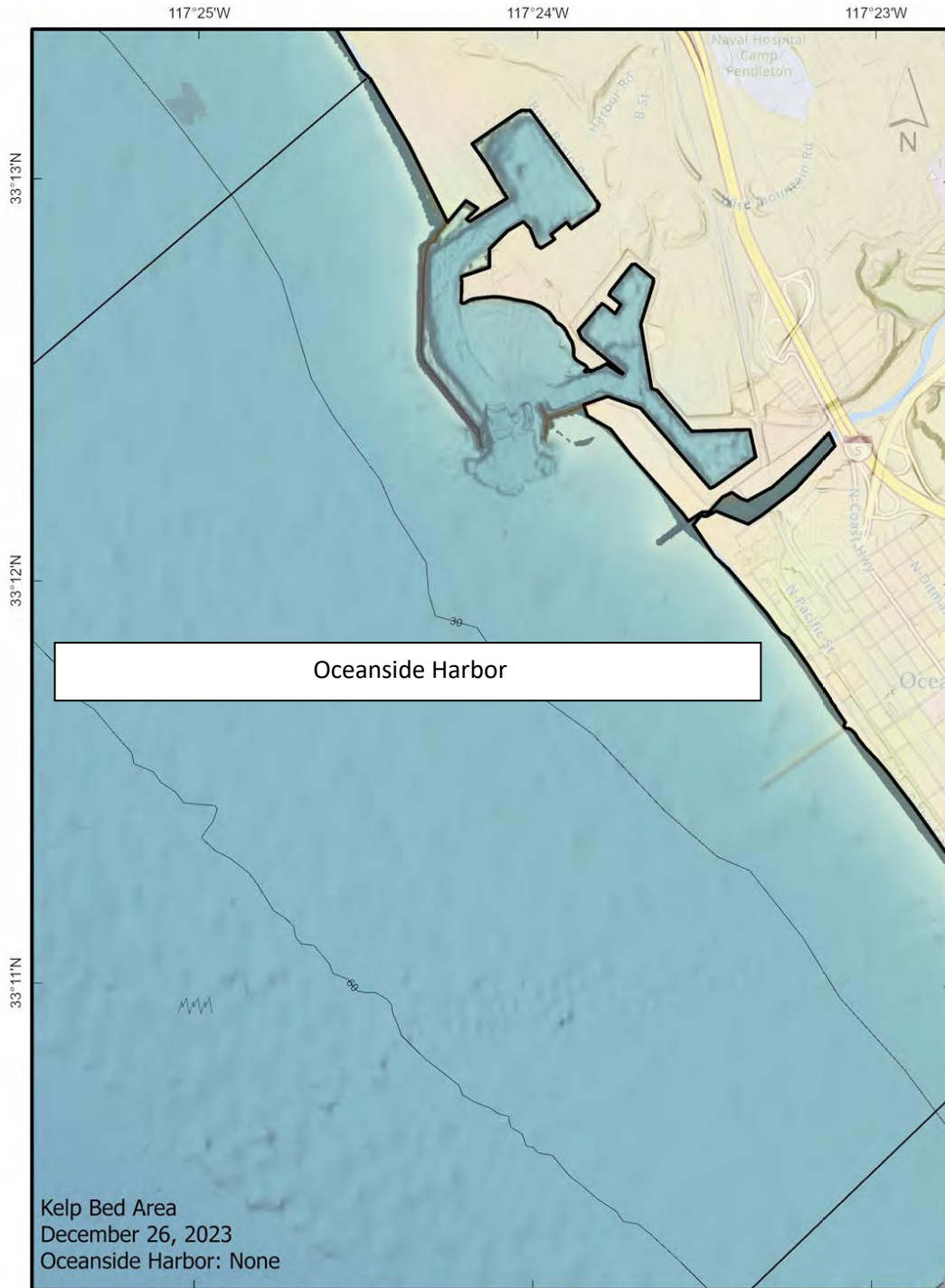
13) Barn Kelp



14) Santa Margarita



15) Oceanside Harbor (not a designated kelp bed)



1:24,000

1 stat. mi. Depth contours in feet

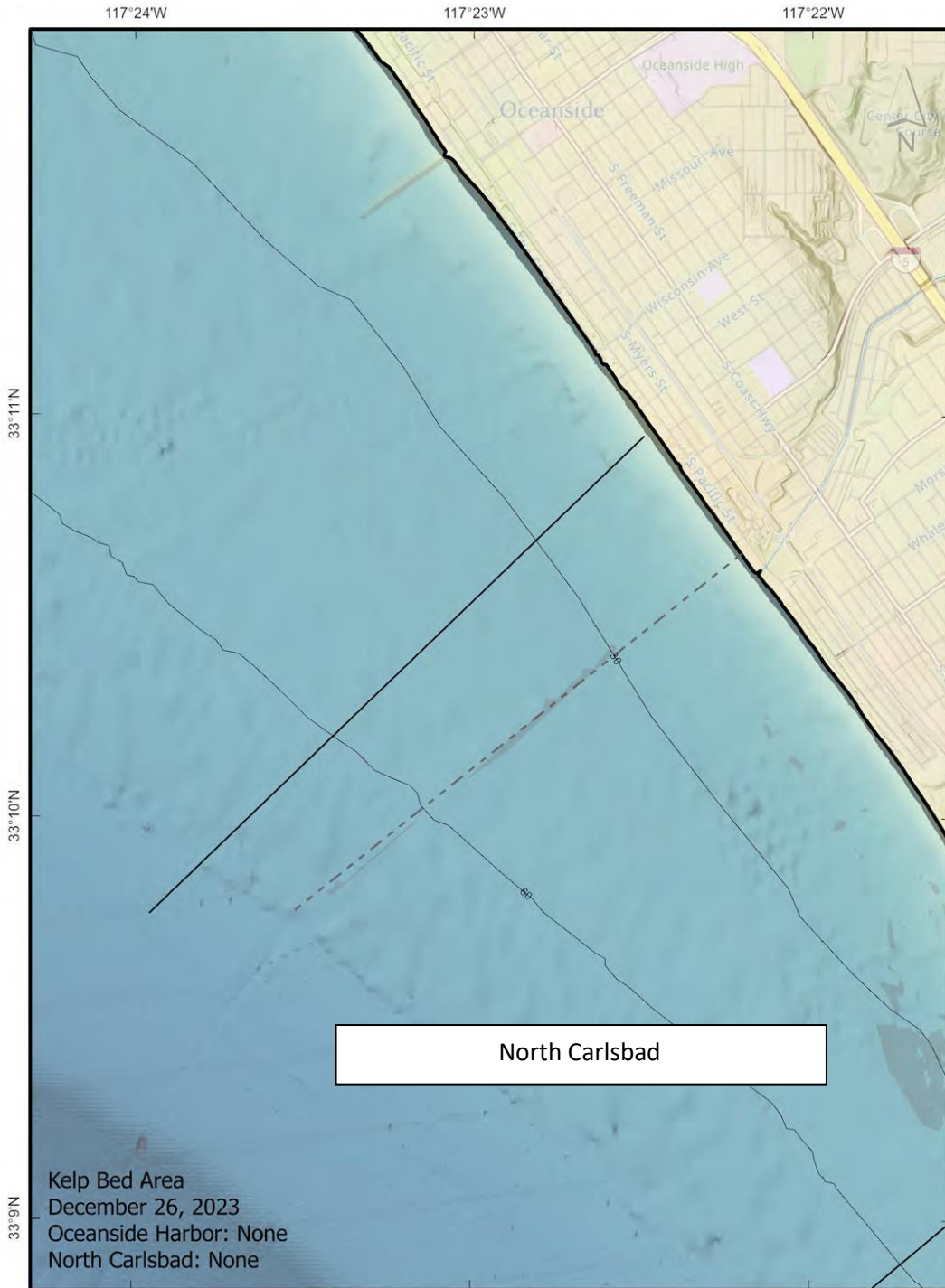
1 Km.

