ESSENTIAL FISH HABITAT ASSESSMENT

BETA UNIT GEOPHYSICAL SURVEY OFFSHORE HUNTINGTON BEACH, CALIFORNIA

Project No. 1602-1681

Prepared for:

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

In support of a permit application to National Marine Fisheries Service (NMFS), and to satisfy the requirements of Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act, the following assessment of potential impacts to Essential Fish Habitat (EFH) has been prepared. This EFH assessment is for the Beta Operating Company, LLC (Beta) Unit Offshore Geophysical Survey Project (Project). This assessment is prepared in accordance with 50 Code of Federal Regulations (CFR) 600.920(g)(2) and addresses the managed fish and invertebrate taxa that could occur at the Project site.

EFH is defined as "…those waters and substrate necessary for fish spawning, breeding, feeding, or growth to maturity." "Waters," as used in this definition, are defined to include "aquatic areas and their associated physical, chemical, and biological properties that are used by fish." These may include "…areas historically used by fish where appropriate; 'substrate' to include sediment, hard bottom, structures underlying the waters, and associated biological communities." "Necessary" means, "the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem." EFH is described as a subset of all habitats occupied by a species (NOAA, 1998). The Pacific Fishery Management Council (PFMC) is responsible for managing certain groundfish, coastal pelagic species, highly migratory species, and salmon from 3 to 200 miles (5 to 322 kilometer) offshore of Washington, Oregon, and California. As amended in 1986, the Magnuson-Stevens Act requires PFMC to evaluate the effects of habitat loss or degradation on their fishery stocks and take actions to mitigate such damage.

1.1 PROPOSED ACTION

Beta proposes to conduct a geophysical survey of the Beta Unit located within Federal outer continental shelf (OCS) waters located approximately eight miles offshore Huntington Beach, California (Figure 1-1). The objective of the Beta Unit Geophysical Survey is to provide subsurface imaging of the oil productive formations which lie 3,000 to 5,000 feet (914 to 1,524 meters) below the seafloor within the Beta Unit field. The enhanced imaging of the subsurface geology will enable more efficient recovery of the remaining natural resources within the field. The survey will be used to map the subsurface geology to locate remaining resources thereby reducing the number of wells required to recover the resource.

The survey is planned to be conducted in Fall 2018, a time when the population of migratory marine mammals in the area is at a minimum. All appropriate mitigation measures will be taken to prevent impacts to marine resources, commerce, and recreational activity during the two weeks of equipment deployment and recovery and the three to four weeks of the survey. The people of the United States (U.S.) will benefit from increased royalty and tax revenue as a result of enhancing the recovery of the natural resources on Federal submerged lands.

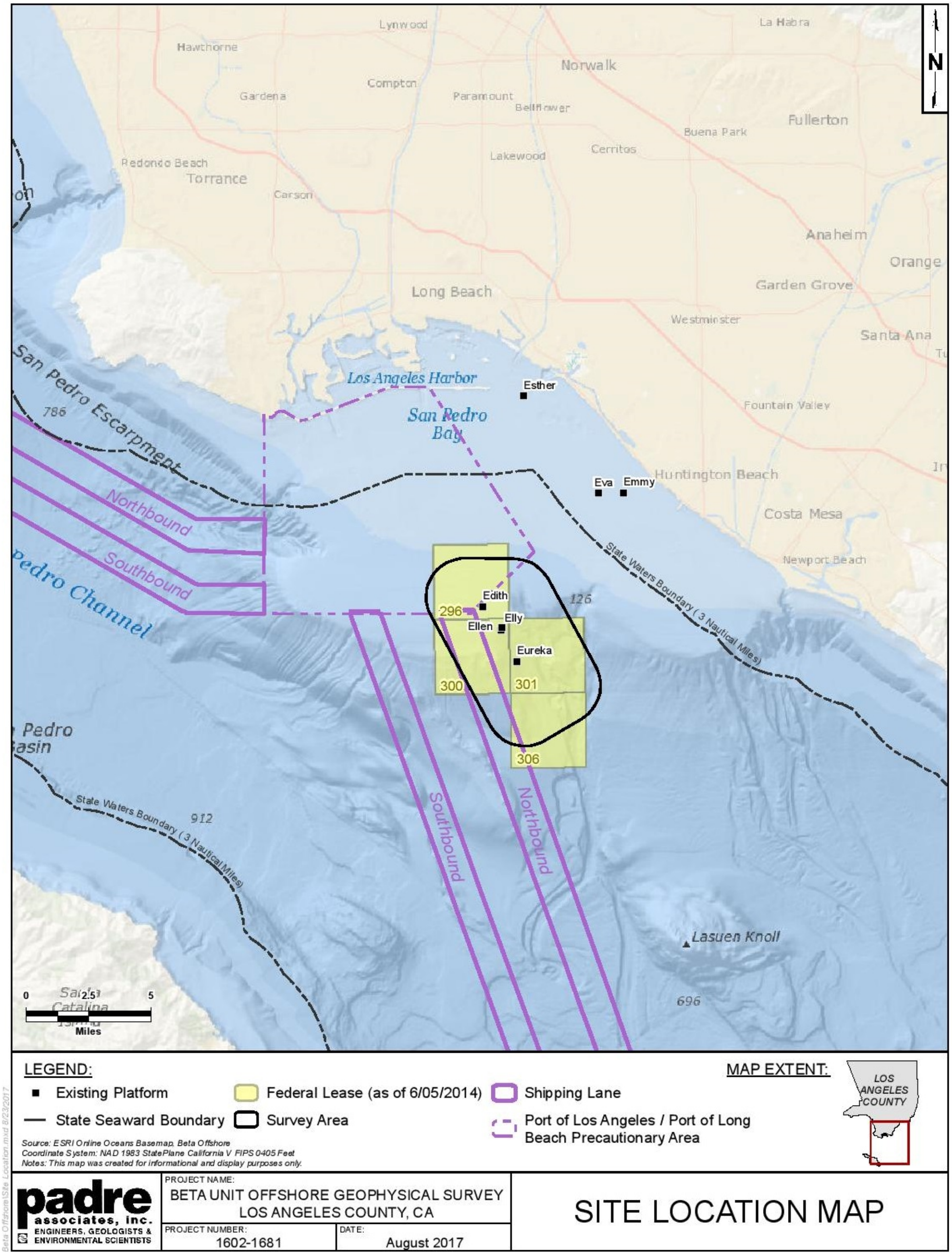

Figure 1-1. Site Location Map

1.1 PROPOSED GEOPHYSICAL SURVEY AREA

The geophysical survey area (Project area) is located approximately eight miles offshore Huntington Beach, California. Coordinates of the offshore survey area are provided in Table 1-1. The size of the survey area is approximately 18.885 square miles (48.91 square kilometers) in a North Northwest (NNW) to South Southeast (SSE) direction (Figure 1-2). Approximately 17 track lines per directional change are anticipated (approximately 68 survey loops). Water depths in the survey area range from 148 to 1,083 feet (45 to 330 meters).

A subsurface geophysical survey utilizing one source array (including 3 sub-arrays) and autonomous nodes (nodes) temporarily deployed on the seafloor is proposed to reach an estimated imaging depth of 2,500 to 5,000 feet (762 to 1,524 meters) below the seafloor in the Pliocene and Miocene aged formations, as shown in Table 1-2. The use of nodes accommodates the challenges faced when conducting a survey in the area beneath Platforms Eureka, Edith, and Ellen/Elly; and in close proximity to established shipping lanes located approximately 9,400 feet (2,850 meters) from the Beta Unit Field.

