OCS EIS/EA
BOEM 2023-0061
BOEM Publication 2024-063

California Offshore Wind Draft Programmatic Environmental Impact Statement

November 2024

Volume I: Chapters 1–4

BUREAU OF OCEAN ENERGY MANAGEMENT

COVER SHEET

California Offshore Wind Programmatic Environmental Impact Statement

Draft (x) **Final ( )**

Lead Agency:	U.S Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Docket BOEM-2023-0061
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Area:	OCS-P 0561, 0562, 0563, 0564, and 0565
Date for Comments:	February 12, 2025

ABSTRACT

This Draft Programmatic Environmental Impact Statement (PEIS) assesses the potential biological, socioeconomic, physical, and cultural impacts that could result from floating offshore wind energy development in two wind energy areas (WEAs) offshore Humboldt and Morro Bay, California, as well as the change, avoidance, or reduction of those impacts that could result from adopting programmatic protective mitigation measures. This Draft PEIS considers prospective wind energy development in five leased areas: OCS-P 0561 and 0562 near Humboldt and OCS-P 0563, 0564, and 0565 near Morro Bay (BOEM ID# 2023-0061). BOEM issued these five leases on December 7, 2022. BOEM's programmatic analysis in this Draft PEIS follows the execution of the five leases but precedes future environmental analysis of Construction and Operations Plans (COPs) as required to be prepared by the lease holder under 30 Code of Federal Regulations (CFR) 585.628. This Draft PEIS will not result in the approval of any construction.

This Draft PEIS was prepared in accordance with the requirements of the National Environmental Policy Act (NEPA) (42 United States Code 4321 et seq.), implementing regulations (40 CFR 1500–1508), and the U.S. Department of the Interior (DOI) NEPA regulations (43 CFR Part 46).

Additional copies of this Draft PEIS may be obtained by writing to BOEM (address above); by telephone at (805) 384-6387; or by downloading from the BOEM website at https://www.boem.gov/renewable-energy/state-activities/california-offshore-wind-programmatic-environmental-impact.

Publication of the Draft PEIS initiates a 90-day public comment period, after which comments received will be assessed and considered by BOEM in preparation of a Final PEIS.

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Abbreviations and Acronyms

AC	alternating current
ADLS	aircraft detection lighting system
AIS	Automatic Identification System
ASLF	ancient submerged landform features
ATON	aid to navigation
BA	Biological Assessment
BBCS	Bird and Bat Conservation Strategy
BIA	biologically important area
BOEM	Bureau of Ocean Energy Management
BP	before present
BSEE	Bureau of Safety and Environmental Enforcement
BWM	Ballast Water Management
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standards
California PA	Programmatic Agreement Among the U.S. Department of the Interior, Bureau of Ocean Energy Management, The State Historic Preservation Office of California, The Advisory Council on Historic Preservation Regarding Review of Outer Continental Shelf Renewable Energy Activities Offshore California Under Section 106 of the National Historic Preservation Act
CCC	California Coastal Commission
CCLME	California Current Large Marine Ecosystem
CCS	California Current System
CDFW	California Department of Fish and Wildlife
CEQ	Council on Environmental Quality
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CH_4	methane
CNDDB	California Natural Diversity Database
CO	carbon monoxide
CO_2e	carbon dioxide equivalent
COBRA	CO-Benefits Risk Assessment
COP	Construction and Operations Plan
CPFV	Commercial Passenger Fishing Vessel
CRPR	California Rare Plant Rank
CWA	Clean Water Act
dB re 1 µPa	decibels referenced to a pressure of 1 microPascal
DC	direct current
DE	diesel exhaust
DoD	Department of Defense

DOI	U.S. Department of the Interior
DPM	diesel particulate matter
DPS	distinct population segment
EA	Environmental Assessment
EFH	essential fish habitat
EIS	Environmental Impact Statement
EJScreen	Environmental Justice Mapping and Screening Tool
EMF	electromagnetic field
ENP	Eastern North Pacific
ENSO	El Niño-Southern Oscillation
EO	Executive Order
ESA	Endangered Species Act
ESU	evolutionary significant unit
FAA	Federal Aviation Administration
FAD	fish aggregation device
FMP	Fisheries Management Plan
FONSI	Findings of No Significant Impact
FOV	field of view
FUDS	Formerly Used Defense Sites
G&G	geophysical and geotechnical
GDP	gross domestic product
GHG	greenhouse gas
GIS	geographic information system
GW	gigawatts
HAP	hazardous air pollutant
HAPC	Habitat Areas of Particular Concern
HDD	horizontal directional drilling
HRG	high-resolution geophysical
HVAC	high-voltage alternating current
HVDC	high-voltage direct current
Hz	Hertz
ICCP	impressed current cathodic protection
IMO	International Maritime Organization
IOOS	Integrated Ocean Observing System
IPF	impact-producing factor
ITA	Incidental Take Authorization
IWG	Interagency Working Group
KOP	key observation point
LME	Large Marine Ecosystem
LOA	Letter of Authorization
MLLW	mean lower low water

MMPA	Marine Mammal Protection Act
MPA	marine protected area
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MW/km^2	megawatts per square kilometer
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NEXRAD	Next Generation Weather Radar
NHPA	National Historic Preservation Act
nm	nautical mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic Atmospheric Administration
NOI	Notice of Intent
NO_X	nitrogen oxides
NREL	National Renewable Energy Lab
NY Bight PEIS	New York Bight Programmatic Environmental Impact Statement
O&M	operations and maintenance
O_3	ozone
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
ODS	Ocean Disposal Sites
OSRP	Oil Spill Response Plan
OSS	offshore substation
PAH	polycyclic aromatic hydrocarbon
PAM	passive acoustic monitoring
PAPE	preliminary area of potential effects
PATON	private aid to navigation
PBR	Potential Biological Removal
PCV	population collision vulnerability
PDO	Pacific Decadal Oscillation
PDV	population displacement vulnerability
PEIS	Programmatic Environmental Impact Statement
PFMC	Pacific Fishery Management Council
PM	particulate matter
PM_{10}	particulate matter with diameter of 10 microns and smaller
$PM_{2.5}$	particulate matter with diameter of 2.5 microns and smaller
POI	point of interconnection
Programmatic APE	Programmatic area of potential effects
PSO	protected species observer
PTS	permanent threshold shift
ROV	remote-operated vessel

ROW	right-of-way
RPDE	Representative Project Design Envelope
RSZ	rotor-swept zone
RV	recreational vehicle
SAP	Site Assessment Plan
SAR	search and rescue
SB	Senate Bill
SC-GHG	social cost of greenhouse gases
SF_6	sulfur hexafluoride
SLIA	Seascape and Landscape Impact Analysis
SMRMA	State Marine Recreational Management Area
SO_2	sulfur dioxide
SWPPP	stormwater pollution prevention plan
TCP	traditional cultural place
TLP	tension-leg platform
TSS	Traffic Separation Scheme
TTS	temporary threshold shift
USC	United States Code
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
UXO	unexploded ordnance
VIA	visual impact assessment
VOC	volatile organic compound
VPD	vessels per day
VTS	Vessel Traffic Service
WEA	Wind Energy Area
WNP	Western North Pacific
WTG	wind turbine generator

Executive Summary

Executive Summary

ES.1 Introduction

In December 2022, the Bureau of Ocean Energy Management (BOEM) auctioned Commercial Leases OCS-P 0561, 0562, 0563, 0564, and 0565 offshore California. Two leases are offshore Northern California, near Humboldt Bay. The other three leases are offshore Central California, near Morro Bay (Figure ES-1). These leases total over 373,000 acres (about 583 square miles). They are the first wind energy leases offshore California and are anticipated to use floating foundations that anchor in waters from 1,640 to 4,265 feet (500 to 1,300 meters) deep.

All leases grant the lessees the exclusive right to submit Construction and Operation Plans (COP) to BOEM proposing the construction, operation, and decommissioning of offshore wind energy facilities in the leased areas. BOEM identified these leased areas for consideration in development of commercial-scale offshore wind energy projects, subject to the appropriate reviews and approvals, through an extensive data-gathering and engagement process that included the BOEM California Intergovernmental Renewable Energy Task Force, which includes the state of California and numerous Tribal Nations, federal agencies, and local governments.

This Draft Programmatic Environmental Impact Statement (PEIS) analyzes the potential impacts of wind energy development in the five leased areas offshore California and considers mitigation measures that can be implemented to avoid or reduce those impacts. BOEM's Proposed Action for this PEIS is the identification of programmatic mitigation measures to lessen environmental impacts of wind energy development in the leased areas. BOEM may require mitigation measures as conditions of approval for activities proposed by lessees in their COPs.