- Kelp
- Hard Substrate
- Isobath
- Discharge Structure
- Kelp Bed Divide
- ~ Artificial Reef



**Appendix A.23
Oceanside Harbor
and Pier**

16) North Carlsbad



1:24,000

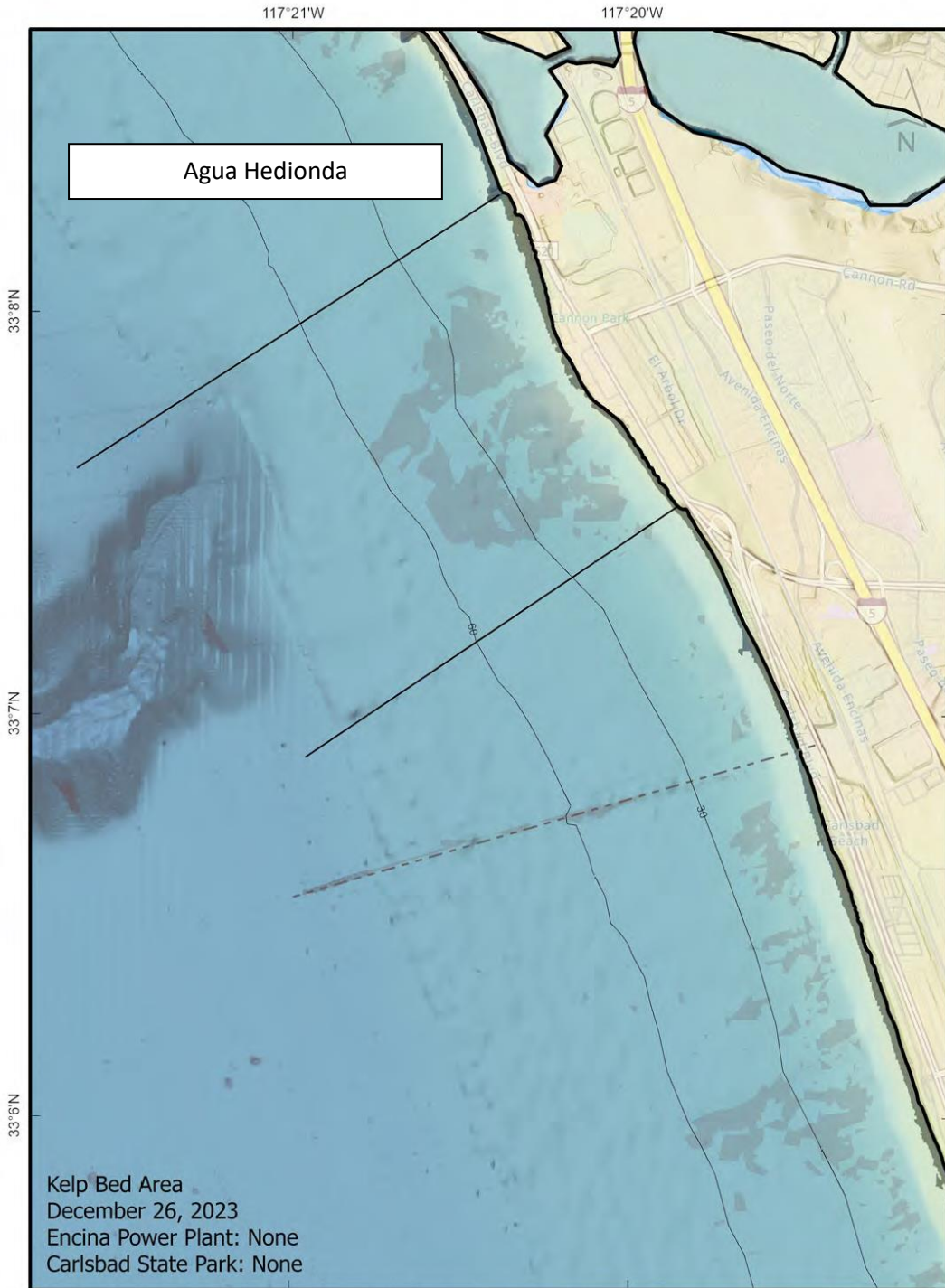
1 stat. mi. 1 Km.

■ Kelp
 Isobath
 Kelp Bed Divide
 Artificial Reef
 Hard Substrate
 Discharge Structure



Appendix A.24
**Oceanside Harbor/
 Pier/ North
 Carlsbad**

17) Agua Hedionda



1:24,000

1 stat. mi. Depth contours in feet

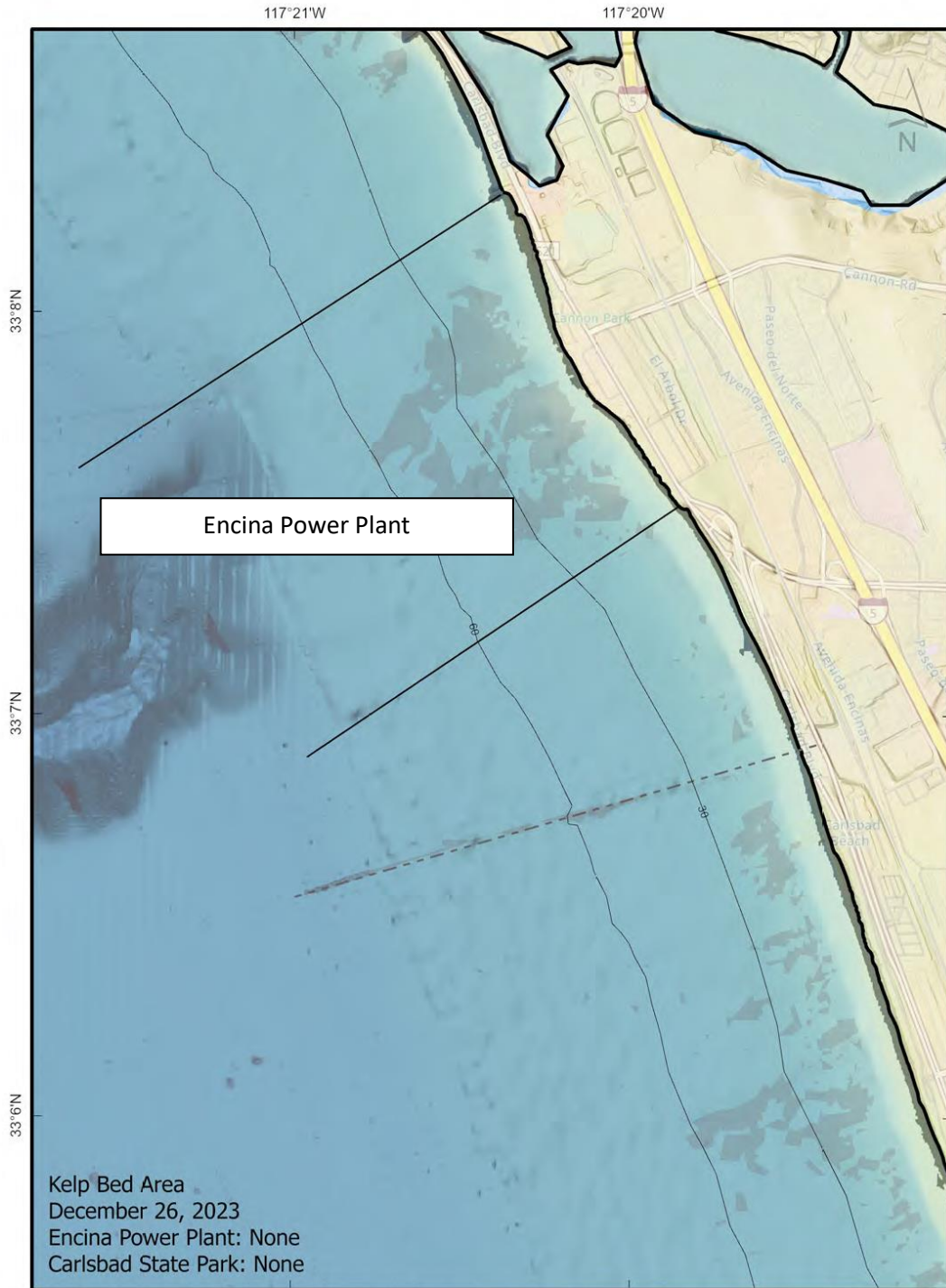
1 Km.

- Kelp
- Hard Substrate
- Isobath
- - - Discharge Structure
- Kelp Bed Divide
- ~ ~ ~ Artificial Reef