Table 1-1. Coordinates of Offshore Survey Area

Corner of Survey Area	Coordinates	
	Latitude	Longitude
Southwest	33°32'13.74"N	118°6'43.91"W
Northeast	33°36’5.55"N	118°9’13.97"W
Northwest	33°36’4.76"N	118°7”11.44"W
Southeast	33°33’0.15"N	118°5’10.89"W

Table 1-2. Geological and Geophysical Model Depths

Unit Name	Depth (feet)	Depth (meters)
Surface	0	0
Seabed	148 - 1,083	45 - 330
Miocene A sands	2,650 - 3,700	808 - 1,128
Miocene C sands	2,900 - 4,500	884 - 1,372
Miocene D sands	3,000 - 4,900	914 - 1,494
Miocene F sands	3,400 - 4,450	1,036 - 1,356

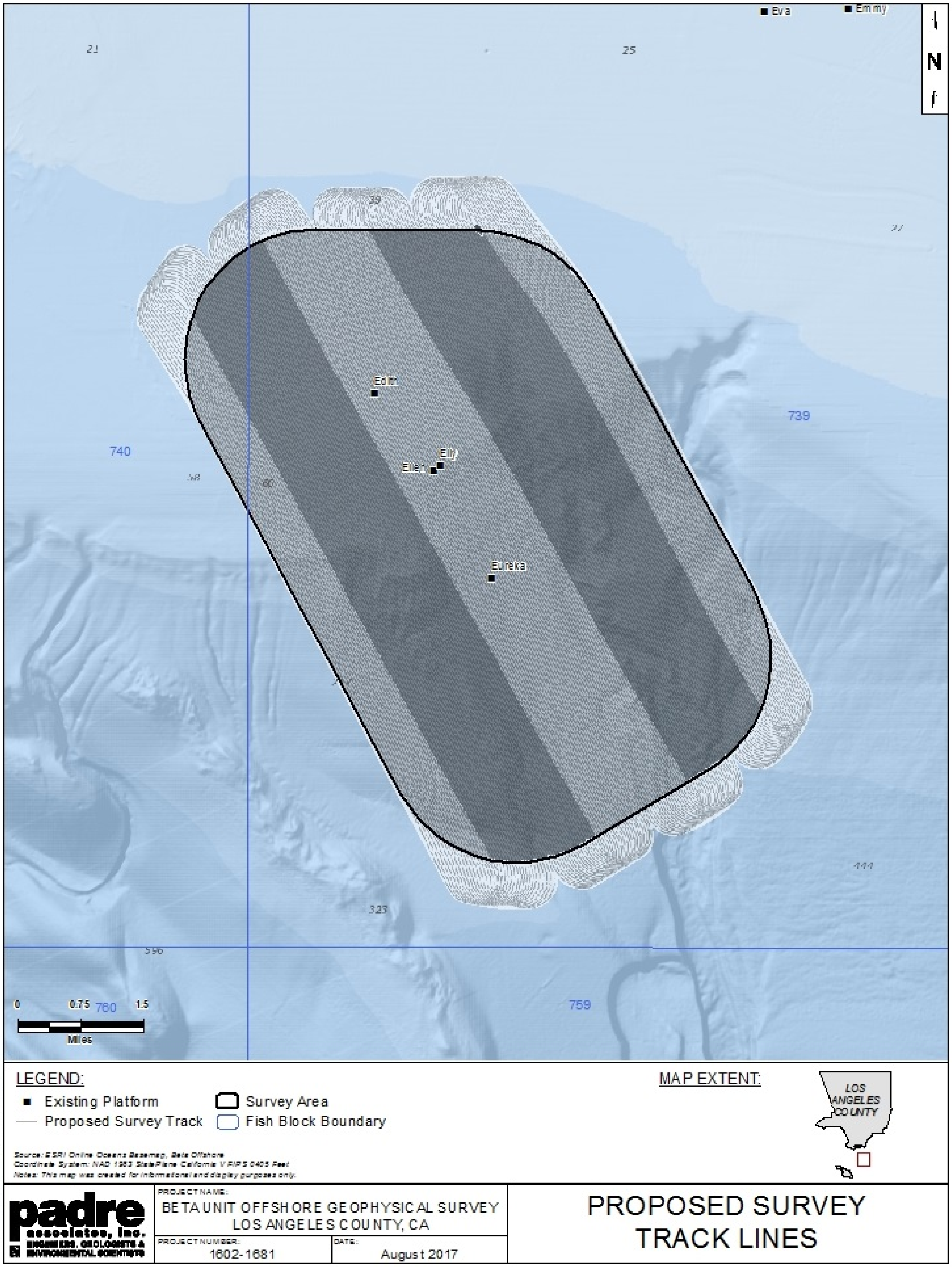

Figure 1-2. Source Vessel Track Map of Beta Unit Proposed Geophysical Survey Area

1.2 PROJECT ACTIVITIES

The proposed scope of work offshore will require operating a node deployment/recovery vessel, geophysical survey vessel, support/monitoring vessels; as well as transit of the vessels between the survey area and nearby harbors (Port of Los Angeles [POLA] / Port of Long Beach [POLB]). The geophysical survey vessel will tow one source array consisting of three sub-arrays along the pre-determined transects shown in Figure 1-2 to acquire geophysical reflection data from the subsurface rock beds within the survey area.

1.2.1 Project Vessel Configuration and Mobilization

The proposed node deployment/recovery vessel is the Marine Vessel (M/V) *Clean Ocean*. The M/V *Clean Ocean* is based out of the POLA/POLB and is an offshore supply vessel that will be configured to support node storage, deployment, and retrieval. It is expected that the M/V *Clean Ocean* will be available to support the 2018 survey activities, however if the M/V *Clean Ocean* is unavailable; an equivalent vessel will be secured.

The proposed geophysical survey vessel has not been selected at this time; however, either a locally available work vessel utilizing containerized equipment (e.g. M/V *Silver Arrow)* or specialized geophysical survey vessel (e.g. R/V *Marcus G. Langseth)* will be used to conduct the survey. The M/V *Silver Arrow* would function as a containerized commercial vessel outfitted on behalf of the proposed survey activities. The R/V *Marcus G. Langseth* is a research vessel that is operated by Columbia University's Lamont-Doherty Earth Observatory's Office of Marine Operations (OMO) and can be utilized if available for commercial use. It is expected that one of these vessels would be available to support the 2018 survey activities, however if they are unavailable; an equivalent vessel will be secured. For the purposes of the enclosed analysis, the equipment aboard the M/V *Silver Arrow* is referenced as a likely case scenario, but an alternative vessel would have similar equipment and equivalent (or better) effects. The M/V *Silver Arrow* would be mobilized from Seattle, Washington to Southern California POLA/POLB and Beta Unit offshore Project area. Upon completion of the offshore survey operations, the vessel would return to the POLA/POLB to be outfitted for its next work location.

The M/V *Jab* or equivalent will also provide support during the proposed geophysical survey for operations coordination and vessel preclusion activities. The M/V *Jab* will also be based out of the POLA/POLB during the proposed Project activities.

1.2.2 Offshore Survey Operations

The following sections outline the general equipment specifications and methodology proposed to complete the offshore geophysical survey. Figure 1-3 shows an illustration of the survey technique.