BOEM may require all, some, or additional measures before approving a specific COP if the environmental analysis warrants. This PEIS will neither analyze a specific COP nor result in the approval of any construction and operation activities.

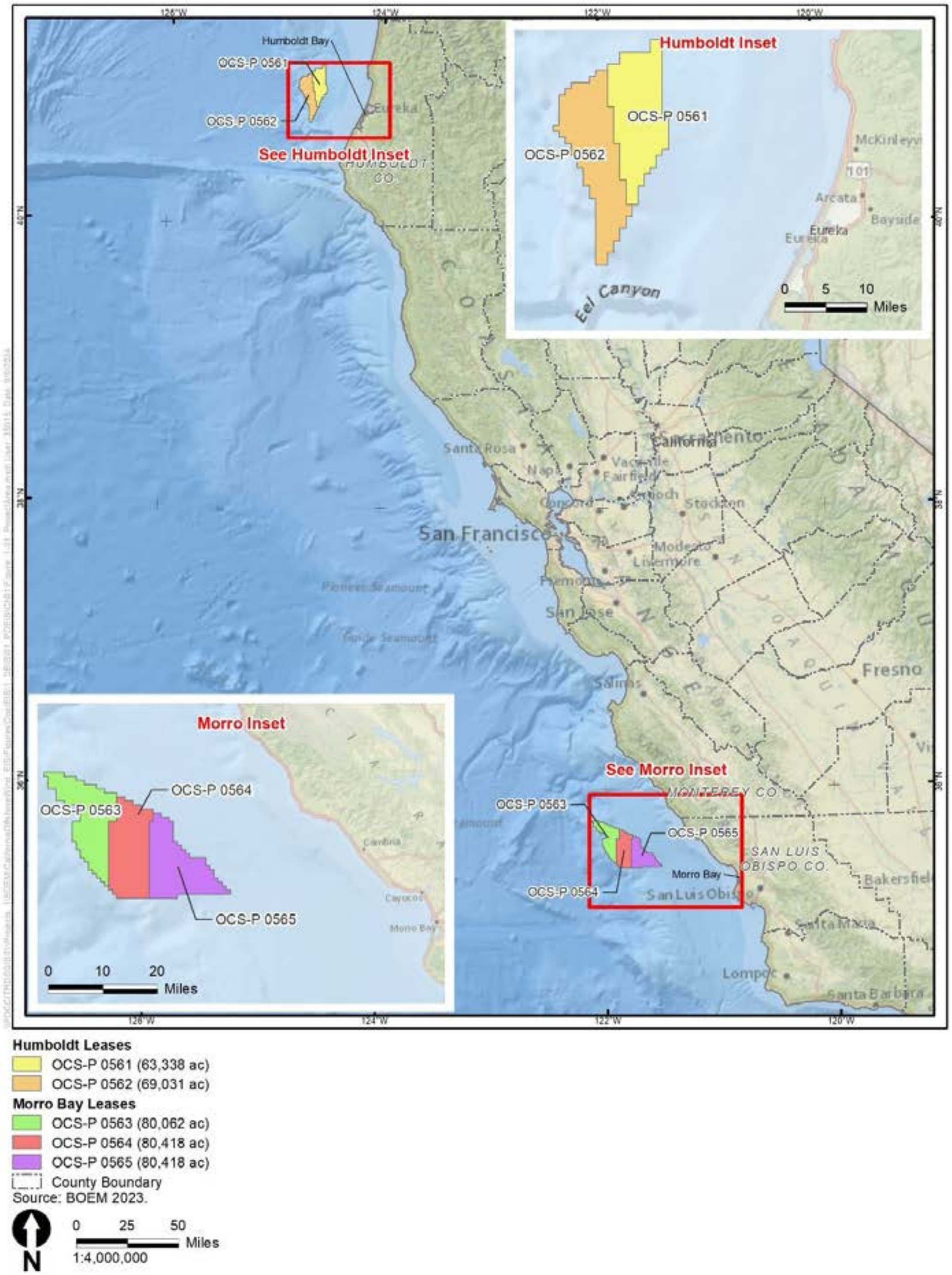

Figure ES-1. Humboldt and Morro Bay leased areas

ES.2 Purpose of and Need for the Proposed Action

The purpose of the Proposed Action is to identify and analyze potential mitigation measures that BOEM can, but may not necessarily, require as conditions of approval for future COPs or that lessees can incorporate directly into their COPs. BOEM will conduct subsequent site-specific National Environmental Policy Act (NEPA) analyses and consultations for individual proposed wind energy projects that focus on the impacts of approving a particular COP, including identification of mitigation measures that are best suited for that project.

Lessees may also incorporate mitigation measures into their proposed COPs in addition to any measures they may develop independently. Project-specific environmental analysis for individual project COPs may tier to or incorporate by reference this PEIS.

This PEIS will help BOEM make timely decisions on COPs submitted by lessees for the Humboldt and Morro Bay leased areas. Timely decisions further the United States' policy to make Outer Continental Shelf (OCS) energy resources available for expeditious and orderly development, subject to environmental safeguards. Wind energy development in the leased areas will assist with meeting federal and state renewable energy goals. These include the federal government's goals of deploying 30 gigawatts of offshore wind energy capacity by 2030 and 15 gigawatts of floating offshore wind capacity by 2035 and the State of California's goal of generating 2 to 5 gigawatts of offshore wind energy by 2030.

ES.3 Public Involvement

On December 20, 2023, BOEM issued a Notice of Intent to prepare a PEIS consistent with NEPA regulations (42 U.S. Code § 4321 et seq.) to assess the potential impacts of the Proposed Action and alternatives (88 *Federal Register* 88107). The Notice of Intent commenced a public scoping process to identify issues, alternatives, and mitigation measures for consideration in the PEIS. The formal scoping period was from December 20, 2023, through February 20, 2024. BOEM held two virtual public scoping meetings on February 6 and 8, 2024. Throughout the scoping period, federal agencies, Tribes, state and local governments, and the public had the opportunity to help BOEM identify potentially significant resources and issues, impact-producing factors, a range of reasonable alternatives, and potential mitigation measures to analyze in the PEIS, as well as provide additional information. The Notice of Intent requested comments from the public in written form, delivered by mail or delivery service, or through the regulations.gov web portal through searching for Docket Number BOEM-2023-0061. BOEM also used the scoping process to initiate the consultation process under Section 106 of the National Historic Preservation Act (54 U.S. Code § 300101 et seq.), as permitted by 36 Code of Federal Regulations 800.2(d)(3), which requires federal agencies to assess the effects of federal undertakings on historic properties.

During the scoping period, BOEM received a total of 198 comments, 187 of which were unique. BOEM reviewed and considered all scoping comments in the development of the Draft PEIS. The scoping summary report, included in Appendix B, *Scoping Report*, of this PEIS, summarizes the comments received and the methods for analyzing them. In addition, all public scoping comments received can be viewed online at http://www.regulations.gov by typing "BOEM-2023-0061" in the search field. As detailed in the scoping summary report, the most referenced resource areas or NEPA topics were cumulative impacts; mitigation measures; reasonable alternatives; birds; demographics, employment, and economics; fishes, invertebrates, and essential fish habitat; commercial and for-hire recreational fishing; marine mammals; navigation and vessel traffic; scenic and visual resources; and Tribal values and concerns.

Publication of the Draft PEIS initiates a 90-day public comment period, after which all comments received will be assessed and considered by BOEM in preparation of a Final PEIS.

ES.4 Alternatives

BOEM considered a reasonable range of alternatives during the PEIS development process. The alternatives were identified through coordination with cooperating and participating agencies and Cooperating Tribal Governments and through public comments received during the public scoping period for the PEIS. The Draft PEIS evaluates the No Action Alternative and two action alternatives (Alternatives A, B, and C, further detailed below).

Chapter 2, Section 2.2, *Alternatives Considered but Not Analyzed in Detail,* describes the alternatives that were considered but not carried forward in this Draft PEIS and the rationale for not completing a co-equal analysis of these alternatives.

ES.4.1 Alternative A – No Action Alternative

Alternative A, the No Action Alternative, assumes that no wind energy development would occur in any of the five Humboldt and Morro Bay leased areas. However, Alternative A assumes all other ongoing or other reasonably foreseeable planned activities described in Appendix C, *Planned Activities Scenario,* would continue. In the absence of development in the five Humboldt and Morro Bay leased areas, other reasonably foreseeable planned impact-producing activities would be realized, which would cause changes to existing baseline conditions. Current resource conditions, trends, and impacts from ongoing activities provide context for the analyses of Alternatives B and C, as well as a baseline for the evaluation of cumulative impacts.