Appendix A.26
Encina Power
Plant/ Carlsbad
State Park

18) Encina Power Plant



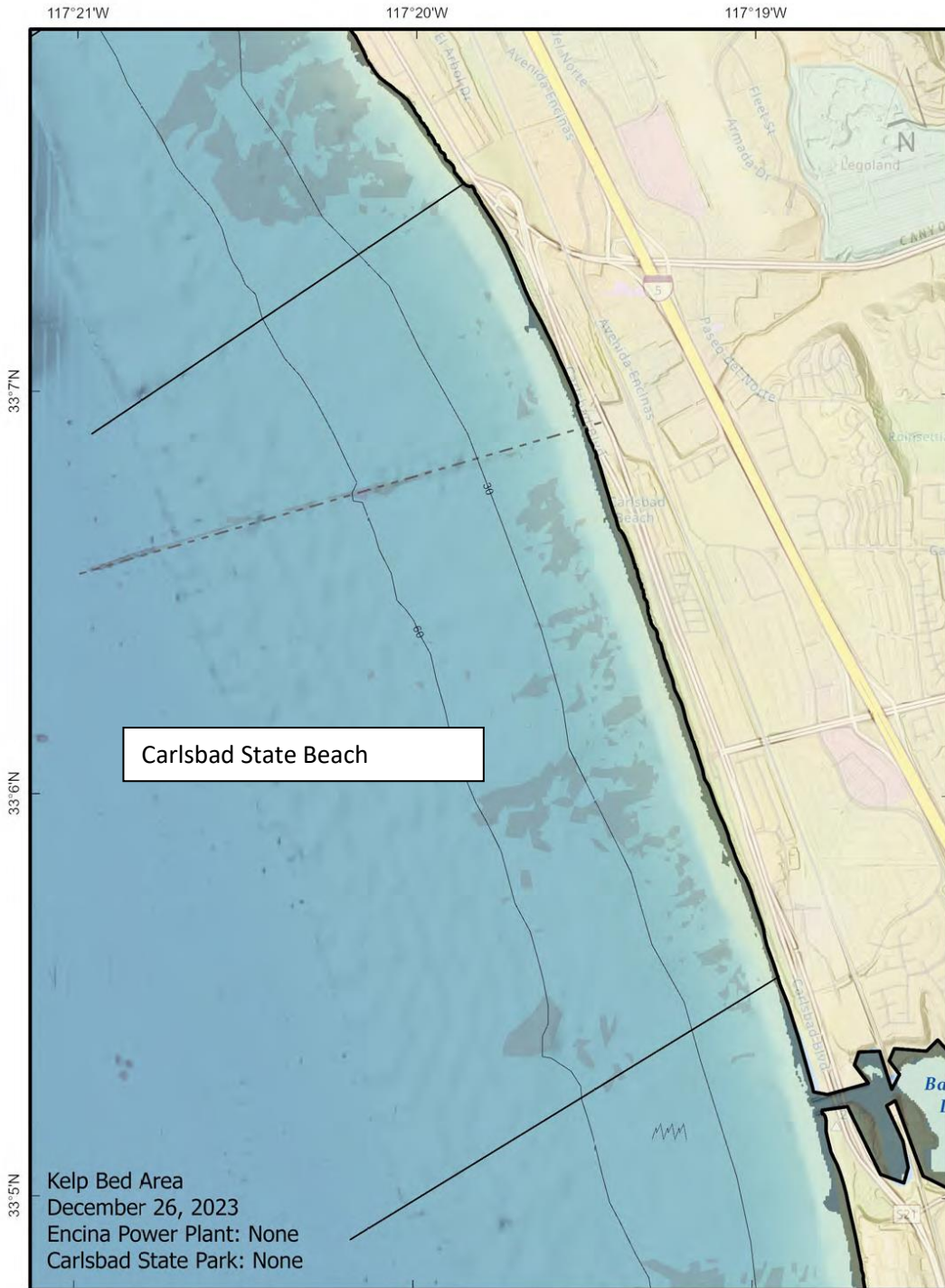
1:24,000
 1 Km. 1 stat. mi. Depth contours in feet

- Kelp
- Isobath
- Kelp Bed Divide
- Artificial Reef
- Hard Substrate
- Discharge Structure



**Appendix A.26
 Encina Power
 Plant/ Carlsbad
 State Park**

19) Carlsbad State Beach



1:24,000

1 stat. mi. 1 Km.

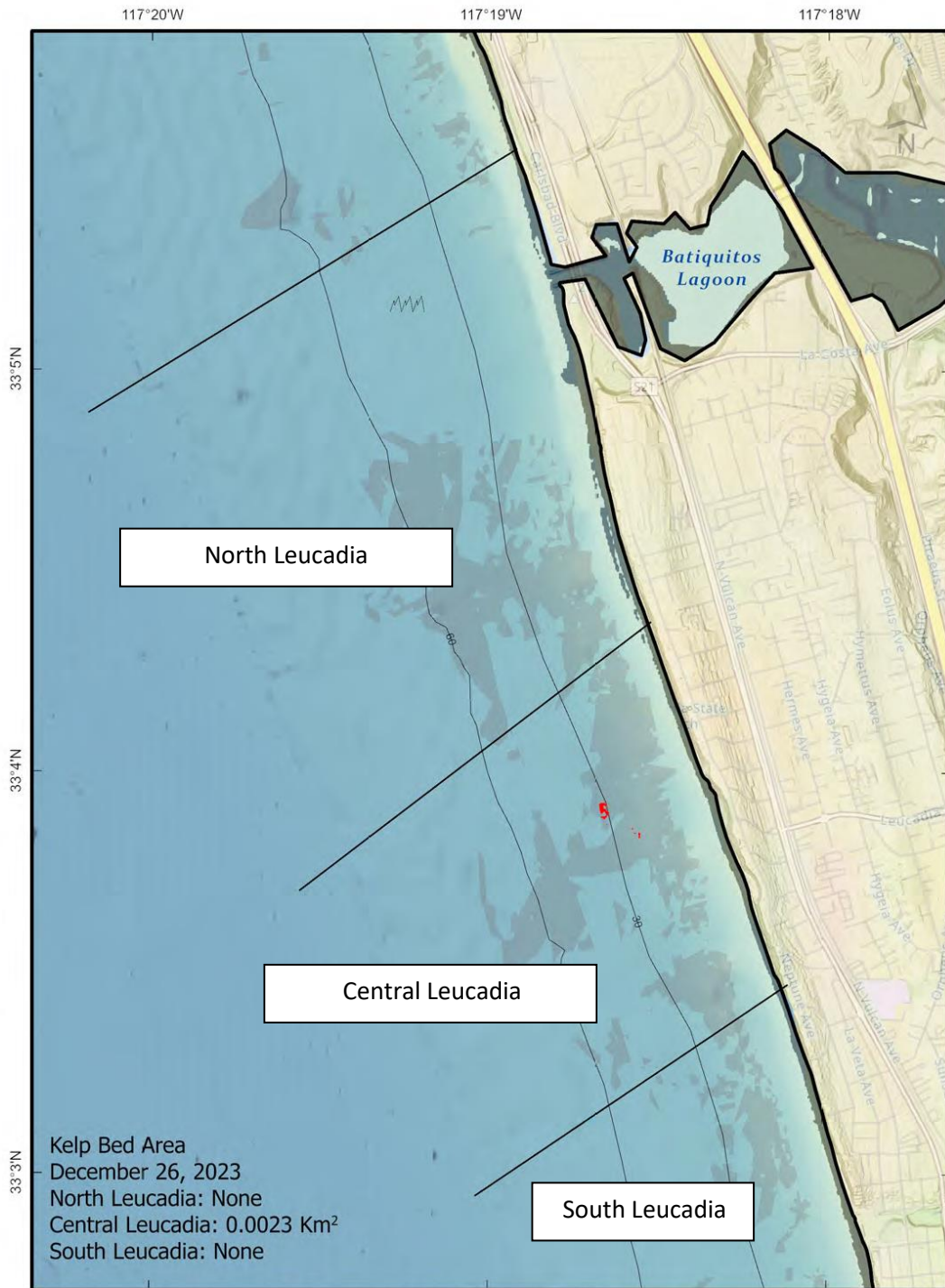
Depth contours in feet

- Kelp
- Isobath
- Kelp Bed Divide
- ⋯ Artificial Reef
- Hard Substrate
- Discharge Structure



Appendix A.27
Encina Power
Plant/ Carlsbad
State Park

20) Leucadia



Kelp Bed Area
 December 26, 2023
 North Leucadia: None
 Central Leucadia: 0.0023 Km²
 South Leucadia: None

1:24,000

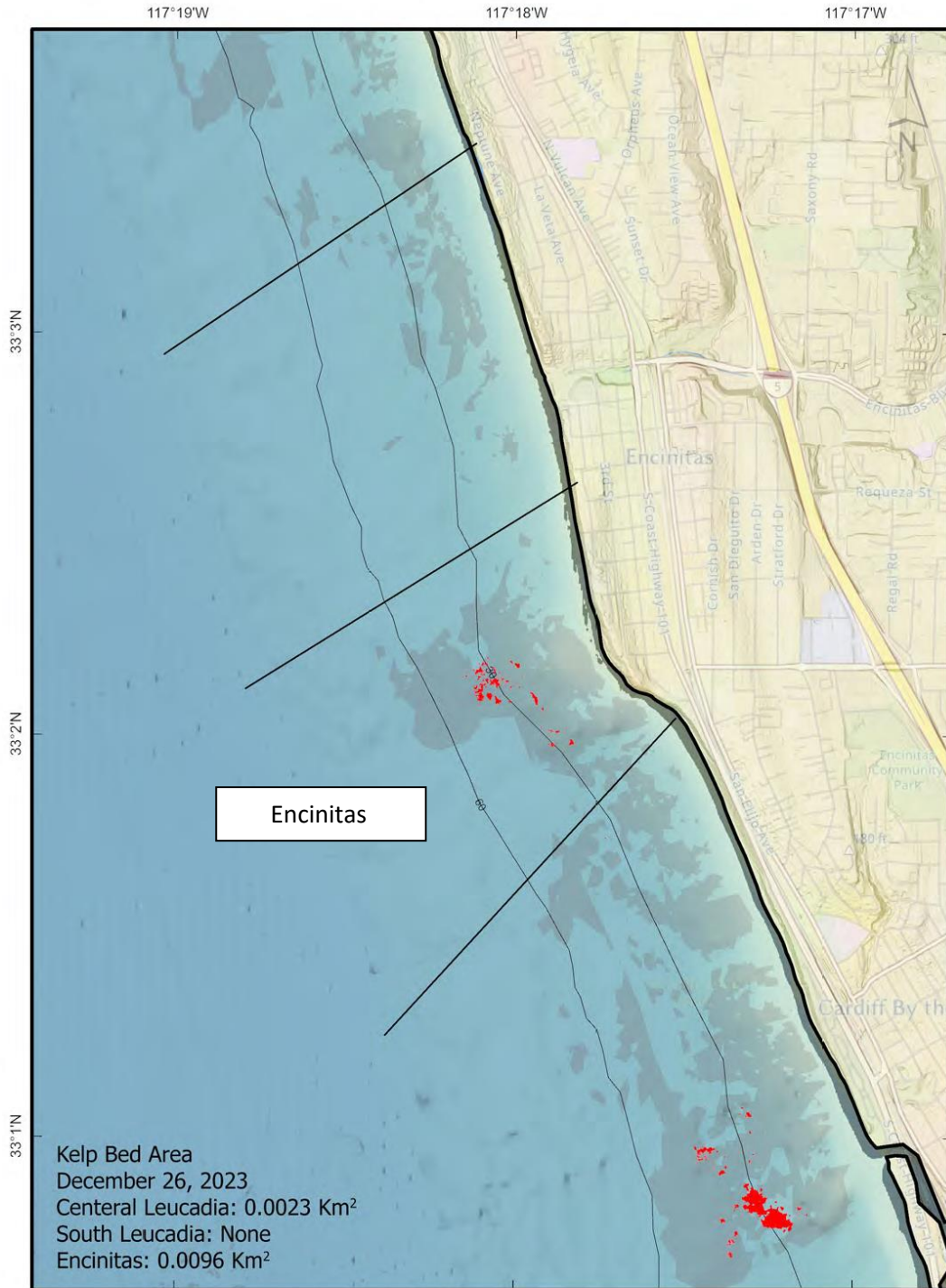
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■ Kelp
 Isobath
 Kelp Bed Divide
 Artificial Reef
 Hard Substrate
 Discharge Structure