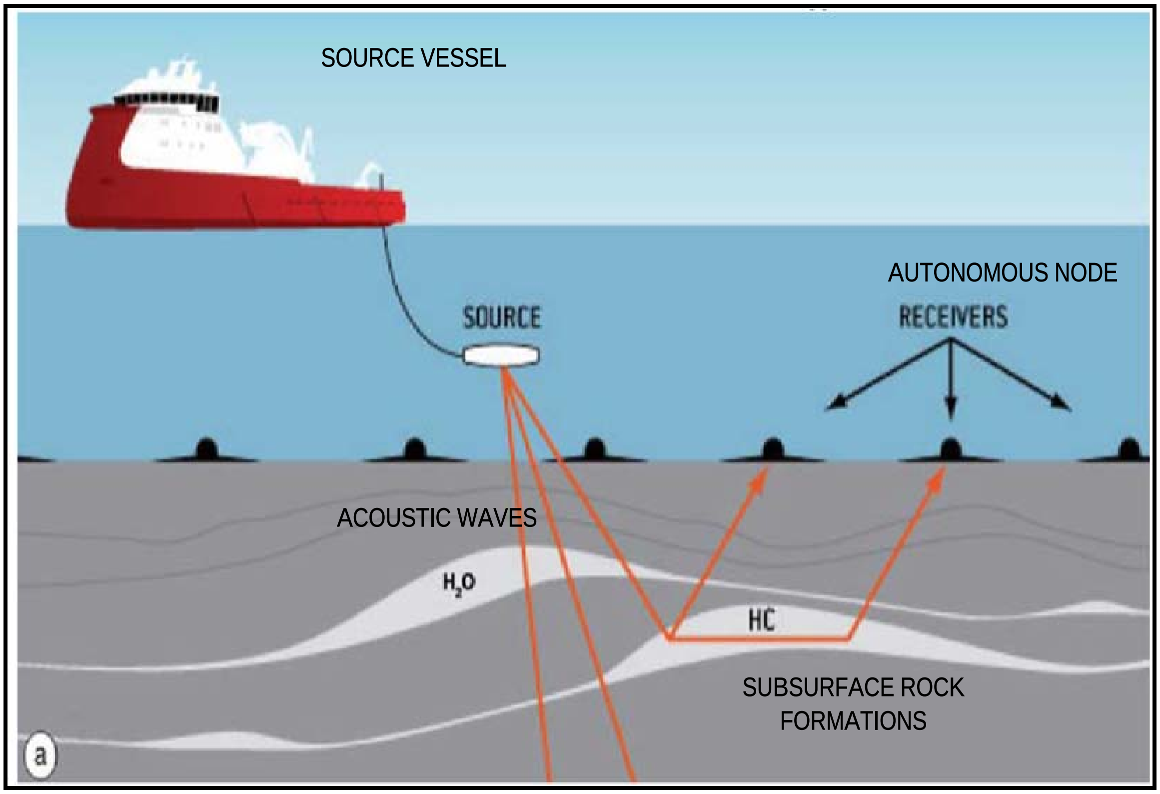

Figure 1-3. Illustration of the Nodal Marine Geophysical Subsurface Survey

1.2.2.1 Vessel Specifications and Methodology

Node Deployment/Retrieval. The M/V *Clean Ocean*, or similar vessel, will be used to deploy and retrieve the ocean bottom nodes. The M/V *Clean Ocean* is a dynamically positioned vessel suitable for working near fixed structures and in deep water, where anchoring is not feasible. The ship meets all current EPA and CARB emission specifications, powered by two, Tier 3 Cummings QSK-19 engines with 1,500 horsepower. It has a length of 155 feet (47.24 meters), a beam of 36 feet (10.97 meters), and a maximum draft of 9.9 feet (3.0 meters). The vessel also has an 18-ton crane. The M/V *Clean Ocean* (Figure 1-4) will be configured and outfitted for the proposed Project in support of node deployment/retrieval activities as further described in Section 1.5.3.3 (Autonomous Nodes) below.

Source Vessel Operations. The M/V *Silver Arrow* (Figure 1-5), or similar vessel, will tow the source array along predetermined survey transects. The M/V *Silver Arrow* is a DP2 ship, has a length of 240 feet (73.2 meters), a beam of 54 feet (16.5 meters), and a maximum draft of 14.10 feet (4.52 meters). The M/V *Silver Arrow* is an offshore supply vessel that will be configured in support of the proposed activities. The ship is powered by two Caterpillar 3516C main diesel engines, each producing 4,000 horsepower, which drive the 4-blade propellers directly. The vessel also has three Caterpillar C18 primary generators. The operation speed during geophysical data acquisition is typically 4.5 knots (8.3 kilometers per hour). When not towing geophysical survey gear, the M/V *Silver Arrow* typically cruises at 10.0 knots (18.5

kilometers per hour). When the M/V *Silver Arrow* is towing the source array, the vessel would "fly" the appropriate United States Coast Guard (USCG) approved day shapes (mast head signals used to communicate with other vessels) and display the appropriate lighting to designate the vessel has limited maneuverability.

Figure 1-4. M/V Clean Ocean Node Deployment/Retrieval Vessel

Figure 1-5. M/V Silver Arrow Survey Vessel

The geophysical support vessel M/V *Jab* has a length of 43 feet (13.10 meters), a beam of 15.5 feet (4.72 meters) and a draft of 2.0 feet (0.6 meters). The ship is powered by two Cummins QSC 8.3 500 horsepower engines. It also has two 8-kw generators. It has a top speed of 34 knots (63.0 kilometers per hour). The M/V *Jab* will be utilized in support of the geophysical survey including enforcement of the proposed operational Exclusion Zone.

1.2.2.2 Source Description

The proposed geophysical source array is comprised of 3 sub-arrays with a combined volume of 3,480 cubic inches (57 liters). An example sub-array is shown in Figure 1-6. The sub-arrays would be configured as three identical, linear arrays or “strings” (Figure 1-7). Each string will have eleven active sound sources (and one spare) in six clusters. Each of the clusters is approximately 9.18 feet (2.8 meters) apart. Each of the three sub-arrays would be towed approximately 328 to 492 feet (100 to 150 meters) behind the vessel and separated from each other by approximately 23 feet (seven meters). Depth ropes from source floats would be used to keep the sound source at a depth of 23 feet (seven meters). The vessel speed during data collection would range from 4 to 5 knots (7.4 to 9.3 kilometers per hour). Depths are monitored by depth sensors mounted on the arrays and horizontal positions are monitored using surface GPS relative to the vessel. The expected timing of the shots is once approximately every seven seconds, and/or approximately every 82.02 feet (25 meters) based on an assumed boat speed of 4.5 knots (8.3 kilometers per hour).

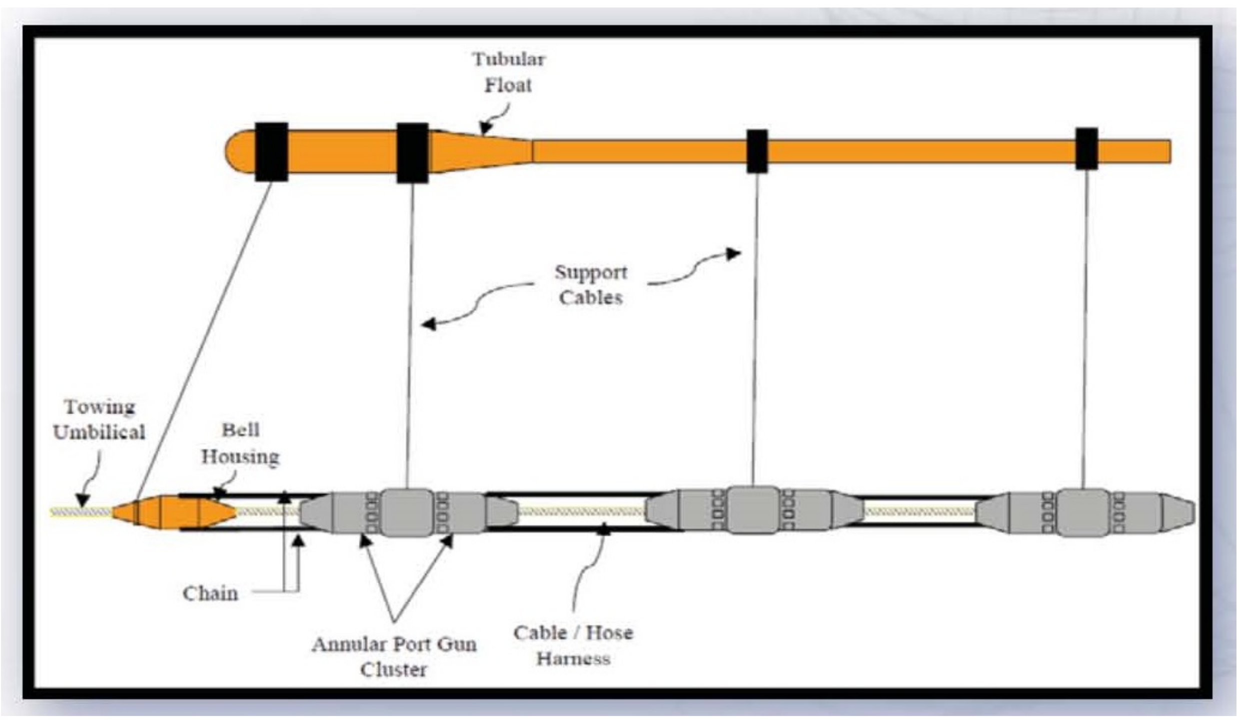

Figure 1-6. APG Sub-Array Sound Source (Example)