As of the publication of this document, several prospective Wind Energy Areas (WEAs) are being studied offshore California and Oregon, but none have been leased; therefore, the WEAs are considered too speculative to include as part of the baseline analysis of this PEIS. In April 2024, BOEM published a draft environmental assessment associated with the prospective leasing of two Oregon WEAs (off Brookings and Coos Bay). The environmental assessment focuses on potential effects of site characterization and site assessment activities expected to take place after BOEM's possible future issuance of commercial wind energy leases. Such activities are intended to allow lessees to gather sufficient information to inform future submittal of COPs. Therefore, for the purposes of this PEIS, site characterization and site assessment activities of the two Oregon WEAs are considered reasonably foreseeable. Please refer to the draft environmental assessment for a discussion of associated environmental effects at https://www.boem.gov/renewable-energy/state-activities/commercial-wind-lease-issuance-pacific-outer-continental-shelf.

ES.4.2 Alternative B – Development with No Mitigation Measures

Alternative B considers future offshore wind development in the Humboldt and Morro Bay leased areas without the application of any mitigation measures. Non-routine activities and events during construction, operations and maintenance, and decommissioning are also considered as part of the analysis for Alternative B.

Analysis of Alternative B considers two scenarios intended to provide minimum/maximum impact levels: (1) one representative project in a Humboldt leased area and one in a Morro Bay leased area), and (2) a total of five representative projects (two in Humboldt and three in Morro Bay, corresponding to one project in each of the five leased areas). The analysis of both scenarios considers potential impacts of such development on the environment. Alternative B also provides analysis for tiering at the COP-specific NEPA stage, including context that can be used in the analyses and against which proposed actions at the COP-specific stage may be compared.

As of 2024, all existing offshore wind turbines in the United States are secured directly to the Atlantic Ocean seafloor; there are no offshore wind turbines on the Pacific OCS. There are no floating offshore wind turbines off any U.S. coast and only limited operational floating offshore wind globally. Offshore California, ocean depths of more than 1,640 feet (500 meters) make fixed-bottom foundations infeasible. Wind turbine generators (WTGs) and offshore substations (OSSs) in the subject lease areas would, therefore, require floating substructures. While floating offshore wind technology continues to evolve, understanding of the technical and design requirements is at a point where reasonable assumptions can be made for the analysis within this PEIS.

The basis for Alternative B is a Representative Project Design Envelope (RPDE) developed in conjunction with the National Renewable Energy Laboratory and input from the five California lessees. The RPDE is a range of technical parameters that describe a representative offshore wind energy project that could occur within any of the Humboldt and Morro Bay leased areas. Table ES-1 outlines the parameters of the RPDE that are being used for the analysis of one representative project. The RPDE is not meant to be prescriptive, nor is it representative of any single lessee's project. Instead, the RPDE is a hypothetical, informed representative project to help guide environmental analysis in this PEIS and streamline subsequent COP-specific NEPA analysis.

Because the analysis in this Draft PEIS is being prepared before the Humboldt Bay or Morro Bay COPs have been submitted by lessees, actual locations of landfall and onshore facilities are unknown at this time. Therefore, this Draft PEIS describes the types of impacts anticipated or assumed from construction and operation of onshore components based on reasonable assumptions of corridors and buffers for export cable routes and landfall locations. Onshore elements are included in BOEM's analysis in the

Draft PEIS to support the evaluation of a complete project and for future tiering; however, BOEM's authority under the Outer Continental Shelf Lands Act extends only to the activities on the OCS.[1]

The same types of design parameters described for one project each in Humboldt and Morro Bay would also apply to development in all five Humboldt and Morro Bay leased areas, except that the number and length of each parameter would be scaled for five projects.

Table ES-1. Assumed RPDE parameters

Element	Project Design Element	Typical Range
Plant layout	Plant capacity	750–3,000 MW
	Number of WTGs	30–200
	Turbine spacing	0.5–1.6 nautical miles (920 meters–3 kilometers)
	Watch circle radius	Up to 1,150 feet (350 meters)
	Capacity density	3–9 MW/km^2
WTGs	Turbine rating	15–25 MW
	Turbine rotor diameter	750–1,000 feet (230–305 meters)
	Total turbine height	850–1,100 feet (260–335 meters)
	Turbine installation method	A floating substructure, with turbine pre-installed at port or sheltered location, towed out to site by a towing vessel group or floating substructure towed to site, with turbine installed at site by a wind turbine installation vessel or heavy-lift vessel.
	WTG substructure type	Semisubmersible, barge, or tension-leg platform (TLP); conventional spar may not be feasible but other ballast-stabilized designs may be considered.
Moorings	Mooring line configuration	Taut, semi-taut, or tension leg; catenary moorings are possible but less likely.
	Mooring arrangements	3–12 mooring lines per turbine or substation, shared-anchor arrangements are possible, shared-mooring arrangements are possible but less likely.
	Mooring line materials	Synthetic fiber rope (polyester, high-modulus polyethylene (HMPE), nylon), steel chain, steel wire rope, steel or fiber tendons (e.g., carbon fiber). May also include buoyancy modules, clump weights, load reduction devices, and other accessories.
	Anchor type	Depending on soil type and mooring configuration: suction caisson, helical anchor, plate anchor (vertical load anchor or suction-embedded plate anchor), dynamically embedded (torpedo) anchor, driven pile, drilled pile, micropile, gravity anchor; drag embedment anchor is possible but less likely.
	Anchor materials	Steel or concrete; drilled piles and micropiles may use grout
	Seabed footprint radius	160–8,500 feet (50–2,600 meters)
	Seabed contact area	0.05–75 acres (200–300,000 square meters)

[1] For this PEIS, *offshore* means on the OCS. *Nearshore* means state waters (up to 3 nm from shore).

Element	Project Design Element	Typical Range
OSSs	Number and type of OSSs	1–6
	OSS substructure type	Floating: semisubmersible, barge, TLP, spar Emerging technology: subsea substation[2]
	OSS seabed footprint radius	160–8,500 feet (50–2,600 meters)
	OSS seabed contact area	0.05–75 acres (200–300,000 square meters)
Array cables	Total array cable length	0.5–2.7 nm (1–5 kilometers) average per WTG; individual cables may be up to 10.8–16.2 nm (20–30 kilometers) in some circumstances.
	Array cable diameter	5.5–9.8 inches (14–25 centimeters)
	Target array cable depth	At least 200 feet (60 meters) below water surface.
	Array cable configurations	Cables and mooring lines may be suspended in the water column, laid on the seabed, or buried; suspended configurations can include, but are not limited to, lazy wave, catenary, steep wave, or suspended U.
	Array cable installation methods	Cable lay vessel, possibly assisted by a remotely operated vessel (ROV) and/or construction support vessel.
	Cable protection types	Dynamic cables: accessories for cable protection may include bend stiffeners, dynamic bend restrictors, buoyancy modules, sleeves, seabed tethers, anchors or any other combination of protection means as determined by the site-specific design Seabed: protection could include burial, rock dumping, or mattresses.
Export cables	Number of export cables	2–8
	Total export cable route length	19–270 nautical miles (35–400 kilometers) per cable (offshore)
	Export cable voltage	Up to 525 kV (DC) or 420 kV (AC)
	Export cable diameter	4.7–14 inches (12–36 centimeters)
	Export cable configuration	Dynamic cable between a floating substation and the seabed, with a transition joint to static cable for remaining length; static cable between a subsea substation and cable landfall.
	Export cable seabed disturbance (width)	Up to 43 feet (13 meters), or cable diameter if not buried.
	Export cable spacing	2–3 times the water depth on at least one side of a cable to provide repair access; minimum 160–660 feet (50–200 meters) between adjacent cables.
	Target export cable burial depth	3–10 feet (1–3 meters); burial may not be required along full cable route depending on seabed conditions, vessel traffic, and other factors considered in a cable burial risk assessment.

[2] As subsea substations are considered an emerging technology, they are not discussed further in this PEIS because of the uncertainty around potential impacts.

Element	Project Design Element	Typical Range
	Export cable installation methods	Trenchless: horizontal direct drilling (HDD), direct pipe, micro-tunnel, jack and bore. Trenched: open cut trench, direct burial. Tools and vessels: cable lay vessel, ROV, cable plow, hydro plow, jetting sled, vertical injector, tracked trencher.
	Cable protection types	Dynamic cables: accessories for cable protection may include bend stiffeners, dynamic bend restrictors, buoyancy modules, sleeves, seabed tethers, anchors, or any other combination of protection means as determined by the site-specific design. Seabed: burial, rock, concrete mattress (at crossings).
Onshore facilities	Transmission points of interconnection	Various potential points of interconnection may be considered.
	Ports	Potential staging and integration ports: Port of Humboldt, Port of Long Beach, Port of Los Angeles. Additional ports in California that could support component storage, laydown, fabrication, or operations and maintenance: the Ports of Stockton, Benicia, Richmond, Oakland, San Francisco, Redwood City, San Luis, Hueneme, and San Diego; the Crescent City Harbor District; the cities of Alameda, Pittsburg, and Morro Bay; Pillar Point Harbor; the Diablo Canyon Power Plant; Ellwood Pier. Ports outside California may also support component manufacturing, storage, or installation.