**Appendix A.28
 Leucadia (North,
 Central, South)**

21) Encinitas

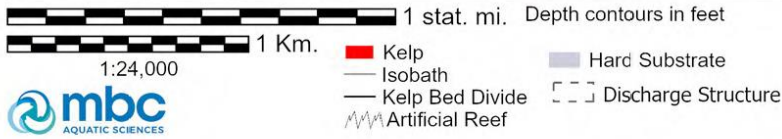
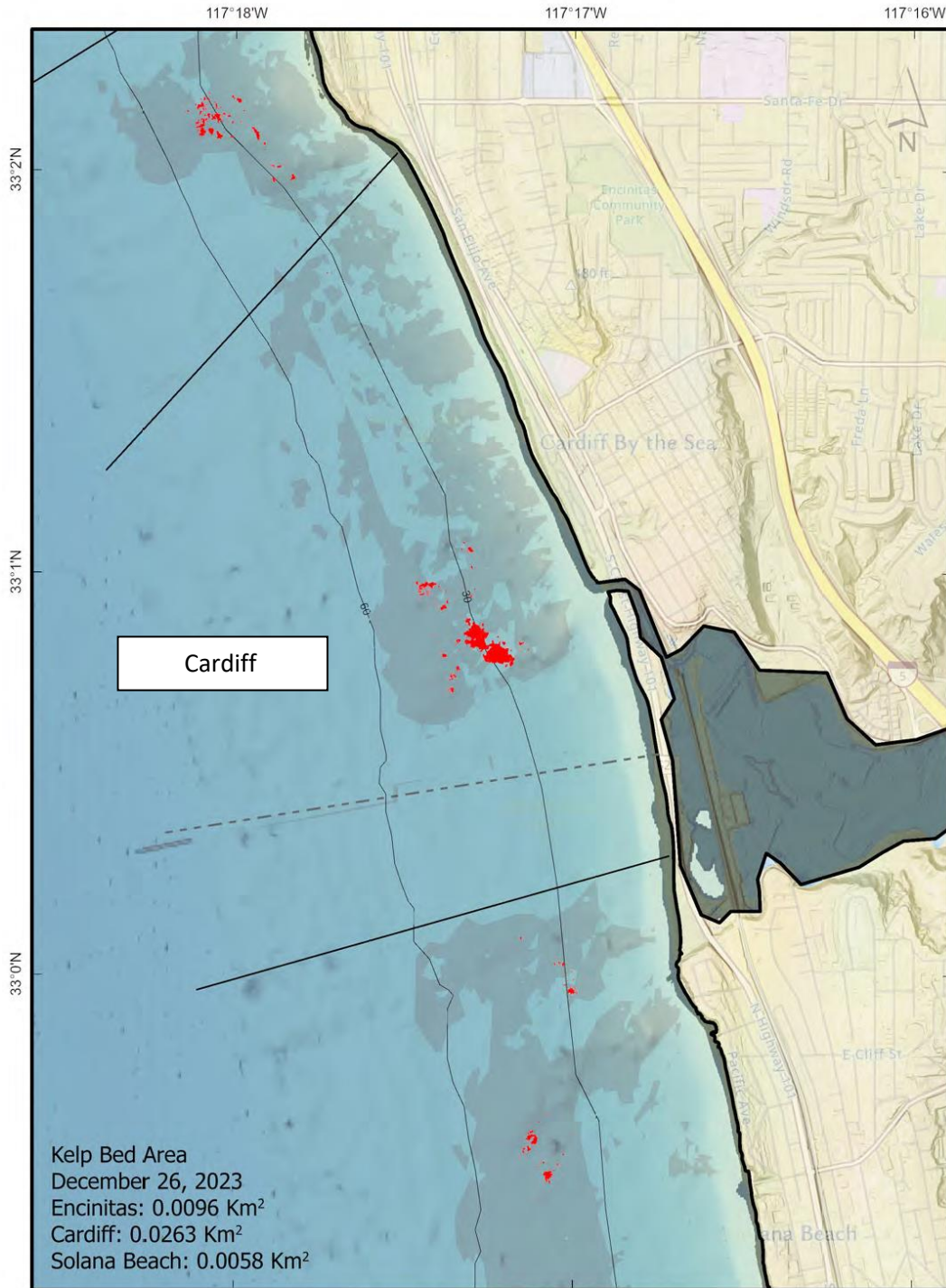


1 stat. mi. Depth contours in feet
 1 Km.
 1:24,000

- Kelp
- Isobath
- Kelp Bed Divide
- Artificial Reef
- Hard Substrate
- Discharge Structure

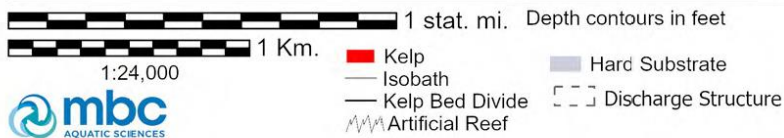
**Appendix A.29
Leucadia (Central and South)/
Encinitas/ Cardiff**

22) Cardiff



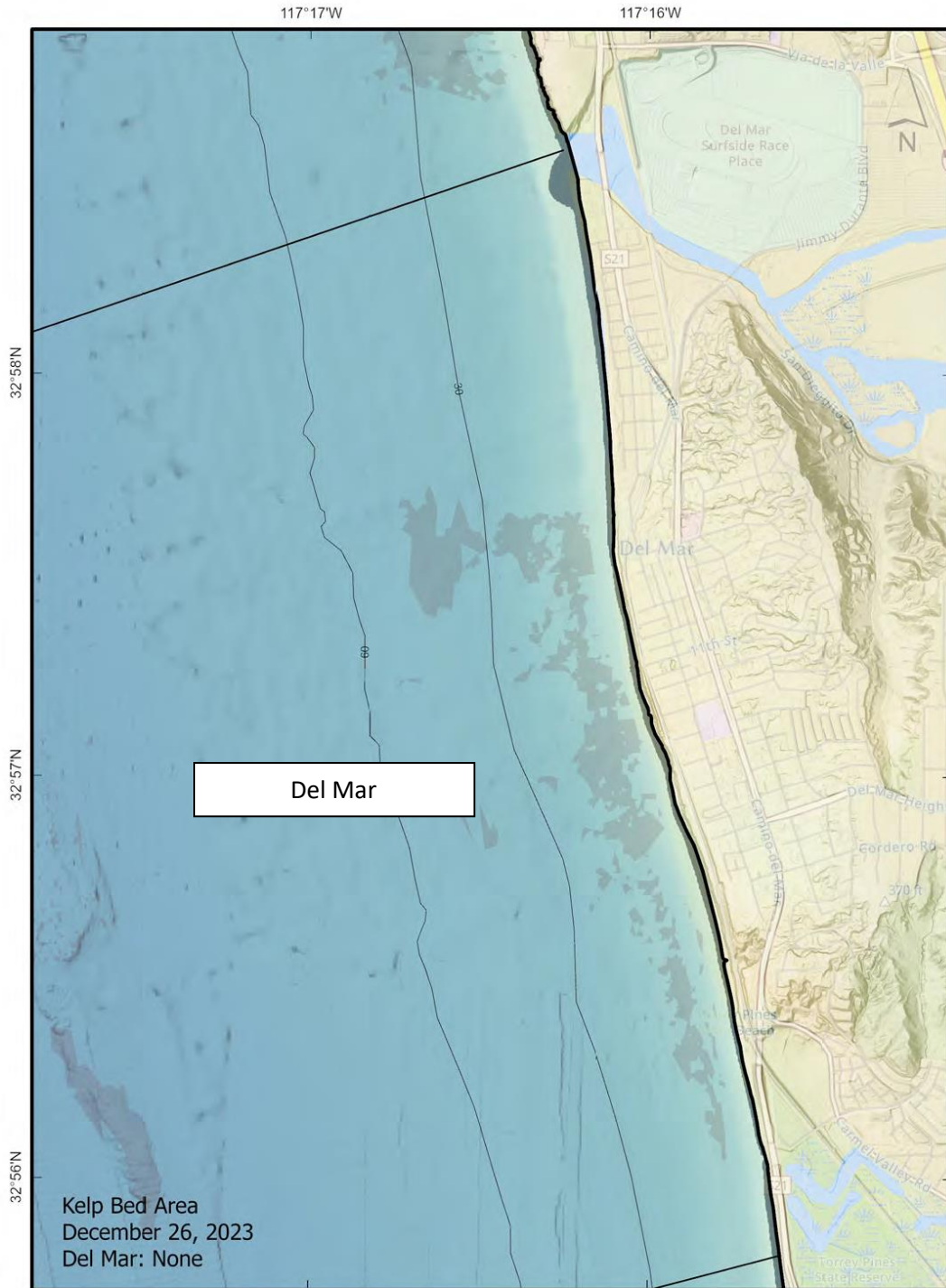
Appendix A.30
Encinitas/ Cardiff/ Solana Beach