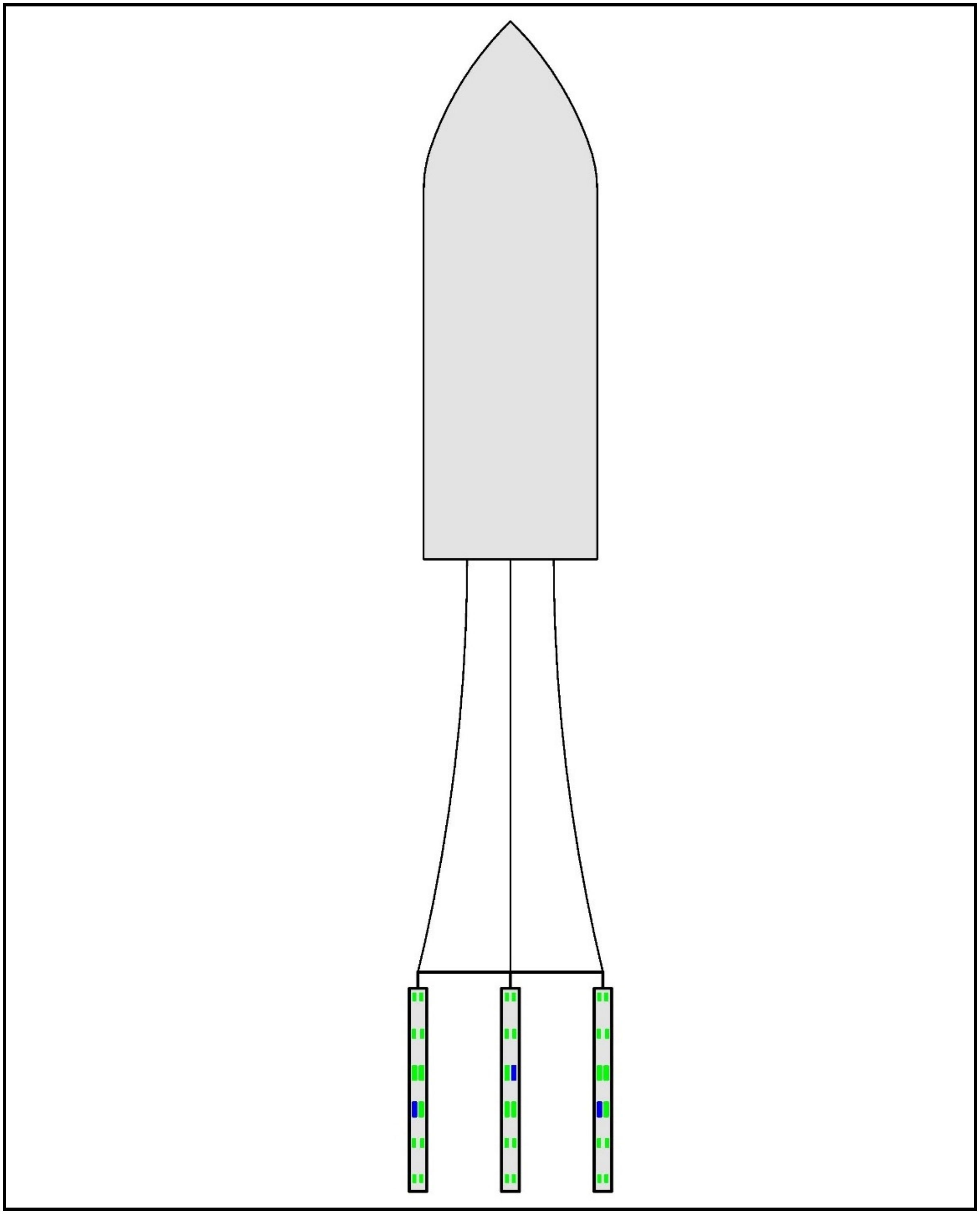

Figure 1-7. Source Array Configuration

The discharge pressure of the array is approximately 2,000 pounds per square inch. To reduce potential noise, the sound source will be operated in "distributed or popcorn mode". During discharge, a brief (~0.1 seconds) pulse of sound is emitted. The sound source would be silent during the intervening periods. Because the actual source is a distributed sound source rather than a single point source, the highest sound levels measurable at any location in the water will be significantly less than the nominal single point source level emitted (as would be the case during other non-related "typical" geophysical surveys). Specifically, rather than activating all sound sources at the same time to generate a sharp source peak, the sound source is initiated independently over a short period of time to generate a firing sequence with reduced peak amplitudes. As only one sound source would be firing at any given time, the effective (perceived) source level for sound propagating would be substantially lower than the nominal source level because of the distributed nature of the sound from the source array. The source array is designed to focus maximum energy downwards rather than in the horizontal directions.

1.2.2.3 Autonomous Nodes

The autonomous nodes are described in Table 1-3. There are 20 receiver lines proposed containing approximately 730 nodes total as shown in Figure 1-9. The survey was designed to satisfy a maximum offset consistent with the design, which is approximately 410 feet (125 meters) so node separation would be no more than 820 feet (250 meters). The system is autonomous and would not require electrical cable connection for operation, though nodes are physically tethered together by cable/rope. The nodes are circular and approximately 65 pounds (lbs.) (29.5 kilograms) in air, and are 17.0-inches in diameter by six-inches high (43.2 centimeters by 15.2 centimeters) (Figure 1-8). Typical node specifications (Example: FairfieldNodal, 2016) are provided in Table 1-4.

Table 1-3. Node Specifications

Node spacing distance	820 feet (250m)
Receiver line separation	820 feet (250m)
Number of receiver lines	20
Number of nodes total	730
Shot distance	82 feet (25m) inline
Shot line separation	82 feet (25m)
Bin dimension	41 x 41 feet (12.5m x 12.5m)
Azimuth of RL	328.84 deg
Azimuth of SL	53.84 deg
Shots per Sq.km.	1,600
Active nodes per shot	506

Figure 1-8. Shallow Water Node (FairfieldNodal, 2016)

The nodes will be loaded onto the deployment vessel, the M/*V Clean Ocean*, with the onboard crane at the POLA/POLB. The M/*V Clean Ocean* will then travel to the offshore Project site and deploy the nodes at their designated locations. The nodes will be connected to each other by a line no greater than 0.65 inches (1.6 centimeters) in diameter in accordance with National Marine Fisheries Service (NMFS) recommended protocol and manufacturer specifications. Installation of the nodes will be completed when sea state and weather conditions are conducive to safe operations and will be via "live-boat" (no anchoring is proposed), deployment being from the stern of the vessel while moving over the proposed locations at approximately 2 to 4 knots (3.7 to 7.4 kilometers per hour). Installation of the nodes is anticipated to take approximately seven operational days (one week).

After the nodes have been placed on the seafloor, recording will be conducted for the duration of the Project. At the end of the survey, the M/V Clean Ocean will retrieve each line of temporary nodes. Retrieval of the nodes following survey activities is also anticipated to take approximately seven operational days (one week).

1.3 PROJECT PERSONNEL AND EQUIPMENT

1.3.1 Equipment Requirements

The following vessels and equipment are being evaluated for use in the proposed offshore geophysical survey.

- M/V *Clean Ocean* for node deployment/recovery;
- M/V *Silver Arrow* or R/V *Marcus Langseth* for geophysical survey;
- One source array (consisting of three sub-arrays); and
- M/V *Jab* for operations support.