ES.4.3 Alternative C (Proposed Action) – Adoption of Mitigation Measures

Alternative C, the Proposed Action, is BOEM's prospective adoption of a suite of program-level mitigation measures that could be, but may not necessarily be, applied to activities associated with Alternative B to reduce or avoid potential impacts. This alternative analyzes the change in impacts from those discussed under Alternative B. Appendix E, *Mitigation*, identifies the mitigation measures that make up the Proposed Action.

Other than the adoption of mitigation measures, all design parameters for Alternative C would be the same as described under Alternative B for project components and activities undertaken for construction, operations and maintenance, and decommissioning. Similar to Alternative B, Alternative C examines two build-out scenarios: (1) one representative project each in Humboldt and Morro Bay and (2) five representative projects (two in Humboldt and three in Morro Bay).

ES.5 Environmental Impacts

This Draft PEIS analyzes the No Action Alternative first to consider existing baseline conditions. The existing condition of resources as influenced by past and ongoing activities and trends represents the existing baseline condition for impact analysis. This document analyzes the additive effects of future planned activities described in Appendix C. The impact analysis of the action alternatives (Alternatives B and C) considers the effects of one representative project each in Humboldt and Morro Bay (i.e., two total projects), as well as five representative projects when added to the existing baseline condition of each resource. Cumulative impacts for the action alternatives are then developed by considering the additive effects of reasonably foreseeable planned activities.

Table ES-2 summarizes the impacts of each alternative; refer to the Chapter 3 resource sections for additional analysis supporting these impact determinations.

Table ES-2. Summary and comparison of impacts among alternatives

Resources	Alternative A – No Action	Alternative B – Development with No Mitigation Measures	Alternative C (Proposed Action) – Adoption of Mitigation Measures
3.2.1 Air Quality and Greenhouse Gas Emissions	Existing environmental trends and ongoing activities would continue to affect air quality. Ongoing activities would continue to have regional air quality impacts primarily through air pollutant emissions, accidental releases, and climate change. Ongoing activities would likely result in impacts on air quality because of air pollutant emissions and GHGs.	Alternative B could have a net decrease in overall emissions for the region compared to emissions from conventional fossil-fuel power plants. Alternative B would result in air quality impacts during construction, maintenance, and decommissioning, but there would be a beneficial impact on air quality in the surrounding region to the extent that the wind energy produced would displace energy produced by fossil-fuel power plants.	Alternative C would result in the same impacts and beneficial impacts as Alternative B; however, emissions (related to construction) could be reduced through mitigation measures.
3.2.2 Water Quality	Water quality would continue to follow current regional trends and respond to ongoing environmental and commercial activities, including climate change. Ongoing activities would likely result in temporary impacts primarily through accidental releases and sediment suspension related to vessel traffic, port utilization, presence of structures, discharges/intakes, and land disturbance.	Alternative B would likely have impacts across several IPFs, including accidental releases, invasive species, and anchoring.	Alternative C would result in the same impacts as Alternative B; mitigation measures would reduce impacts of anchoring and sediment disturbance.
3.3.1 Bats	Bats would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities would have temporary, long-term, and permanent impacts (disturbance, displacement, injury, and mortality) on bats primarily through noise, lighting, presence of structures, traffic, and climate change.	Alternative B would likely have impacts on bats. The most acute risk would be from operation of the offshore WTGs, which could lead to long-term impacts (injury and/or mortality). Impacts are anticipated to be more likely during spring and fall migration when higher numbers of bats have been documented offshore. However, there is currently insufficient data on bat presence, abundance, and behavior in the OCS to quantify these impacts.	Alternative C would result in the same impacts as Alternative B; however, mitigation measures under Alternative C may reduce impacts on bats in the offshore environment, though the extent of any reduction would depend on project-level detail not available at the programmatic stage.

Resources	Alternative A – No Action	Alternative B – Development with No Mitigation Measures	Alternative C (Proposed Action) – Adoption of Mitigation Measures
3.3.2 Benthic Resources	Ongoing activities such as repetitive channel deepening, dredging, trawling for commercial fisheries, and the ongoing installation and maintenance of submarine cables would continue to have short- and long-term impacts. Impacts on species would be unavoidable but are not expected to result in population-level effects, especially if sensitive habitats are avoided and disturbances are temporally and spatially distributed.	Alternative B would likely have impacts on benthic resources. Beneficial impacts are expected for species that are able to colonize the newly added hard surfaces and those attracted by new food sources or shelter.	Alternative C would result in the same impacts as Alternative B; however, mitigation measures may benefit benthic communities, especially sensitive species. Beneficial impacts are also expected for species that would colonize the newly added hard surfaces and benefit from the fish aggregation device. This may, in turn, benefit species attracted to these areas for food sources and shelter, increasing the reef effect.
3.3.3 Birds	Birds would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities would continue to have temporary and permanent impacts (disturbance, displacement, injury, mortality, habitat degradation, habitat alteration) primarily through construction and climate change.	Alternative B would have impacts on birds depending on the offshore lighting scheme, the duration and timing of construction activities, and affected species. Operation of the offshore WTGs would pose the largest risk and could lead to long-term impacts (mortality and displacement). Alternative B could also result in increased foraging opportunities for some marine birds.	Alternative C would result in the same impacts as Alternative B; however, mitigation measures could reduce potential impacts on birds. Alternative C could also result in increased foraging opportunities for some marine birds.
3.3.4 Coastal Habitat, Fauna, and Wetlands	Ongoing activities would continue to have temporary, long-term, and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on coastal habitat and fauna. Land disturbance from onshore development would cause temporary and permanent loss of wetlands. Permanent wetland impacts would likely occur, requiring compensatory mitigation because climate change is predicted to affect coastal habitat and fauna.	Alternative B would have impacts on coastal habitat, fauna, and wetlands, depending on the amount and quality of coastal habitat altered or removed and the area/type of wetlands affected (if any) and duration of impact. Any identified wetland impacts would be subject to mitigation requirements set forth in the Clean Water Act Section 404(b)(1) guidelines of avoidance, minimization, and compensatory mitigation, likely reducing such impacts.	Alternative C would result in the same impacts as Alternative B; however, mitigation measures could reduce some impacts associated with cable installation and maintenance, EMFs and cable heat, and noise. Impacts on wetlands would remain similar and remain subject to Clean Water Act requirements/associated minimization and mitigation.

Resources	Alternative A – No Action	Alternative B – Development with No Mitigation Measures	Alternative C (Proposed Action) – Adoption of Mitigation Measures
3.3.5 Fishes, Invertebrates, and Essential Fish Habitat	Ongoing activities would continue to have temporary and permanent impacts on fishes, invertebrates, and EFH primarily through climate change, commercial fishing activities, dredging, anthropogenic noise, new cable installation, invasive species, port improvements, and the presence of structures.	Alternative B would result in impacts, depending on the IPF and which leased areas would be developed. Alternative B would result in the potential loss of HAPCs in leased areas. For both project scenarios, beneficial impacts are expected for species that can colonize newly added hard surfaces.	Alternative C would result in the same impacts as Alternative B; although mitigation measures would reduce impacts. For both project scenarios, beneficial impacts are also expected for species that can colonize newly added hard surfaces.
3.3.6 Marine Mammals	Ongoing activities such as climate change would continue to affect marine mammal foraging and reproduction through changes to the distribution and abundance of marine mammal prey.	Alternative B would have impacts on mysticetes, odontocetes, pinnipeds, and fissipeds, with potentially beneficial impacts on odontocetes and pinnipeds though such benefits may be offset by increased entanglement risk with WTG structures/moorings.	Alternative C would result in the same impacts as Alternative B; however, mitigation measures would reduce impacts for mysticetes, odontocetes, pinnipeds, and fissipeds. Potentially beneficial impacts would occur for odontocetes and pinnipeds.
3.3.7 Sea Turtles	Sea turtles would continue to be affected by existing environmental trends and ongoing activities. In addition to climate change, BOEM expects a range of sea turtle impacts (disturbance, displacement, injury, mortality, and reduced foraging success).	Alternative B would result in impacts on sea turtles. Beneficial impacts are expected from the presence of structures primarily due to an increase in foraging opportunity due to the reef effect. These beneficial effects could be offset by increased risk of entanglement due to derelict fishing gear on the structures.	Alternative C would result in the same impacts as Alternative B; however, mitigation measures would reduce some impacts. Impacts under Alternative C would not affect the continued viability of any sea turtle populations. Beneficial impacts are expected from the presence of structures/reef effect.
3.4.1 Commercial Fisheries and For-Hire Recreational Fishing	Ongoing activities would continue to have temporary to long-term impacts on commercial fisheries and for-hire recreational fishing. The extent of impacts would vary by fishery due to differing target species, gear type, and location.	Alternative B would result in impacts on commercial fisheries and for-hire recreational fishing overall. Beneficial impacts on for-hire recreational fishing may also occur based on the potential bolstering of for-hire recreational fishing opportunities due to the reef effect. Such benefits would depend on the ability of fore-hire vessels to safely fish around structures and would be limited to for-hire vessels capable of making longer trips that	Alternative C would result in the same impacts as Alternative B; however, mitigation measures would reduce impacts although impacts on commercial fisheries and for-hire recreational fishing would be similar, overall. Under Alternative C, beneficial impacts on for-hire recreational fishing may also occur based on the potential bolstering of for-hire recreational fishing opportunities due to the reef effect.