23) Solana Beach



**Appendix A.31
Solana Beach**

24) Del Mar



Kelp Bed Area
 December 26, 2023
 Del Mar: None

1:24,000

1 stat. mi. 1 Km.

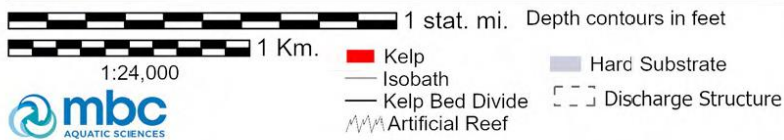
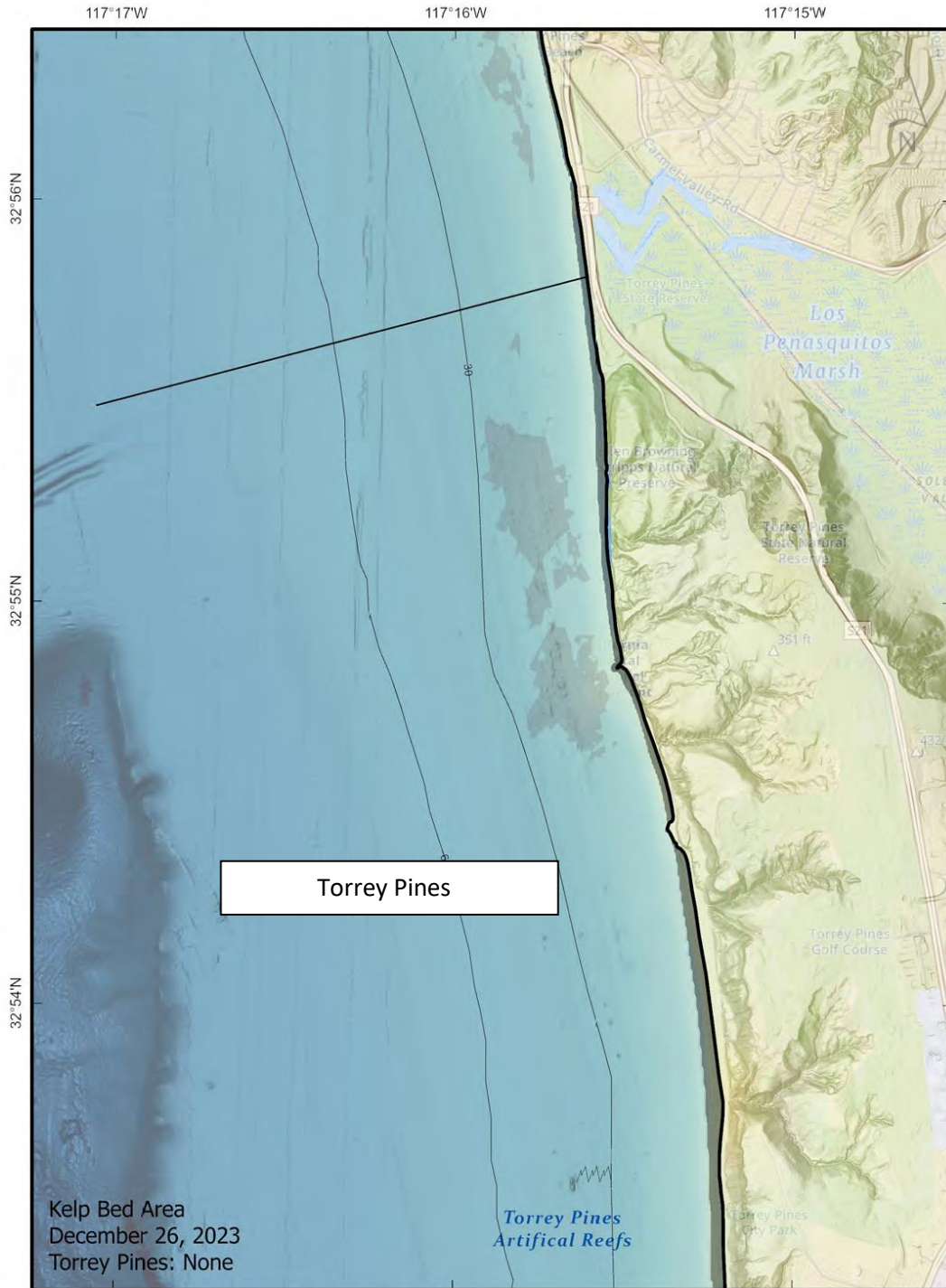
Depth contours in feet

- Kelp
- Hard Substrate
- Isobath
- Discharge Structure
- Kelp Bed Divide
- ~ Artificial Reef