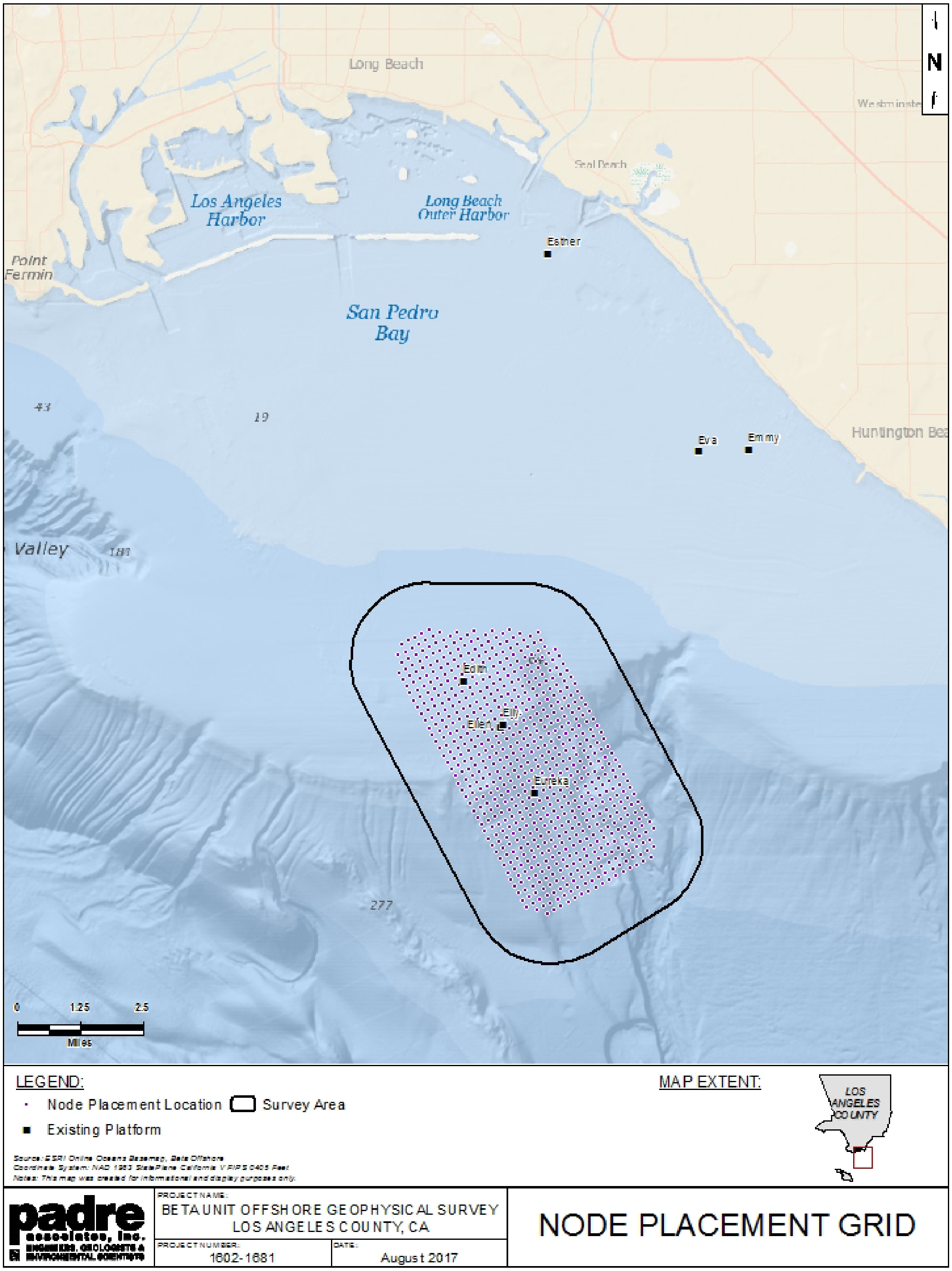

Figure 1-9. Anticipated Node Placement Grid

Table 1-4. Typical Node Specifications (FairfieldNodal, 2016)

Typical Node Specifications

Seismic Data Channels: 4

ADC Resolution: 24 bits

Sample Interval: 2, 4 milliseconds

Preamplifier Gain

0 dB to 36 dB in 6 dB steps

Anti-Alias Filter

206.5 Hz (82.6% of Nyquist) @ 2 ms,
Linear Phase

DC Blocking Filter

1 Hz to 60 Hz, 6 dB/Octave, or OUT

Operating Temperature Range

-10˚C to +60˚C

Operating Life (100% Charge)

Up to 60 days continuous recording

Battery

Charging Temperature Range
+3˚C to +40˚C

Recharge Time: < 8 hours

Acquisition Channel

(2 ms sample interval, 25°C, 31.25 Hz,
internal test, unless otherwise indicated)

Total Harmonic Distortion
0.0003% @ 12 dB gain, -3dB Full Scale

Equivalent Input Noise
1.0 μVrms @ 0 dB
0.4 μVrms @ 12 dB
0.3 μVrms @ 24 dB
0.3 μVrms @ 36 dB

Full Scale Input Signal
2500 mV peak @ 0 dB
625 mV peak @ 12 dB
156 mV peak @ 24 dB
39 mV peak @ 36 dB

Gain Accuracy: 0.50%*

Dynamic Range
120 dB @ 0 dB Preamplifier Gain

Crossfeed
<-100 dB Geophone Channels
<-80 dB Hydrophone Channel**

Common Mode Rejection Ratio
>+90 dB Geophone Channels
>+40 dB Hydrophone Channel**

DC Offset
<10% of Input Noise with DC Blocking
Filter IN

Timing Accuracy
CSAC clock

Self Test Features

Internal Noise (preamp input terminated)

Internal THD

Internal Gain Accuracy

Internal CMRR

Internal Crossfeed

Internal Impulse

Sensor Impedance

Sensors

Geophone
3 orthogonal, omni directional, 15 Hz @ -3
dB, 70% damped 0.57 V/in/s (22.4 V/m/s)

Hydrophone
3.4 Hz @ -3 dB, 8.9 V/Bar

Orientation
±1.5° tilt indication
±5° azimuth (at Latitudes within
± 50° of the Equator)

Physical

Weight: 65 lb (29.5 kg) in air, 40 lb
(18.1 kg) in water

Dimensions: 17 in (43.2 cm) diameter by
6 in (15.2 cm) high

Operating Depth: 700 meters

* Does not include high-impedance low-cut filter for directly coupled hydrophone interface.
** Channel includes high-impedance low-cut filter for directly coupled hydrophone interface.

All specifications relate to Node Part Number 221.6862.0003 only.
FairfieldNodal reserves the right to change specifications without notice to provide the best possible product.

Drawing Number 601.0002.0003 Rev. -
Z700 Node (Version 3) Specifications Sheet

August 2016

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1.3.2 Personnel Requirements

It is estimated that the following personnel will be required for the proposed offshore geophysical survey. Additional Project-related personnel may also participate as needed.

- M/V *Clean Ocean* (node deployment/recovery): 10 + including monitors
- M/V *Silver Arrow* (survey): 15 + including monitors
- M/V *Jab* (support): 5
- Administrative/computer support: 3

1.4 PROJECT SCHEDULE

The proposed activities, including mobilization and demobilization, are expected to take approximately 42 operational days (six weeks) to complete. Deployment/recovery of the node units is expected to take approximately 14 days (two weeks – one week for deployment and one week for recovery), and the geophysical survey would take approximately 28 days. This estimate includes time for instrument deployment, profiling, instrument recovery, and demobilization. The survey is targeted for September 2018, following completion of all required environmental reviews and permitting. The September-November time window is the annually lowest population of marine mammals in the survey vicinity.

1.5 PROJECT REPORTS AND PLANS

The Project has been designed to minimize environmental impacts to the greatest extent feasible. The following reports and plans have been prepared to support the Project application and the measures to be implemented to reduce potential impacts as further described in Section 1.9 below. These reports and plans include the following:

- Reports and Assessments
  - Biological Assessment (BA)
  - Essential Fish Habitat Assessment (EFHA)
  - Air Emissions Calculations
- Plans
  - Marine Wildlife Contingency Plan (MWCP)
  - Fisheries Management Plan (FMP)
  - Vessel-based Oil Spill Prevention and Contingency Plan(s)

2.0 EXISTING CONDITIONS

The Project is located offshore of San Pedro Bay in approximately 148 to 1,083 feet (ft) (45 to 330 meters [m]) of water. The Project spans through the outer edge and upper slope on the San Pedro Shelf. The closest prominent seafloor features to the Project area include the San Gabriel Submarine Canyon, 0.6 mi (1.0 km) to the east of the Platform Elly, and a 1.5 mi (2.4 km)-long rock feature located 914 m (3,000 ft) west of Platform Eureka. Seafloor sediments within the Project area are primarily sand and muddy sand (BOEM, 2011). Sediment samples collected at Platforms Elly and Eureka are characterized by a transition from silts and sands at the shelf break near Platform Elly to clays and clayey silts down the upper San Pedro Slope towards Platform Eureka (BOEM, 2011).

A remote operated vehicle (ROV) pipeline survey of the corridor between Platform Edith and Platform Elly recorded epibenthic invertebrate and fish assemblages that are representative of outer shelf assemblages in the San Pedro Basin. Benthic species invertebrates associated with soft bottom sediments that were found in the survey included white urchin (*Lytechinus pictus*), bat stars (*Asterina miniata*), sea pens (*Acanthoptilum* sp.), and sea cucumbers (*Parastichopus* spp) at depths of 250 to 400 ft (72 to 123 m); while deeper waters included spiny sea stars (*Orthasterias koehleri*) and sea pens (cf *Stylatula elongata*). Most of the taxa present in that survey were also found in the 2003 regional survey, although the closest sample was taken 3,000 ft (914 m) to the north of Platform Edith (BOEM, 2011).

2.1 HABITAT AREAS OF PARTICULAR CONCERN

EFH guidelines defines Habitat Areas of Particular Concern (HAPC) based on one or more of the following considerations:

- The importance of the ecological function provided by the habitat;
- The extent to which the habitat is sensitive to human-induced environmental degradation;
- Whether, and to what extent, development activities are or will be stressing the habitat type; and,
- The rarity of the habitat type.

Federal regulations recognize three HAPCs: Rock reefs, canopy kelps, and seagrass beds. In addition, waters and substrate associated with the platform jackets of 13 specified oil production platforms in Southern California waters are designated groundfish HAPC. The platform jacket groundfish HAPC could be influenced by the Project. In addition, open water pelagic habitat is critical for the larval stages of many of the species present within the Project area. The following descriptions include an overview of these habitat types.