Resources	Alternative A – No Action	Alternative B – Development with No Mitigation Measures	Alternative C (Proposed Action) – Adoption of Mitigation Measures
		would be required to reach the leased areas.	
3.4.2 Cultural Resources	Cultural resources would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities would continue to have temporary, long-term, and permanent impacts (marine, terrestrial, and visual) on cultural resources in the Affected Environment through seabed, terrestrial, and visual disturbance.	Alternative B would likely result in impacts on cultural resources because the increased amount of development increases the likelihood that impacts would be physically damaging or cause permanent setting changes, and that such impacts would occur on a greater number of cultural resources.	Alternative C would result in the same impacts as Alternative B. Adoption of mitigation measures could enable a more consistent process, allowing the future COP-specific NEPA and NHPA reviews, consultations, and plans to be focused on project-specific impacts. However, at this programmatic stage, more conclusive determinations of the effectiveness of mitigation are not possible; therefore, their impact on cultural resources have yet to be determined.
3.4.3 Demographics, Employment, and Economics	Tourism, recreation, and ocean-based industries such as marine transportation would continue to be important components of the regional economies. Ongoing activities would continue to have impacts on demographics, employment, and economics in the Affected Environment. Beneficial impacts on demographics, employment, and economics would occur from the continued operation of existing sectors in the ocean economy.	Alternative B would result in impacts on demographics, employment, and economics through job creation and increased business revenue. Effects could be offset by beneficial effects on regional economies from increased economic activity and employment associated with the development of offshore wind energy in the regions of greatest port and manufacturing activity.	Under Alternative C, impacts on demographics, employment, and economics would likely remain the same as Alternative B, i.e., impacts through job creation and increased business revenue.
3.4.4 Environmental Justice	Numerous ongoing activities, both on- and offshore, would continue to affect environmental justice communities in the Affected Environment. Additional impacts would be driven by the effects of climate change and the ability for coastal communities to readily adapt to population	Alternative B would have impacts on environmental justice communities. Alternative B may also result in beneficial impacts from port expansion/use resulting from positive contributions to employment and revenue from offshore wind energy development activities. In addition, the potential long-term health benefits	Under Alternative C, impacts on environmental justice communities would be slightly reduced compared to Alternative B as a result of mitigation, including the measure intended to lessen impacts on commercial and for-hire recreational fishing.

Resources	Alternative A – No Action	Alternative B – Development with No Mitigation Measures	Alternative C (Proposed Action) – Adoption of Mitigation Measures
	migration (housing disruptions), sea level rise, and storm surge threats.	associated with displacement of energy produced by fossil-fueled power plants would have beneficial health effects to the extent that current health issues are related to fossil-fuel power plants.	
3.4.5 Tribal Values and Concerns Analysis	Ongoing activities would continue to have temporary, long-term, and permanent impacts on resources of Tribal value and concern in the prospective Affected Environment through seabed, terrestrial, and visual disturbances and intrusions.	Alternative B would result in impacts with the degree or extent of impacts anticipated to be greater in proportion to the level of development. Greater economic activity in ports could have beneficial impacts on Tribal communities and, in turn, resources of Tribal value and concern. Impacts of one or five representative projects would be due to the extent of onshore and offshore development that could introduce physical and visual impacts on resources of Tribal value and concern.	Under Alternative C, adherence to mitigation measures could lessen impacts on resources of Tribal value and concern, but given numerous uncertainties about the location, nature, and extent of such resources, impacts would, at this programmatic stage, remain the same as Alternative B— impacts with the potential for beneficial economic impacts for either one or five representative projects.
3.4.6 Land Use and Coastal Infrastructure	Land use and coastal infrastructure would continue to be affected by existing environmental trends and ongoing activities, as well as climate change.	Alternative B would likely have impacts because of increased onshore land disturbance and infrastructure, as well as beneficial impacts from port utilization.	Alternative C would result in the same impacts and beneficial impacts as Alternative B. The mitigation measure that would be implemented under Alternative C may slightly reduce overall impacts on land use by minimizing temporary construction impacts.
3.4.7 Navigation and Vessel Traffic	Navigation and vessel traffic would continue to be affected by existing socioeconomic trends and ongoing activities. Under the No Action Alternative, ongoing activities would continue to have short- and long-term impacts on navigation and vessel traffic, primarily through the IPFs of anchoring, cable installation and maintenance, port utilization, and vessel traffic.	Alternative B would result in impacts. Needed port upgrades for offshore wind development would contribute to baseline traffic levels. Impacts on vessels (not associated with wind energy) include changes in navigation routes, delays in ports, degraded radar signals, and increased difficulty of offshore search and rescue or surveillance missions in each of the leased areas, all of which would	Alternative C would result in the same impacts as Alternative B, including anchoring and the remaining IPFs, as impacts cannot be fully avoided. The mitigation measures that would be implemented under Alternative C could reduce impacts associated with cable installation, presence of structures, and vessel traffic depending on project-level details.

Resources	Alternative A – No Action	Alternative B – Development with No Mitigation Measures	Alternative C (Proposed Action) – Adoption of Mitigation Measures
		increase navigational safety risks. Commercial deep-draft vessels would choose to avoid the leased areas altogether, leading to potential funneling of vessel traffic along leased-area borders. In addition, increased potential for marine accidents, which may result in injury, loss of life, and property damage, could produce disruptions for ocean users.	
3.4.8 Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)	Other uses would continue to be affected by existing environmental trends and activities. Existing operations nearshore and on the OCS could increase vessel traffic and navigational complexity of the region.	Alternative B would result in impacts on other uses. The construction of WTGs would result in increased navigational complexity and increased allision risk. The presence of WTGs in the line of sight could interfere with radar systems. The seafloor footprint of WTG anchors and the presence of offshore export cables would affect existing cables and pipelines. Scientific research and surveys would be affected, particularly for NOAA surveys supporting commercial fisheries and protected-species research programs.	Alternative C would result in the same impacts as Alternative B. The mitigation measures that would be implemented under Alternative C would reduce impacts on radar systems relative to Alternative B.
3.4.9 Recreation and Tourism	Under the No Action Alternative, recreation and tourism would continue to be affected by existing environmental trends and ongoing activities. Under Alternative A, impacts of ongoing activities would continue to have effects on recreation and tourism in the Affected Environment. The extent of impacts on recreational fisheries would vary by fishery due to different target species, gear type, and location of activity. These effects would primarily stem	Alternative B would have impacts due to increased anchoring, cable installation and maintenance, and presence of structures.	Alternative C would result in the same impacts as Alternative B. Mitigation measures could reduce impacts on recreation and recreational fishing by ensuring environmental cleanliness and navigational safety, ensuring minimal habitat disruption, and minimizing nighttime visual disturbances.

Resources	Alternative A – No Action	Alternative B – Development with No Mitigation Measures	Alternative C (Proposed Action) – Adoption of Mitigation Measures
	from climate change, with fisheries-management agencies expected to adjust to shifting distributions and other climate-related factors.		
3.4.10 Scenic and Visual Resources	Under the No Action Alternative, regional trends and activities would continue, and scenic and visual resources would continue to be affected by natural and human-caused IPFs. The coastal landscape's character would change in the short and long terms through natural processes and ongoing activities that would continue to shape onshore features, character, and viewer experience.	Alternative B would result in impacts, due to view distances; minor to moderate FOVs; strong, moderate, and weak visual contrasts; clear-day conditions; and nighttime lighting. Due to distance, extensive FOVs, strong contrasts, large scale of change, and level of prominence, as well as heretofore undeveloped ocean views, the representative projects would affect the open ocean character unit and viewer boating and cruise ship experiences.	Alternative C would result in the same impacts as Alternative B. Mitigation has potential to avoid or reduce these impacts by grouping transmission infrastructure and developing and adhering to a visual monitoring plan.