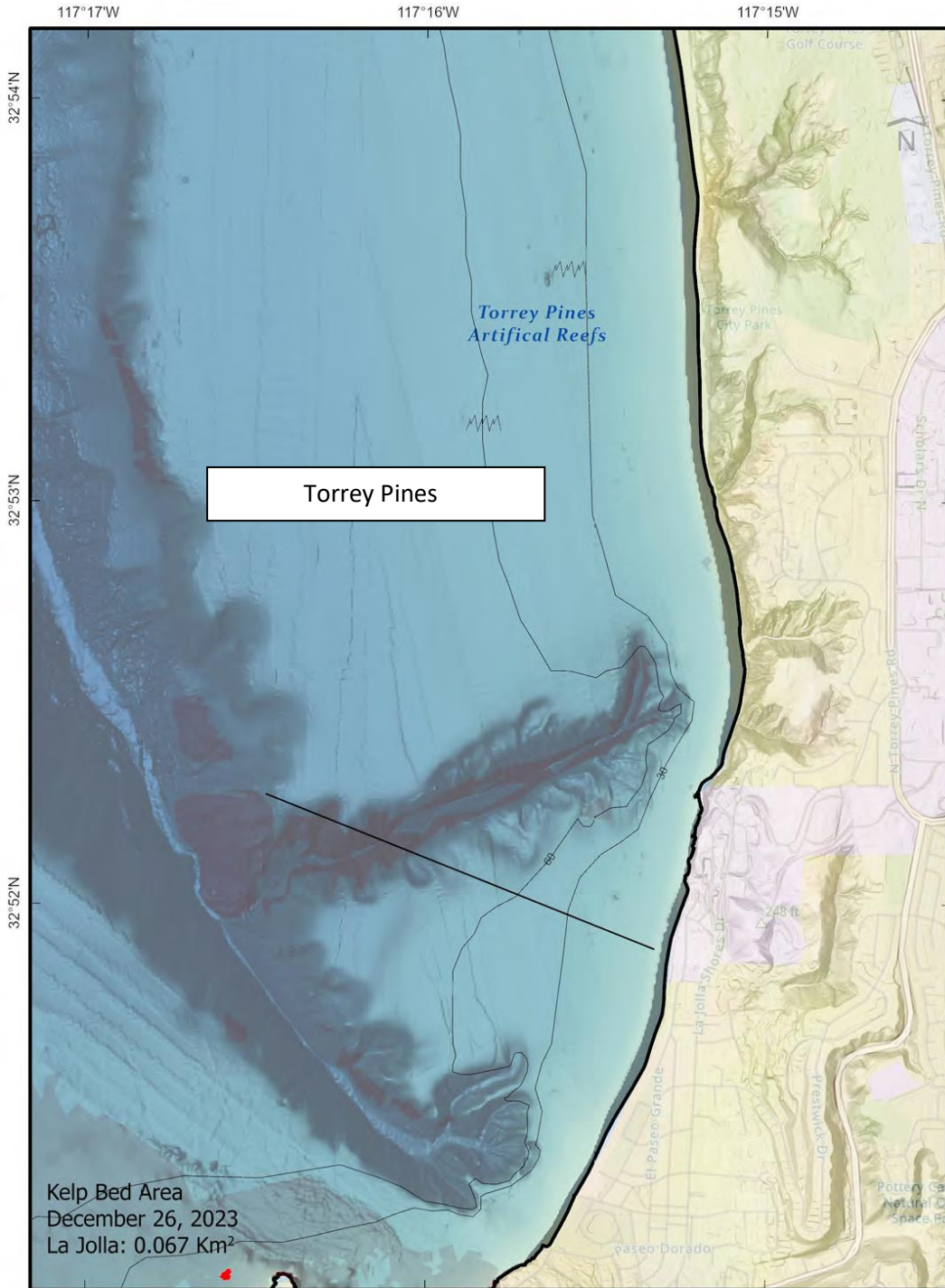


Appendix A.32
Del Mar

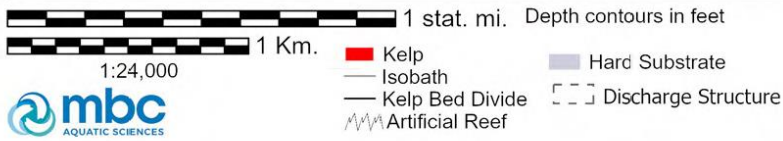
25) Torrey Pines



Appendix A.33
Torrey Pines
(North)

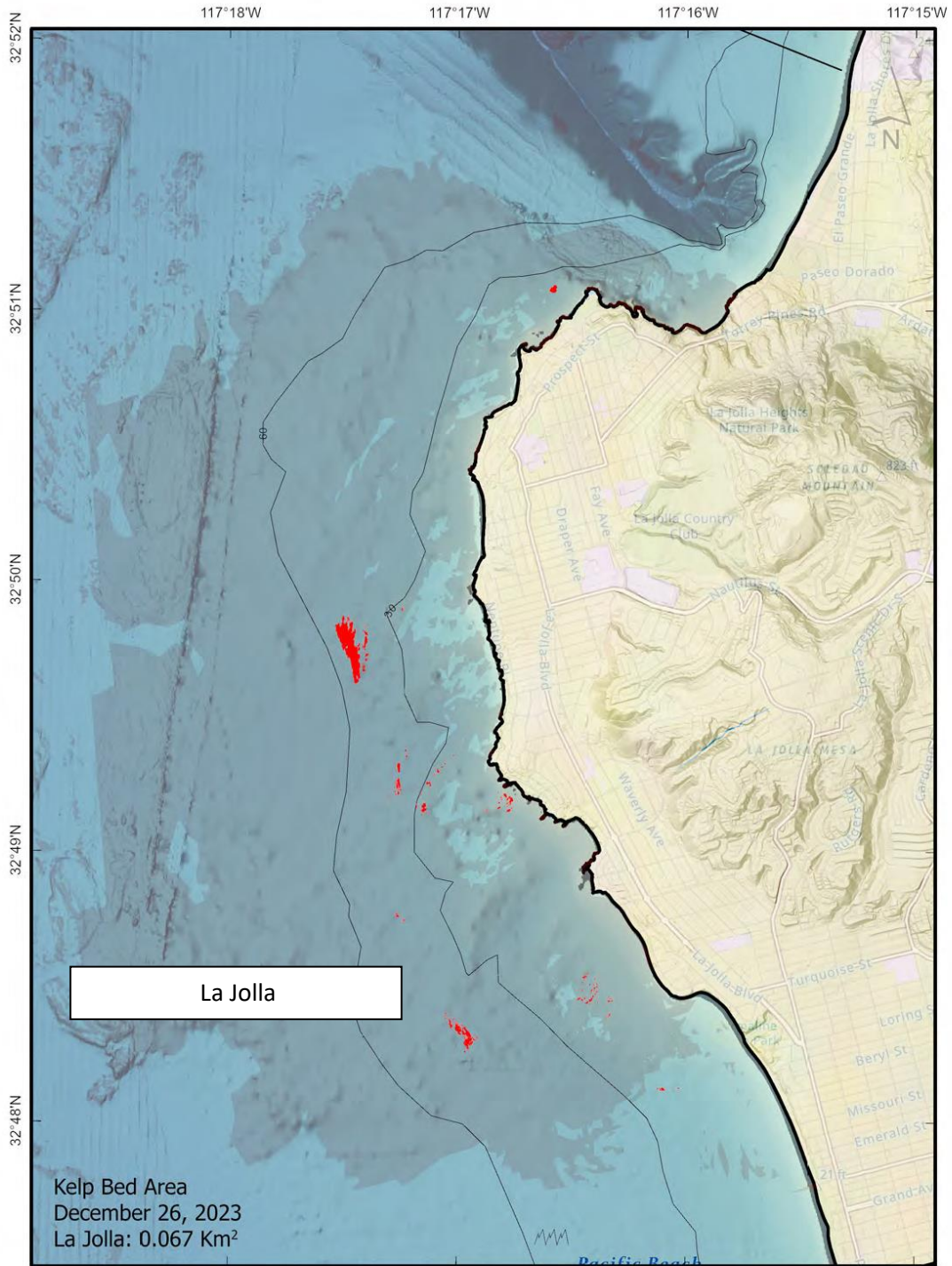


Kelp Bed Area
 December 26, 2023
 La Jolla: 0.067 Km²



Appendix A.34
Torrey Pines Reef
(South)

26) La Jolla



1 stat. mi.

1 Km.

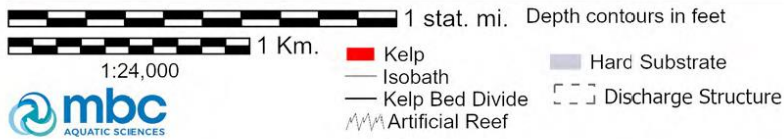
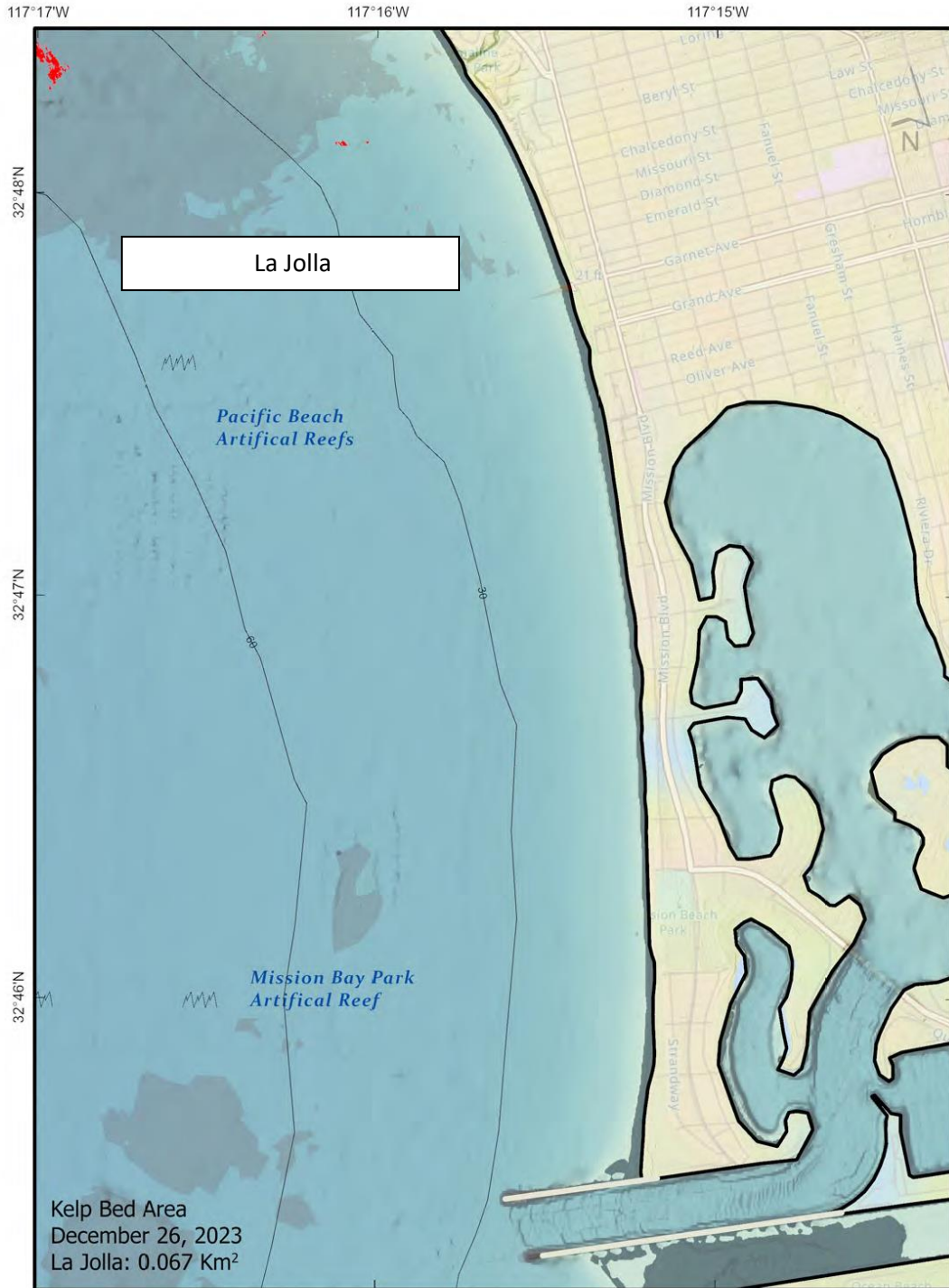
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Depth contours in feet