2.1.1 Platform Jacket Habitat

Project platforms (Elly, Ellen, and Eureka) are not considered HAPC; however, the adjacent DCOR Platform Edith located within the Project area, is a designated HAPC. Surveys demonstrate that high concentrations of groundfish have been observed in association with these platforms, including California Department of Fish and Wildlife (CDFW) special of special concern bocaccio (*Sebastes paucispinis*) and cowcod (*Sebates levis*) (Love, et al. 2003). In addition to providing suitable habitat, most of these platform jackets are not fished and act as de facto reserves. The platforms rise steeply from the bottom and provide unique high-relief habitat (PFMC, 2005).

2.1.2 Rock Reefs

Rocky reef habitats can be categorized as either nearshore or offshore, in reference to the proximity of the habitat to the coastline. Rocky habitat may be composed of bedrock with varying degrees of vertical relief, boulders, or smaller rocks, such as cobble and gravel. Hard substrates are among the most important habitats for groundfish. The rocky reefs HAPC includes those waters, substrates, and other biogenic features associated with hard substrate up to the mean higher high-water mark.

Rock reef habitats can support biologically diverse communities and are sensitive to impacts from oil and gas operations because of the slow recovery rates of some invertebrate and fish species. A sonar survey was completed in November 2010 by Fugro Consultants, Inc. and found 11 seafloor features or targets within 6 to 6,600 ft (20 to 2,012 m) of the Beta Unit intrafield pipelines. These targets are likely debris or scaring and not rock or hard-bottom features. The closest rock outcrops occur over 2,000 ft (610 m) to the east of Platform Edith and approximately 1,000 feet (305 m) east-southeast of platform Elly at water depth of 300 ft (91 m). Outside of the survey area, is an approximately 8,000 ft (2,438 m) -long, north-south trending rock feature has been identified between the 250 and 600 ft (76 and 182 m) isobaths and as close as 3,000 ft (914 m) west of Platform Eureka. Other hard bottom areas within the Project region include a smaller feature, identified as either a topographic depression or rocky habitat located approximately 1,000 ft (305 m) southeast of Platform Ellen, and apparent rock outcroppings along and within the head of the western portion of the San Gabriel Submarine Canyon.

2.1.3 Canopy Kelps

Of the habitats associated with the rocky substrate on the continental shelf, kelp forests are of primary importance to the ecosystem and serve as important groundfish and epipelagic species nursery habitat. Kelp forest communities are found relatively close to shore along the open coast. Due to the water depth and the lack of rock reef habitat in the photic zone, canopy kelps HAPC is not expected to occur within the Project area.

2.1.4 Seagrasses

Two important seagrass species found on the West Coast of the U.S. are eelgrass (*Zostera* spp.) and surfgrass. These grasses are vascular plants, not algae, forming dense beds of leafy shoots year-round in the lower intertidal and subtidal areas. Eelgrass is found on soft-bottom substrates in intertidal and shallow subtidal areas of estuaries and in some nearshore areas, such as the Channel Islands and Santa Barbara Channel. Surfgrass occurs on hard-bottom substrates along higher energy coastlines. Studies have shown seagrass beds to be among the areas of highest primary productivity in the world. Due to the water depths, distance from the coastline, and the lack of rock reef habitat, seagrass HAPC is not expected to occur within the Project area.

2.1.5 Pelagic Open Water

Although this is not considered a HAPC, for purposes of this Project, the offshore pelagic habitat within which the Project will be conducted is of importance because it is habitat for the life stages of many fish species. Larvae, in particular, are seasonally abundant in surface layers shallower than 10 m (33 ft) where they feed on smaller phytoplankton and zooplankton.

The open-water domain or pelagic zone is the largest habitat on earth and home to about 40 percent of the fish species observed off California (BOEM, 2011). Several managed species known to occur in various life stages within the pelagic zone, may be present in the Project area (refer to Section 3 – Managed Species of Interest). Fish assemblages often overlap between the mesopelagic and bathypelagic zones, and offshore southern California, the common species that inhabit these zones include bent-tooth bristlemouth, California smooth-tongue, Mexican lampfish, northern lampfish, and showy bristlemouth (BOEM, 2011).

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3.0 MANAGED SPECIES OF INTEREST

NMFS EFH online mapper was utilized to identify which management units are located within the offshore Project area (NMFS, 2017). Distribution and habitat information available in Miller and Lea (1972) and McCain (2005) was used to estimate which of the species listed in each management unit could occur in the Project area. Table 3-1 lists the managed species that could occur within the geographical region, water depth range, and habitat types found within the Project area.

Table 3-1. EFH Designated Species and Live Stages with the Potential to Occur in the Project Area

	Life Stages		
	Larvae/Neonates	**Juveniles**	**Adults**
Coastal Pelagic Species			
Northern anchovy (*Engraulis mordax*)	X	X	X
Pacific sardine (*Sardinops sagax*)	X	X	X
Pacific mackerel (*Scomber japonicus*)	X	X	X
Jack mackerel (*Trachurus symmetricus*)	X	X	X
Market squid (*Loligo opalescens*)	X	X	X
Pacific herring (*Clupea pallasii*)	X	X	X
Krill – *Euphausia pacifica*	X	X	X
Krill – *Thysanoessa spinifera*	X	X	X
Highly Migratory Species			
North Pacific albacore (*Thunnus alalunga*)		X	X
Yellowfin tuna (*Thunnus albacares*)		X	X
Bigeye tuna (*Thunnus obesus*)		X	X
Skipjack tuna (*Katsuwonus pelamis*)			X
Northern Bluefin (*Thunnus orientalis*)		X	X
Common thresher shark (*Alopias vulpinus*)	X	X	X
Pelagic thresher shark (*Alopias pelagicus*)	X	X	X
Bigeye thresher shark (*Alopias superciliosus*)		X	X
Shortfin mako (*Isurus oxyrhinchus*)	X	X	X
Blue shark (*Prionace glauca*)	X	X	X
Striped marlin (*Tetrapturus audax*)			X
Pacific swordfish (*Xiphias gladius*)		X	X
Dorado (*Coryphaena hippurus*)		X	X
Pacific Groundfish			
Arrowtooth flounder (*Atheresthes stomias*)	X	X	X
Butter sole (*Isopsetta isolepis*)	X	X	X
Curlfin sole (*Pleuronichthys decurrens*)	X	X	X
Dover sole (*Microstomus pacificus*)	X	X	X

	Life Stages		
	Larvae/Neonates	Juveniles	Adults
English sole (*Parophrys vetulus*)	X	X	X
Flathead sole (*Hippoglossoides elassodon*)	X	X	X
Pacific sanddab (*Citharichthys sordidus*)	X	X	X
Petrale sole (*Eopsetta jordani*)	X	X	X
Rex sole (*Glyptocephalus zachirus*)	X	X	X
Rock sole (*Lepidopsetta bilineata*)	X	X	X
Sand sole (*Psettichthys melanostictus*)	X	X	X
Starry flounder (*Platichthys stellatus*)	X	X	X
Aurora Rockfish (*Sebastes aurora*)	X	X	X
Bank Rockfish (*Sebastes rufus*)	X	X	X
Black Rockfish (*Sebastes melanops*)	X	X	X
Blackgill Rockfish (*Sebates melanostomus*)	X	X	X
Blue Rockfish (*Sebates mystinus*)	X	X	X
Bocaccio (*Sebastes paucispinis*)	X	X	X
Brown Rockfish (*Sebates auriculatus*)	X	X	X
Calico Rockfish (*Sebates dalli*)	X	X	X
California Scorpionfish (*Scorpaena guttata*)	X	X	X
Canary Rockfish (*Sebates pinniger*)	X	X	X
Chilipepper (*Sebastes goodei*)	X	X	X
China Rockfish (*Sebastes nebulosus*)	X	X	X
Copper Rockfish (*Sebastes caurinus*)	X	X	X
Cowcod (*Sebates levis*)	X	X	X
Darkblotched Rockfish (*Sebastes carmeri*)	X	X	X
Flag Rockfish (*Sebastes rubrivinctus*)		X	X
Gopher Rockfish (*Sebastes carnatus*)	X	X	X
Greenblotched Rockfish (*Sebastes rosenblatti*)	X	X	X
Greenstriped Rockfish (*Sebastes elongates*)	X	X	X
Honeycomb Rockfish (*Sebastes umbrosus*)	X	X	X
Longspine Thorneyhead (*Sabastolobus altivelis*)	X	X	X
Mexican Rockfish (*Sebastes macdonaldi*)	X	X	X
Olive Rockfish (*Sebastes serranoides*)	X	X	X
Pacific Ocean Perch (*Sebastes alutus*)	X	X	X
Pink Rockfish (*Sebastes eos*)	X	X	X
Quillback Rockfish (*Sebastes maliger*)	X	X	X
Redbanded Rockfish (*Sebastes babcocki*)	X	X	X
Redstripe Rockfish (*Sebastes proriger*)	X	X	X
Rosethorn Rockfish (*Sebastes helvomaculatus*)	X	X	X
Rosy Rockfish (*Sebastes rosaceus*)	X	X	X
Rougheye Rockfish (*Sebastes aleutianus*)	X	X	X
Sharpchin Rockfish (*Sebastes zacentrus*)	X	X	X