GHGs = greenhouse gases; IPFs = impact-producing factors; EMFs = electromagnetic fields; EFH = essential fish habitat; HAPCs = Habitat Areas of Particular Concern; NHPA = National Historic Preservation Act; FOVs = fields of view

Chapter 1

Introduction

1.1 Overview

In December 2022, through a competitive leasing process under 30 Code of Federal Regulations (CFR) 585.210, the Bureau of Ocean Energy Management (BOEM) auctioned Commercial Leases OCS-P 0561, 0562, 0563, 0564, and 0565 offshore California. These leases total over 373,000 acres (about 583 square miles). They are the first wind energy leases offshore California and are anticipated to use floating foundations to anchor in waters from 1,640 to 4,265 feet (500 to 1,300 meters) deep. Two leases are offshore Northern California, near Humboldt. The other three leases are offshore central California, near Morro Bay (Figure 1-1).

BOEM identified these areas for consideration in development of commercial-scale offshore wind energy projects, subject to the appropriate reviews and approvals, through an extensive data-gathering and engagement process. This process included the BOEM California Intergovernmental Renewable Energy Task Force, which includes the state of California and numerous Tribal Nations, federal agencies, and local governments.

The Proposed Action does not include the approval of any activity, nor does it require any specific action by BOEM or lessees. Moreover, BOEM's issuance of leases does not convey any right to proceed with construction of a wind energy facility. A lessee would collect survey information to determine whether the leased site is suitable for commercial development and, if so, submit to BOEM a Construction and Operations Plan (COP) with project-specific design parameters. All leases grant the lessees the exclusive right to submit COPs to BOEM proposing the construction, operation, and decommissioning of offshore wind energy facilities in the leased areas. In turn, BOEM would evaluate the impacts of the activities described in the COP in a separate National Environmental Policy Act (NEPA) process, likely an Environmental Impact Statement (EIS).

This subsequent EIS process would include, but would not be limited to, scoping, required consultations with the appropriate federal, Tribal, state, and local entities; public involvement including public meetings and comment periods; collaboration with the BOEM California Intergovernmental Renewable Energy Task Force; and preparation of an independent, comprehensive, site- and project-specific impact analysis using the best available information. BOEM would use the information and analysis provided through the EIS process to determine whether to approve, approve with modification, or disapprove a lessee's COP pursuant to 30 CFR 585.628. BOEM retains the authority to prevent the environmental impacts of a commercial wind power facility from occurring by disapproving a COP for failure to meet the statutory standards set forth in the Outer Continental Shelf Lands Act (OCSLA).

The Proposed Action for this Programmatic EIS (PEIS) is the prospective adoption of programmatic protective mitigation measures that BOEM may consider as conditions of approval for activities proposed by lessees in COPs submitted for the Humboldt and Morro Bay leased areas. The term *mitigation measures* used here complies with the regulatory definition (40 CFR 1508.1(y)) and provides consistent terminology with the five California offshore wind leased areas.

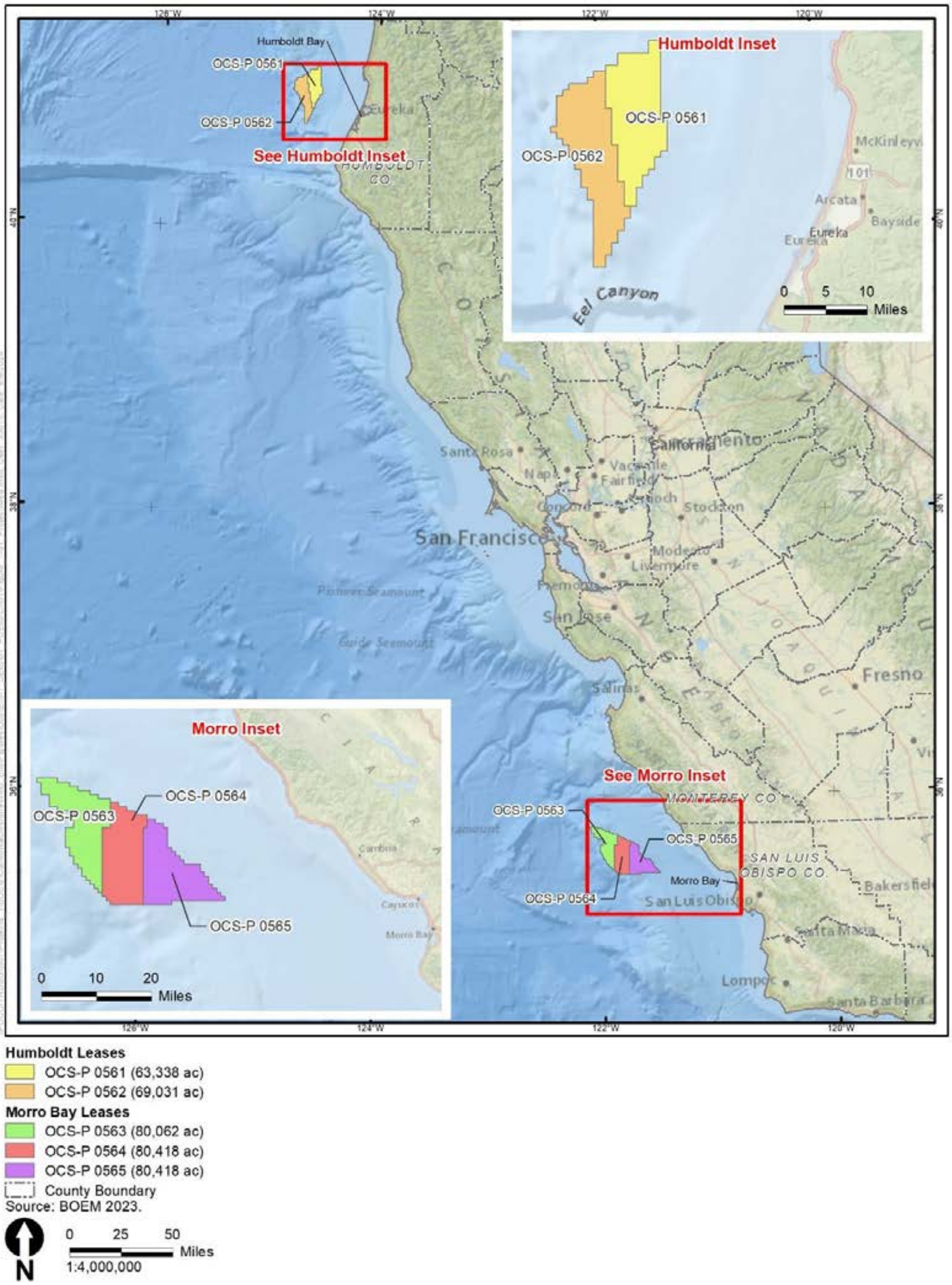

Figure 1-1. Humboldt and Morro Bay leased areas

The PEIS forecasts potentially adverse impacts associated with leased area build out and analyzes proposed mitigation measures that may be implemented to avoid or reduce such impacts. BOEM may require additional or different measures if a COP-specific NEPA analysis indicates such measures would avoid or reduce impacts. This PEIS neither analyzes a specific COP nor will it result in the approval of any construction and operation activities.

BOEM has prepared this Draft PEIS in accordance with the Council on Environmental Quality (CEQ) NEPA implementing regulations effective July 1, 2024. Additionally, this Draft PEIS was prepared consistent with the U.S. Department of the Interior (DOI) NEPA regulations (43 CFR Part 46), federal judicial and regulatory interpretations, and administration priorities and policies.

1.2 Background

In 2009, DOI announced final regulations for the Outer Continental Shelf (OCS) Renewable Energy Program, authorized by the Energy Policy Act of 2005 (Energy Policy Act; Public Law 109-58). BOEM's renewable energy program occurs in four phases: (1) regional planning and analysis, (2) lease issuance, (3) site assessment, and (4) construction and operations. Table 1-1 summarizes the history of BOEM's planning and leasing activities offshore California.