- Kelp
- Isobath
- Kelp Bed Divide
- ⋯ Artificial Reef
- Hard Substrate
- Discharge Structure

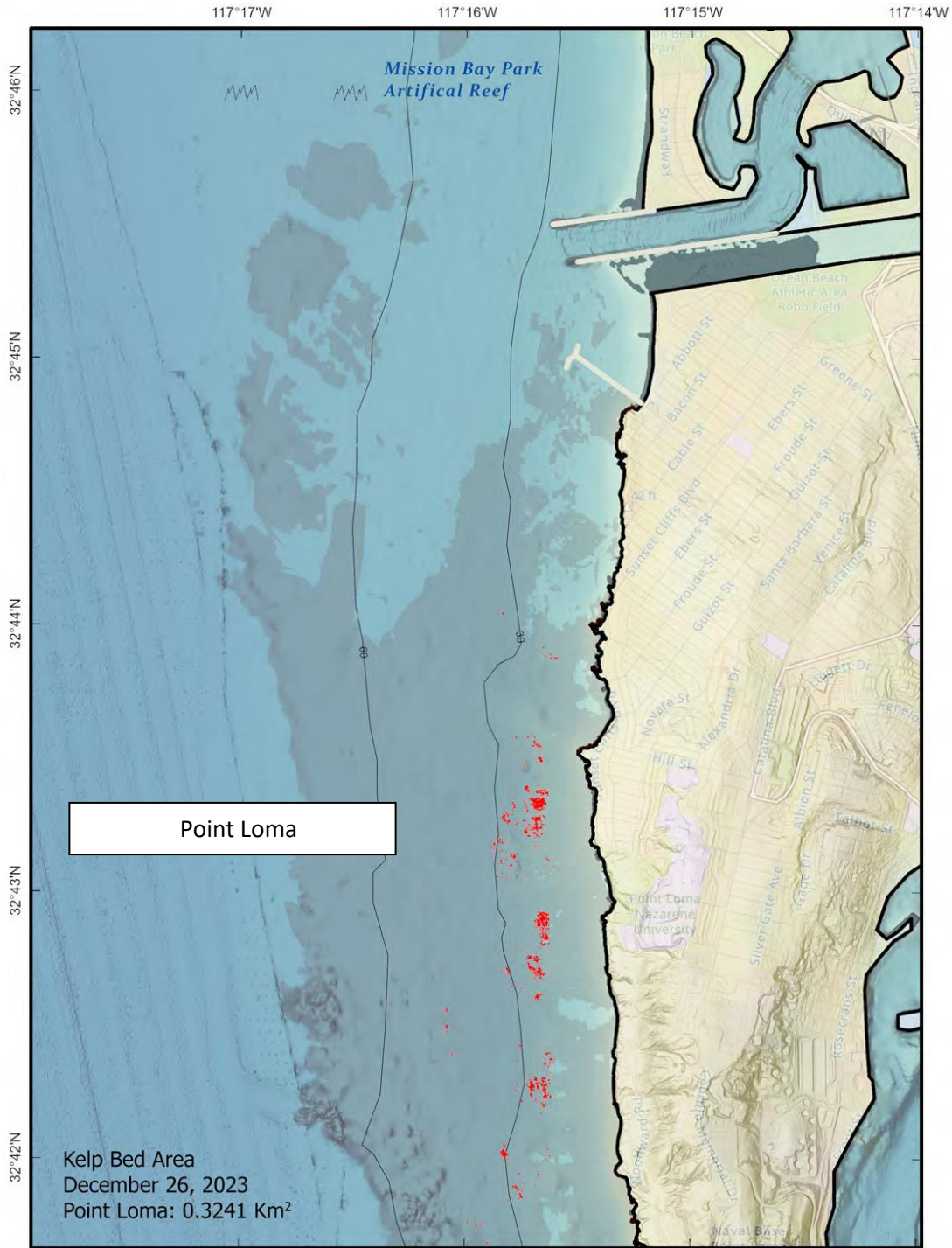
Appendix A.35
La Jolla



Appendix A.36
La Jolla/ Mission Bay

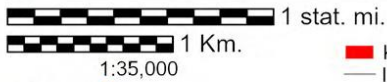


27) Point Loma



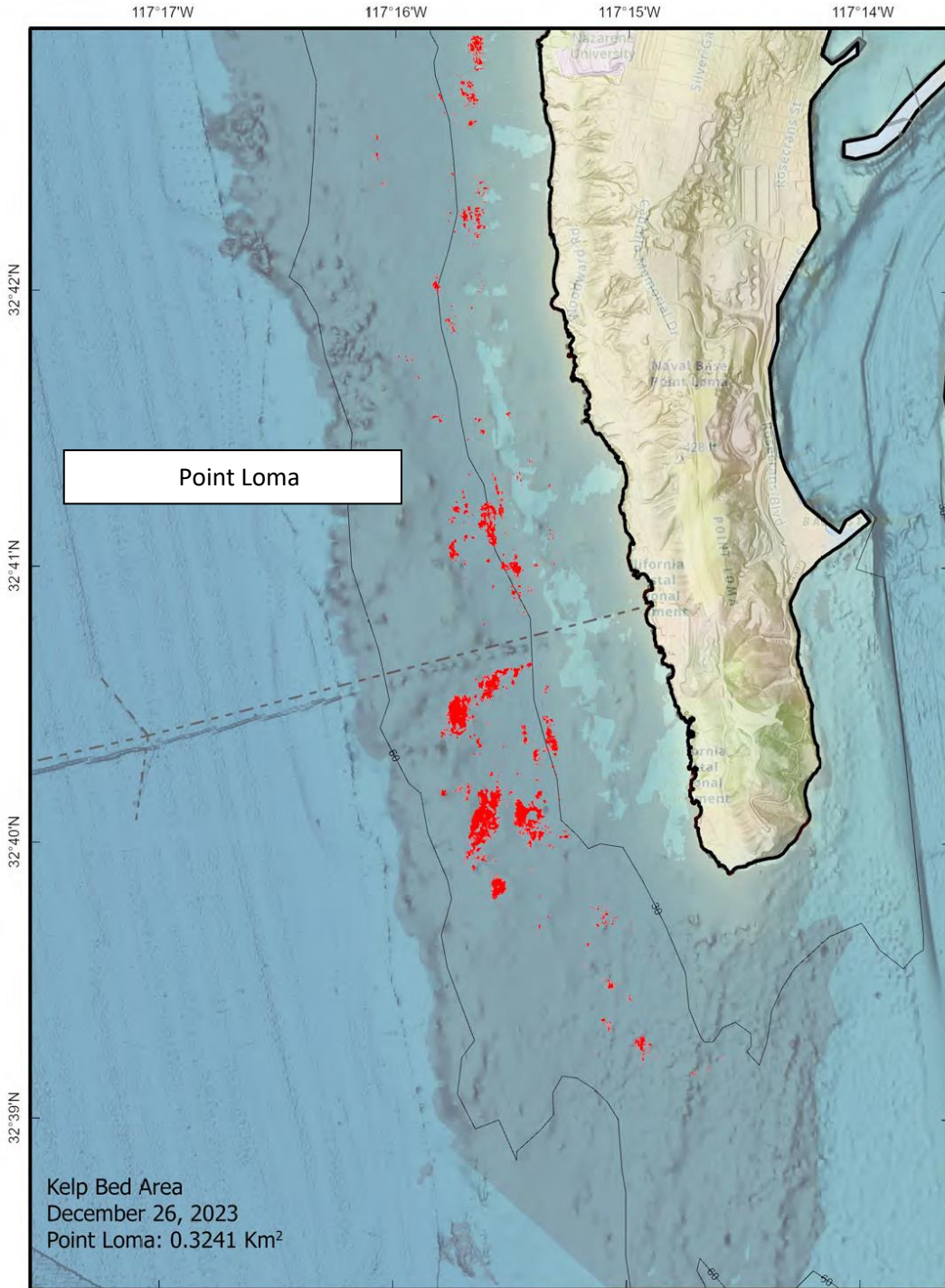
Point Loma

Kelp Bed Area
 December 26, 2023
 Point Loma: 0.3241 Km²



- Kelp
- Isobath
- Kelp Bed Divide
- Artificial Reef
- Hard Substrate
- Discharge Structure