	Life Stages		
	Larvae/Neonates	Juveniles	Adults
Shortbelly Rockfish (*Sebastes jordani*)	X	X	X
Shortspined Thornyhead (*Sebastolobus alascanus*)	X	X	X
Speckled Rockfish (*Sebastes ovalis*)	X	X	X
Splitnose Rockfish (*Sebastes diploproa*)	X	X	X
Squarespot Rockfish (*Sebastes hopkinsi*)	X	X	X
Starry Rockfish (*Sebastes constellatus*)	X	X	X
Stripetail Rockfish (*Sebastes saxicola*)	X	X	X
Treefish (*Sebastes serriceps*)	X	X	X
Vermilion Rockfish (*Sebastes miniatus*)	X	X	X
Widow Rockfish (*Sebastes entomelas*)	X	X	X
Yelloweye Rockfish (*Sebastes ruberriums*)	X	X	X
Yellowtail Rockfish (*Sebastes flavidus*)	X	X	X
Lingcod (*Ophiodon elongates*)	X	X	X
Pacific Cod (*Gadus macrocephalus*)	X	X	X
Pacific Hake (Whiting) (*Merluccius productus*)	X	X	X
Pacific flatnose (*Antimora microlepis*)	X	X	X
Spotted Ratfish (*Hydrolagus colliei*)		X	X
Sable fish (*Anoplaopoma fimbria*)	X	X	
Pacific Grenadier (*Coryphaenoides acrolepis*)		X	X
Leopard shark (*Triakis semifasciata*)		X	X
Soupfin shark (*Galeorhinus galeus*)		X	X
Spiny dogfish (*Squalus acanthias*)		X	X
Big skate (*Raja binoculata*)		X	X
California skate (*Raja inornata*)		X	X
Longnose skate (*Raja rhina*)		X	X

Source: PFMC, 1998 and 2005

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4.0 POTENTIAL IMPACTS

4.1 SEAFLOOR IMPACTS FROM ACOUSTIC NODE INSTALLATION

Placement of autonomous nodes (nodes) has the potential to create localized turbidity and affect nearby soft-bottomed seafloor habitat, and/or rocky substrate. Potentially significant impacts could occur if nodes create turbidity that would reduce water clarify and increase sediment deposition, or if the cable/rope, tethering the nodes, are placed onto or cut across sensitive habitats. Deeper water rock habitats are considered more sensitive in that they are not routinely subjected to natural disturbances (i.e., storm waves) and they support long-lived, slow-growing organisms that are particularly sensitive to disturbance. Further, placing nodes onto habitats could crush attached organisms and tether lines that cross habitat features could abrade and remove, or damage attached epibiota.

Project activities are not expected to impact rock reef habitats with the implementation of applicant proposed mitigation measures (refer to Section 5.1), and the low likelihood of rock reef habitat within the node deployment area.

4.2 NOISE IMPACTS OF GEOPHYSICAL SURVEYS ON FISH

Geophysical surveys using underwater geophones and high-energy geophysical systems can disturb and displace fishes and interrupt feeding, but displacement may vary among species. Pelagic or nomadic fishes leave geophysical survey areas, and displace up to 33 km (20.5 mi) from the survey center (Engås et al., 1996; Lokkeborg and Soldal, 1993, in MMS, 2005). Lamont-Doherty Earth Observatory [L-DEO] (2011) noted that the potential effects of geophysical surveys on fish include: (1) pathological; (2) physiological; and (3) behavioral.

4.2.1 Pathological

The potential for pathological damage to hearing structures in fish depends on the energy level of the received sound and the physiology and hearing capabilities of the species in question (L-DEO, 2011). McCauley et al., 2003, (in MMS, 2005) noted that the Australasian snapper (*Pagrus auratus*) exposed to operating high-energy geophysical systems may sustain extensive damage to their auditory hair cell, which would likely adversely affect hearing. Two months after exposure, the damage had not been repaired. Further, fishes with impaired hearing may have a temporary reduction in fitness resulting in increased vulnerability to predation, less success in locating prey and sensing their acoustic environmental, and, in the case of vocal fishes, reduction in ability to communicate. Some fishes displayed aberrant and disoriented swimming behavior, suggesting vestibular impacts. There was also evidence that seismic survey acoustic-energy sources could damage eggs and fry of some fishes, but the effect was limited to within 3.2 to 6.4 ft (1.0 to 2.0 m) of the array.

Popper et al. (2005, in MMS, 2005) investigated the effects of a 730-cubic inch (in^3) source array on the hearing of northern pike, broad whitefish, and lake chub in the Mackenzie

River Delta. Threshold shifts were found for exposed fish at exposure of sound levels of 177 dB re 1µPa^2 s, as compared to controls in the northern pike and lake chub, with recovery within 24 hours. There was no threshold shift in the broad whitefish.

An experiment of the effects of a single, 700 in^3 source was conducted in Lake Mead, Nevada (USGS, 1999). The data were used in an environmental assessment of the effects of a marine reflection survey of the Lake Mead fault system by the National Park Service (Paulson et al., 1993, in USGS, 1999). The sound source was suspended 11.4 ft (3.5 m) above a school of threadfin shad in Lake Mead and was fired three successive times at a 30-second interval. Neither surface inspection nor diver observations of the water column and bottom found any dead fish.

For a proposed seismic survey in Southern California, USGS (1999) conducted a review of the literature on the effects of high-energy geophysical systems on fish and fisheries. They reported a 1991 study of the Bay Area Fault system from the continental shelf to the Sacramento River using a 10-source system, 5,828 in^3 source array. Brezina and Associates were hired to monitor the effects of the surveys, and concluded that geophysical operations were not responsible for the death of any of the fish carcasses observed, and the geophysical profiling did not appear to alter the feeding behavior of sea lions, seals, or pelicans observed feeding during the surveys.

Fish eggs and larvae are distributed throughout the water column and are more sensitive to sound waves than adults. Some studies have reported, some equivocally, that mortality of fish, fish eggs, or larvae can occur at close range to seismic sources (Kostyuchenko, 1973; Dalen and Knutsen, 1986; Boorman et al., 1996; Dalen et al., 1996, in L-DEO, 2011). Some of the reports claimed seismic effects from treatments quite different from actual seismic survey sounds or even reasonable surrogates. However, Payne et al. (2009, in L-DEO, 2011) reported no statistical differences in mortality/morbidity between control and exposed groups of capelin eggs or monkfish larvae. Saetre and Ona (1996, in L-DEO, 2011) applied a “worst-case scenario” mathematical model to investigate the effects of seismic energy on fish eggs and larvae. They concluded that mortality rates caused by exposure to seismic surveys are so low, as compared against natural mortality rates, that the impact of seismic surveying on recruitment to a fish stock must be regarded as insignificant.

4.2.2 Physiological

Physiological effects refer to cellular and/or biochemical responses of fish to acoustic stress. Such stress potentially could affect fish populations by increasing mortality or reducing reproductive success. Primary and secondary stress responses of fish after exposure to seismic survey sound appear to be temporary in all studies done to date (Sverdrup et al., 1994; Santulli et al., 1999; McCauley et al., 2000a, b, in L-DEO, 2011). The periods necessary for the biochemical changes to return to normal are variable and depend on numerous aspects of the biology of the species and the sound stimulus.

4.2.3 Behavioral Effects

Behavioral effects include changes in the distribution, migration, and reproduction behaviors of exposed fish. Studies investigating the possible effects of sound (including seismic survey sound) on fish behavior have been conducted on both uncaged and caged individuals (Chapman and Hawkins, 1969; Pearson et al., 1992; Santulli et al., 1999; Wardle et al., 2001; Hassel et al., 2003, in L-DEO, 2011). Typically, fish exhibited a sharp startle response at the onset of a sound followed by habituation and a return to normal behavior after the sound ceased.