Table 1-1. History of BOEM planning and leasing activities offshore California

Year	Milestone
2014	The BOEM Offshore Renewable Energy Workshop discussed the potential for California Offshore Wind projects (Dvorak 2014).
2016	The BOEM California Intergovernmental Renewable Energy Task Force was created to provide critical information to the decision-making process for planning future offshore renewable energy development opportunities in federal waters offshore California. The task force is a partnership of members of state, local and Tribal governments, and federal agencies. The first task force meeting was held October 13, 2016. Four additional Task Force meetings occurred from 2016 to 2022 (BOEM 2023).
2016	In January 2016, BOEM received an unsolicited request for a commercial lease from Trident Winds LLC. To determine further interest, BOEM published a request for interest in the *Federal Register* (Docket No. BOEM-2016-0051, August 18, 2016). Based on responses, BOEM determined that competitive interest existed offshore California. BOEM and the state of California initiated the planning and leasing process (DOI 2016).
2016	In early November 2016, BOEM, along with other participating organizations, held the California Ocean Renewable Energy Conference as a forum to share information about regulatory frameworks, resources, technologies, and environmental research relating to wind and wave energy offshore California with the goal of informing and improving collaboration among stakeholders in wind and wave energy offshore California (BOEM 2023).
2017	In March 2017, BOEM joined the state of California and San Luis Obispo County at a local informational forum on offshore wind planning in California to share information with the public about current planning activities for possible offshore wind development (BOEM 2017).
2018	In October 2018, BOEM published a Call for Information and Nominations for three call areas off the California coast (Humboldt Bay, Morro Bay, Diablo Canyon).

Year	Milestone
2020	On July 1, 2020, BOEM held a workshop to take comments on additional considerations for offshore wind energy off the Central Coast of California, which also gave the public the option to submit written comments within the same month (CEC 2020).
2021	On July 22–23, 2021, the Pacific Fishery Management Council held an online public meeting to consider information on marine planning and offshore development and activities. BOEM and the Pacific Fishery Management Council presented information related to the planning process for identifying potential offshore wind energy sites in the U.S. Exclusive Economic Zone (PFMC 2021).
2021	On August 24, 2021, BOEM held a virtual scoping meeting for the Humboldt Wind Energy Area (WEA) Draft Environmental Assessment (EA) (BOEM 2021a).
2021	On September 9, 2021, the California Coastal Commission held an informational briefing on offshore wind. Commission staff provided an informational briefing on the process of federal consistency review for the proposed offshore wind lease sale (CCC 2021).
2021	In December 2021, BOEM held a virtual scoping meeting for the Morro Bay WEA Draft EA (BOEM 2021b).
2022	On May 5, 2022, BOEM issued a news release announcing the availability of the Humboldt WEA Final EA and Finding of No Significant Impact (FONSI; BOEM 2022a).
2022	On May 26, 2022, DOI announced the Proposed Sale Notice for offshore wind development in federal waters off central and northern California.
2022	On October 5, 2022, BOEM announced the availability of the Morro Bay WEA Final EA and FONSI (BOEM 2022b).
2022	On December 6–7, 2022, BOEM's Pacific Office held the California lease auction.
2023	In April 2023, BOEM began issuing leases for the five lease areas in the Humboldt and Morro Bay WEAs.
2023	On December 20, 2023, BOEM published a Notice of Intent (NOI) in the *Federal Register* announcing preparation of a PEIS covering the Humboldt and Morro Bay lease areas.
2024	On February 6 and 8, 2024, BOEM conducted NEPA scoping meetings for the PEIS.

1.3 Purpose of and Need for the Proposed Action

The purpose of the Proposed Action is to identify and analyze potential mitigation measures that BOEM can, but may not necessarily, require as conditions of approval for future COPs or that lessees can choose to incorporate directly into their COPs. This Draft PEIS will also address the following additional objectives.

- Analysis of potential impacts if development is authorized in the five leased areas.
- Analysis of programmatic mitigation measures to apply to development of the five leased areas.
- Analysis of regional cumulative effects.
- Providing a tiering document for project-specific environmental analyses.

This PEIS will allow BOEM to focus subsequent site- and project-specific environmental analyses and consultations on the unique impacts of individual proposed wind energy projects and on cumulative regional impacts. The need for the Proposed Action is to ensure BOEM can make timely decisions on COPs submitted by lessees for the Humboldt and Morro Bay leased areas. Timely decisions further the

United States' policy to make OCS energy resources available for expeditious and orderly development, subject to environmental safeguards (43 United States Code [USC] 1332(3)) and other requirements listed at 43 USC 1337(p)(4). Wind energy development on the leaseholds will assist with meeting federal and state renewable energy goals, including the U.S. Government's goals of deploying 30 gigawatts (GW) of offshore wind energy capacity by 2030 and 15 GW of floating offshore wind capacity by 2035, as well as California's goal of 2–5 GW of offshore wind energy generation by 2030.

1.4 Regulatory Overview

Subsection 8(p) of the OCSLA (43 USC 1331 et seq.)[1] authorizes the Secretary of the Interior to issue leases, easements, and rights-of-way (ROW) on the OCS for activities that "produce or support production, transportation, or transmission of energy from sources other than oil and gas," which include wind energy projects.

The Secretary of the Interior delegated this authority to the former Minerals Management Service, and later to BOEM. Final regulations implementing the authority for renewable energy leasing under the OCSLA (30 CFR Part 585) were promulgated on April 22, 2009.[2] These regulations prescribe BOEM's responsibility for determining whether to approve, approve with modifications, or disapprove COPs submitted for the five leased areas (30 CFR 585.628).

OCSLA Subsection 8(p)(4) requires the Secretary of the Interior to ensure that any activity under subsection 8(p) is carried out in a manner that provides for safety, protection of the environment, prevention of waste, and conservation of the U.S. OCS's natural resources, while allowing for oversight, inspection, research, or other related activities for any given lease, easement, or ROW. Subsection 8(p) also requires that any given activity involve coordination with relevant federal agencies; protect correlative rights[3] in the OCS; provide a fair return to the United States; prevent interference with reasonable uses of the exclusive economic zone, the high seas, and the territorial seas; and consider the location of and schedule related to any agreement over an area of the OCS. As stated in M-Opinion 37067, ". . . subsection 8(p)(4) of the OCSLA imposes a general duty on the Secretary to act in a manner providing for the subsection's enumerated goals. The subsection does not require the Secretary to ensure that the goals are achieved to a particular degree, and she retains wide discretion to determine the appropriate balance between two or more goals that conflict or are otherwise in tension."[4]

Executive Order 14008, Tackling the Climate Crisis at Home and Abroad, (January 27, 2021), states the Biden administration's policy of combating climate change through many means, including the deployment of clean energy technologies and infrastructure. To support the goals of Executive Order

[1] Public Law No. 109-58, Section 119 Stat. 594 (2005).

[2] Renewable Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf, 74 *Federal Register* 19638–19871 (April 29, 2009).

[3] *Correlative rights* refers to a legal doctrine intended to help ensure that shared resources, such underground deposits of fossil fuels, are fairly allocated.

[4] M-Opinion 37067 at page 5, http://doi.gov/sites/doi.gov/files/m-37067.pdf.

14008, the administration announced plans to increase renewable energy production, with a national goal of 30 GW of offshore wind energy capacity by 2030. The potential development of the California leased areas would assist with meeting this goal.

BOEM's evaluation of offshore wind energy development is further governed by various applicable federal statutes and implementing regulations. BOEM is also required to coordinate with federal agencies, Tribes, and state and local governments and ensure that renewable energy development occurs in a safe and environmentally responsible manner. Appendix D, *Consultation and Coordination,* describes BOEM's consultation efforts with Tribal Nations and federal, state, regional, and local stakeholders during development of this PEIS.

1.5 Relevant Existing NEPA and Consulting Documents

BOEM used the following documents to inform the preparation of this Draft PEIS.

- January 2020 Programmatic Agreement between DOI, the California State Historic Preservation Officer, and the Advisory Council on Historic Preservation regarding review of OCS Energy Activities offshore California under Section 106 of the National Historic Preservation Act (NHPA) (BOEM 2020).
- Humboldt and Morro Bay WEA EAs, which examined prospective impacts of site assessment and characterization activities. BOEM adopted FONSIs for Humboldt in May 2022 and Morro Bay in October 2022.

For information on BOEM-funded studies relevant to California offshore wind development, refer to https://www.boem.gov/environment/environmental-studies-pacific.

1.6 Representative Project Design Envelope

A Representative Project Design Envelope (RPDE) is a range of technical parameters that describe a representative offshore wind energy project that could occur in any of the five leased areas. In conjunction with the National Renewable Energy Lab (NREL) and the lessees, BOEM developed an RPDE that reflects realistic project technical details (such as quantities and typologies). Refer to Chapter 2, *Alternatives,* for RPDE parameters and Appendix A, *Representative Project Design Envelope for Floating Offshore Wind Energy,* for the complete RPDE. The RPDE is not meant to be prescriptive, nor is it representative of any single lessee's project. Instead, the RPDE is a hypothetical, informed representative project to help guide environmental analysis in this PEIS and streamline subsequent COP-level review. This Draft PEIS assesses impacts of the RPDE by using the "maximum-case scenario" process to ensure all effects of the most impactful project design scenario are analyzed. The maximum-case scenario is composed of each design parameter or combination of parameters that would result in the greatest impact for each resource.