Appendix A.37
Point Loma (Sunset Cliffs)



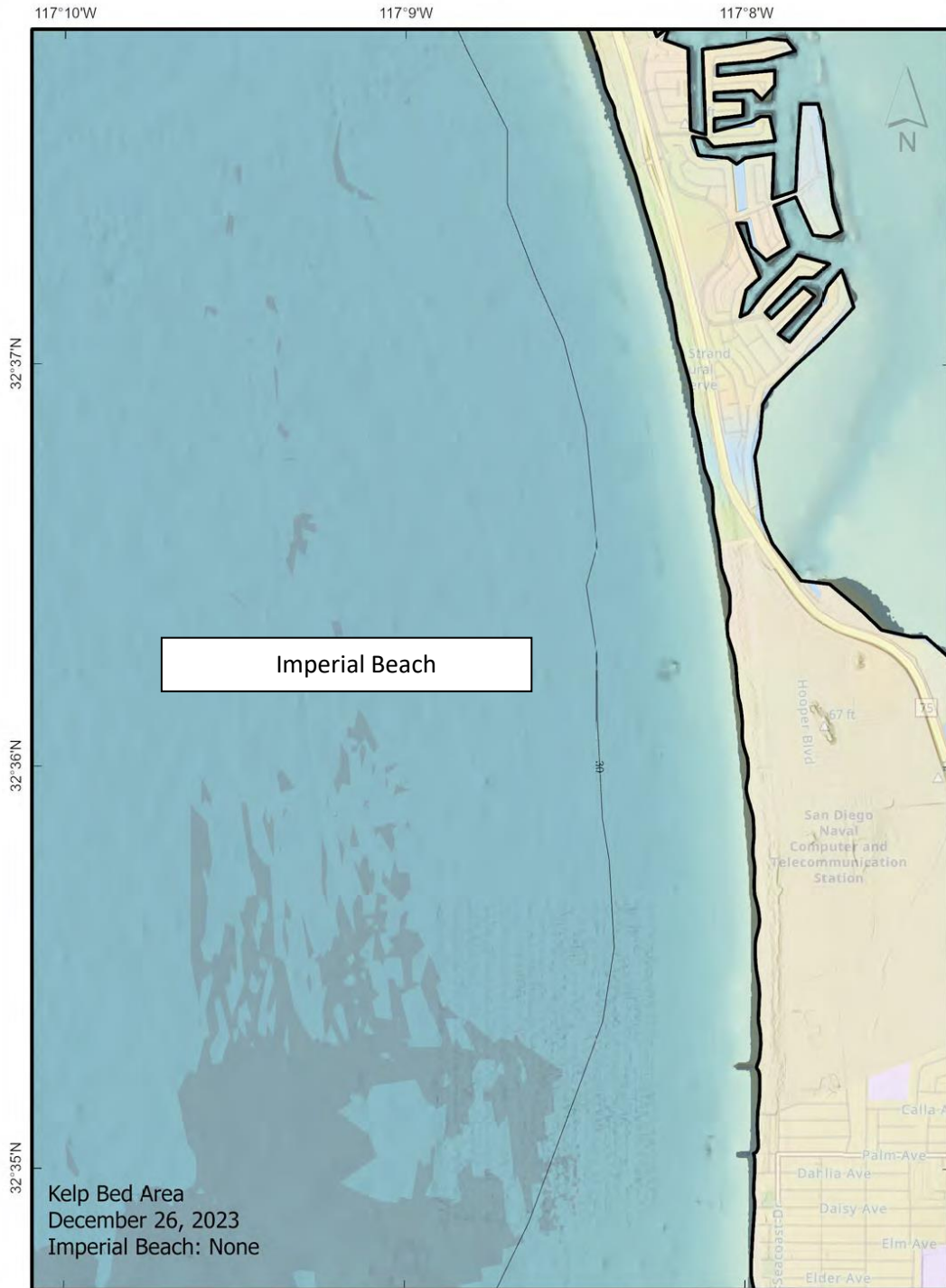
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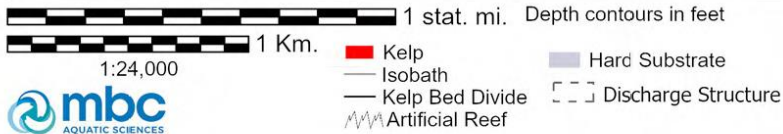
- Kelp
- Isobath
- Kelp Bed Divide
- ⋈ Artificial Reef
- Hard Substrate
- Discharge Structure

Appendix A.38
Point Loma (end of peninsula)

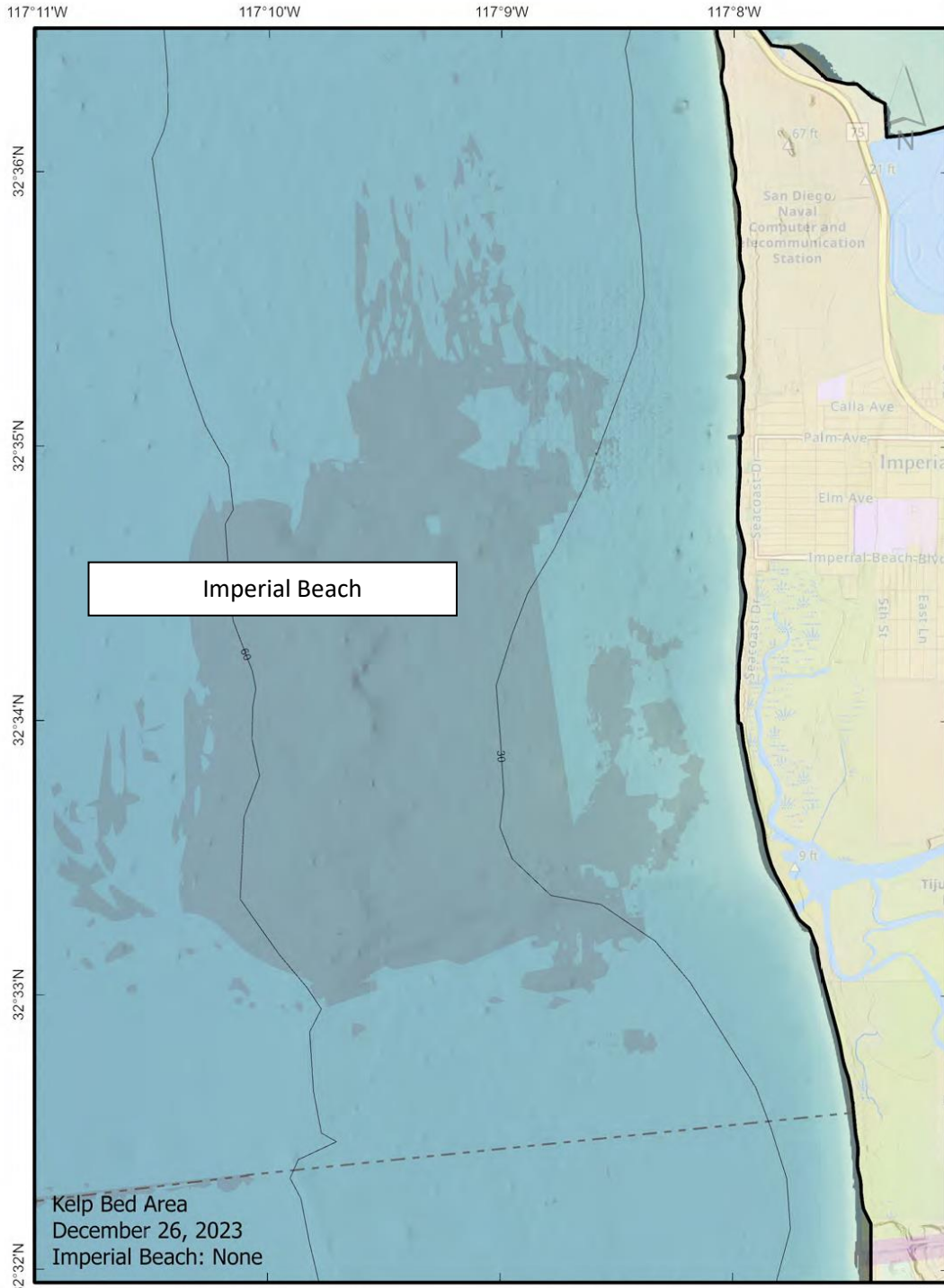
28) Imperial Beach



Kelp Bed Area
 December 26, 2023
 Imperial Beach: None



**Appendix A.44
 Imperial Beach**



117°11'W

117°10'W

117°9'W

117°8'W

32°36'N

32°35'N

32°34'N

32°33'N

32°32'N

Imperial Beach

Kelp Bed Area
December 26, 2023
Imperial Beach: None

1:35,000
1 Km.



- Kelp
- Isobath
- Kelp Bed Divide
- Artificial Reef
- Hard Substrate
- Discharge Structure

Depth contours in feet

**Appendix A.45
Imperial Beach**