MMS (2005) assessed the effects of a proposed seismic survey in Cook Inlet. The seismic survey proposed using three vessels, each towing two, 4-source arrays ranging from 1,500 to 2,500 in^3. MMS (2005) noted that the impact to fish populations in the survey area and adjacent waters would likely to very low and temporary. Seismic surveys may displace the pelagic fishes from the area temporarily when active sources are in use. However, fishes displaced and avoiding the sound are likely to backfill the survey area in minutes to hours after cessation of seismic testing. Fishes not dispersing from the sound (e.g., demersal species) may startle and move short distances to avoid source emissions.

The effects of sound on the habitat is expected to affect only those organisms that are in close proximity of the sound source. Studies have shown that the most common effects of seismic surveys on fish have been behavioral modifications. Results of seismic survey trials in Estero Bay, California, found that sound levels caused changes in rockfish swimming behaviors. There were significant differences in vertical distributions, and startle responses were also observed (Pearson, et al. 1992). Fish returned to pre-exposure behavior after only a few minutes which suggest that the effects on fish would be temporary. Boeger et al. (2006) observed coral reef fishes in field cages before, during, and after exposure to an 8-active source seismic array. There was no result of mortality or external damage to fishes throughout the study. The results did show that most source discharges caused a startle response in the fish, although these behavioral changes lessened with repeated exposure, suggesting habituation.

Wardle et al. (2001) used video and telemetry to observe behavioral responses of marine fishes. The source discharges also caused a startle response in the fish, but Wardle noted that there was no affect to their diurnal migrations or their distribution around the reef. There were also indications of responses to visual stimuli; if the seismic source was visible to the fish they would swim away from it. However, if the source was out of the fish's line of sight, they would continue to swim towards the sound source.

Open water and platform jacket habitats will experience increases in noise levels for the short duration of the Project; however, primary impacts will be to fish behavior which is expected to resume normal conditions as the sound source moves away from any particular region of the survey area. It is expected that fish will be displaced temporarily from areas around the survey vessel; however, the immediate survey area is only a small part of the larger San Pedro Basin habitat and geophysical survey activities are not expected to affect the long-term fitness of local fish populations. Fish larva and egg phases are expected to experience mortality due to geophysical surveys; however, mortality rates caused by exposure to sound sources are low, as compared against natural mortality rates, and the impact of geophysical surveying is not expected to affect the long-term recruitment of fish stocks.

4.3 OIL SPILL EFFECTS

The unintentional release of petroleum into the marine environment from proposed Project activities could result in potentially significant impacts to the marine biota, particularly early life stage forms of fish and invertebrates, which are sensitive to those chemicals. Refined products (i.e., diesel, gasoline.) are more toxic than heavier crude or Bunker-type products, and the loss of a substantial amount of fuel or lubricating oil during survey operations could affect the water column, seafloor, intertidal habitats, and associated biota, resulting in their mortality or substantial injury, and in alteration of the existing habitat quality.

Although many marine organisms have created adaptive strategies to survive in their environment, when these marine organisms are introduced to oil, it adversely affects them physiologically. For example, physiological effects from oil spills on marine life could include the contamination of protective layers, loss of buoyancy, and loss of locomotive capabilities. Direct lethal toxicity or sub-lethal irritation and temporary alteration of the chemical make-up of the ecosystem can also occur. Oil spills have many variables to consider when dealing with the impact of the spill including: oil type, season of occurrence, animal behavior, oceanographic and meteorological conditions, and the cleanup methods employed.

The effects of oil on fish have been well documented both in the field and within a laboratory. Research shows that fish that are unable to avoid hydrocarbons and take them up from food, sediments, and surrounding waters. Once these hydrocarbons are in the organism's tissues, they will affect the life span through a variety of behavioral, physiological, or biochemical changes. Also, exposure to oil will affect a species' ability to search, find, and capture food, which will affect its nutritional health. Early development life stages, such as larvae, will be especially impacted. Small amounts of oil can impact fish embryos by causing physical deformities, damage to genetic material, and mortality (Carls, et. al., 1999). Fishes experience the highest mortalities due to oil exposure when they are eggs or larvae. However, these deaths would not be significant in terms of the overall population in offshore water. Brief encounters with oil by juvenile and adult fish species would not likely be fatal.

While a release of petroleum would be expected to have some short-term effect on the habitats and fish within the Project area, the likelihood of such an event occurring and the existing mitigations that have been built into the Project design reduce the possibility to less than significant.

Project activities are not expected to have long-term, significant effects on open water habitat because a Project-specific oil spill prevention and recovery plan has been developed and will be used to direct the containment and recovery of Project-related petroleum products that are accidentally released into the marine waters. In addition, onboard and supporting equipment and the procedures specified in the spill plan are expected to reduce the effects of accidentally discharged petroleum by facilitating rapid response and cleanup operations. The Project vessels will adhere to a zero-discharge policy.

5.0 PROPOSED MITIGATIVE MEASURES FOR EFH PROTECTION

The applicant proposed mitigation measures detailed in the following section will be implemented to further minimize the potential disturbance to EFH during Project operations. The Project incorporates both design and operational procedures for minimizing potential impacts to EFH and other special-status species.

5.1 MEASURES TO REDUCE SEAFLOOR IMPACTS FROM NODE PLACEMENT

5.1.1 Pre-Project Seafloor Clearance

A pre-Project seafloor clearance will be conducted to confirm habitat type that the nodes will be placed on. In addition, this will provide information on what debris currently exists within the survey area.

5.1.2 Post-Project Seafloor Clearance

A post-Project seafloor clearance will be completed by a remote operated vehicle (ROV) once the Project is complete and all nodes are removed from the seafloor. This seafloor clearance will aid in confirmation that no debris was left behind and to help access if damage occurred as a result of node placement.

5.1.3 Live Boating

Deployment and recovery of the autonomous nodes would be completed when sea state and weather conditions are conducive to safe operations and would be via “live boat” (no anchoring is proposed). During this phase of the Project, mobility of the Project vessel would likely not interfere with any HAPC.

5.2 REDUCING SOUND SOURCE

The discharge pressure of the array is approximately 2,000 pounds per square inch (psi). To reduce potential noise, the sound source will be operated in “distributed or popcorn mode”. During discharge, a brief (~0.1 seconds) pulse of sound is emitted. The sound sources would be silent during the intervening periods. Because the actual source is a distributed sound source (11 sound sources in each of the three sub-array) rather than a single point source, the highest sound levels measurable at any location in the water will be significantly less than the nominal single point source level emitted (as would be the case during other non-related “typical” geophysical surveys). Specifically, rather than activating all sound sources at the same time to generate a sharp source peak, the sound sources are initiated independently over a short period of time to generate a firing sequence with reduced peak amplitudes. As only one sound source would be firing at any given time, the effective (perceived) source level for sound propagating would be substantially lower than the nominal source level because of the distributed nature of the sound from the sound source array. The sound source array is designed to focus maximum energy downwards rather than in the horizontal directions.

5.3 MEASURES TO REDUCE POTENTIAL OIL SPILL IMPACTS

A Project specific oil spill prevention plan will be used to avoid any release of oil-based products into the marine environment, and the existing oil spill response and recovery plan will be used to reduce the effects of accidentally discharged petroleum by facilitating rapid response and cleanup operations. The following mitigations have been incorporated into the plan of operation and will result in reducing the chances of a spill occurring:

- **Beta Unit Oil Spill Prevention and Response.** All Project activities will be subject to the requirements and guidelines included within the "Beta Unit Complex (Platforms Elly, Ellen & Eureka, Beta Pipeline and Beta Pump Station) Oil Spill Prevention and Response Plan (OSPRP) - Revision 3" (2016), (Appendix H).
- **Vessel Specific Oil Spill Response Plan.** The Geophysical Survey will occur via the use of the M/V *Silver Arrow* or equivalent and will be subject to the requirements and guidelines included within the vessel-specific Oil Spill Response Plan.
- **Vessel Discharges.** All vessel discharges will comply with the requirements of the Clean Water Act under the USCG regulation including the proper treatment and monitoring of vessel effluents as necessary.

6.0 CONCLUSION

The Project survey area potentially encompasses one type of HAPC, and two unofficial HAPCs: rock reef, open-water, and platform jacket habitats. EFH within the survey area will experience temporary increases in noise levels; however, primary impacts will be to fish behavior which is expected to resume normal conditions as the sound source moves away from any particular region of the survey area. Fish larva and egg phases are expected to experience mortality due to geophysical surveys; however, mortality rates caused by exposure to sound sources are low, as compared against natural mortality rates, and the impact of geophysical surveying is not expected to affect the long-term recruitment of fish stocks. In addition, impacts to rock reef are not expected with the implementation of applicant proposed mitigation measures. Therefore, no EFH would be permanently altered by the proposed Project.

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