1.7 Assessing Programmatic Impacts

This PEIS also considers the impacts from past, present (ongoing), and reasonably foreseeable future (planned) actions that could contribute to cumulative impacts when combined with impacts from the Proposed Action and alternatives.

1.7.1 Past and Ongoing Activities and Trends (Existing Baseline)

Within this Draft PEIS, each resource-specific *Environmental Consequences* section in Chapter 3, *Affected Environment and Environmental Consequences,* describes the baseline conditions of the Affected Environment. The existing baseline considers past and present activities in the Affected Environment, including activities such as military training, existing vessel traffic, and port operations. Other factors currently affecting a particular resource, including climate change, are also acknowledged for that resource and are noted in the impact-level conclusion.

1.7.2 Planned Activities

It is reasonable to predict that on- and offshore development and related activities may occur over time, and that those activities could affect existing baseline conditions. The baseline condition for the cumulative impact analysis consists of past and present activities (existing baseline) with the addition of future planned activities described in Appendix C, *Planned Activities Scenario*. Each resource-specific *Environmental Consequences* section in Chapter 3 of this Draft PEIS separately analyzes cumulative impacts. Other planned activities of note include the National Oceanic Atmospheric Administration's (NOAA) fall 2024 designation of the Chumash Heritage National Marine Sanctuary (NOAA 2023).

Chapter 2

Proposed Action and Alternatives

This chapter (1) describes the alternatives carried forward for detailed analysis in this Draft PEIS, (2) describes non-routine activities and events that could occur during construction, operations and maintenance (O&M), and decommissioning of Humboldt and Morro Bay offshore wind projects; and (3) presents a summary and comparison of impacts among alternatives and resources affected.

2.1 Alternatives Analyzed in Detail

Under NEPA, the analysis of any major federal action requires consideration of a reasonable range of alternatives framed by the proposed action's purpose and need. Alternatives must be "reasonable," defined as those that are "technically and economically practical or feasible and meet the purpose and need of the proposed action" (43 CFR 46.420(b)). DOI also requires reasonable alternatives to "address one or more significant issues related to the proposed action" (43 CFR 46.415(b)).

BOEM considered alternatives developed in consultation with NREL and lessees. Table 2-1 summarizes these; Sections 2.1.1 through 2.1.3 describes them in detail. Also refer to Section 2.2, *Alternatives Considered but Not Analyzed in Detail*.

Table 2-1. Alternatives analyzed in detail

Alternative	Description
Alternative A – No Action Alternative	Assumes no development would occur in any of the five Humboldt and Morro Bay leased areas but other planned/reasonably foreseeable projects would proceed.
Alternative B – Development with No Mitigation Measures	Assumes offshore wind development in the Humboldt and Morro Bay leased areas without the application of any mitigation measures that could avoid, minimize, mitigate, and monitor those impacts.
Alternative C (Proposed Action) – Adoption of Mitigation Measures	Assumes offshore wind development in the Humboldt and Morro Bay leased areas (as in Alternative B) but with the adoption of programmatic mitigation measures intended to avoid/reduce such impacts.

2.1.1 Alternative A – No Action Alternative

This alternative assumes that no wind energy development would occur in the Humboldt and Morro Bay leased areas. However, Alternative A assumes all other ongoing or other reasonably foreseeable planned activities described in Appendix C, *Planned Activities Scenario,* would continue, which could cause changes to existing baseline conditions. Current resource conditions, trends, and impacts from ongoing activities provide context for the analyses of Alternatives B and C (described in Sections 2.1.2 and 2.1.3), as well as a baseline for the evaluation of cumulative impacts.

As of publication of this document, several prospective WEAs are being studied offshore[1] California and Oregon, but none have been leased and, thus, are considered too speculative for including as part of the baseline analysis of this PEIS. In April 2024, BOEM published a draft EA associated with the prospective leasing of two Oregon WEAs (off Brookings and Coos Bay). The EA focuses on potential effects of site characterization/site assessment activities that could take place following BOEM's possible future

[1] For this PEIS, *offshore* means on the OCS. *Nearshore* means state waters (up to 3 nm from shore).

issuance of commercial wind energy leases. Such activities are intended to allow lessees to gather sufficient information to inform future submittal of COPs. Therefore, for the purposes of this PEIS, site characterization and site assessment activities of the Oregon WEAs are considered reasonably foreseeable. Please refer to BOEM's draft EA for a discussion of associated environmental effects at https://www.boem.gov/renewable-energy/state-activities/commercial-wind-lease-issuance-pacific-outer-continental-shelf.

2.1.2 Alternative B – Development with No Mitigation Measures

Alternative B considers future offshore wind development in the Humboldt and Morro Bay leased areas, including non-routine activities and events during construction, O&M, and decommissioning, but without inclusion of any mitigation measures.

Analysis of Alternative B considers two scenarios intended to provide a basis for assessing minimum/maximum impact levels: (1) one representative project each in Humboldt and Morro Bay, and (2) five representative projects (two in Humboldt and three in Morro Bay, corresponding to the distribution of leased areas). Both scenarios consider potential impacts of such development on the environment. Alternative B also provides analysis for tiering at the COP-specific NEPA stage, including context that can be used in the analyses and against which proposed actions at the COP-specific stage may be compared.

As of 2024, all existing offshore wind turbines in the United States are secured directly to the Atlantic Ocean seafloor. There are no offshore wind turbines on the Pacific OCS. There are no floating offshore wind turbines off any U.S. coast and only limited operational floating offshore wind turbines globally. Offshore California, ocean depths of more than 1,640 feet (500 meters) make fixed-bottom foundations infeasible. Wind turbine generators (WTGs) and offshore substations (OSSs) in the subject leased areas would, thus, require floating substructures. While floating offshore wind technology continues to evolve, BOEM's understanding of the technical and design requirements is at a point where reasonable assumptions can be made for this PEIS. To this end, many RPDE parameters reflect multiple variations/options for particular criteria.

The basis for Alternative B is an RPDE developed in conjunction with NREL and input from the five California lessees. Table 2-2 outlines the parameters of the RPDE*;* refer to Appendix A, *Representative Project Design Envelope for Floating Offshore Wind Energy*, for the complete RPDE. The RPDE is not associated with any particular leased area but is instead intended to be a reasonable representation of the level of offshore wind development that could feasibly occur in any of the five Humboldt and Morro Bay leased areas. The RPDE is not meant to be prescriptive or to establish limits for future development. To provide bounds for this PEIS's analysis, the RPDE contains anticipated minimum and maximum values for most parameters or, alternatively, multiple options that could be selected. In general, maximum values in the RPDE represent the most intensive level of development that could occur. For example, any one of the five leased areas are not expected to contain more than 200 WTGs (the upper end of the RPDE).

Table 2-2. Assumed RPDE parameters

Element	Project Design Element	Typical Range
Plant layout	Plant capacity	750–3,000 megawatts
	Number of WTGs	30–200
	Turbine spacing	0.5–1.6 nautical miles (nm) (920 meters–3 kilometers)
	Watch circle radius	Up to 1,150 feet (350 meters)
	Capacity density	3–9 megawatts per square kilometer (MW/km^2)
WTGs	Turbine rating	15–25 megawatts
	Turbine rotor diameter	750–1,000 feet (230–305 meters)
	Total turbine height	850–1,100 feet (260–335 meters)
	Turbine installation method	A floating substructure, with turbine pre-installed at port or sheltered location, towed out to site by a towing vessel group or floating substructure towed to site, with turbine installed at site by a wind turbine installation vessel or heavy lift vessel.
	WTG substructure type	Semisubmersible, barge, or tension-leg platform (TLP); conventional spar may not be feasible but other ballast-stabilized designs may be considered.
Moorings	Mooring line configuration	Taut, semi-taut, or tension leg; catenary moorings are possible but less likely.
	Mooring arrangements	3–12 mooring lines per turbine or substation, shared-anchor arrangements are possible, shared-mooring arrangements are possible but less likely
	Mooring line materials	Synthetic fiber rope (polyester, high modulus polyethylene (HMPE), nylon), steel chain, steel wire rope, steel or fiber tendons (e.g., carbon fiber). May also include buoyancy modules, clump weights, load reduction devices, and other accessories.
	Anchor type	Depending on soil type and mooring configuration: suction caisson, helical anchor, plate anchor (vertical load anchor or suction embedded plate anchor), dynamically embedded (torpedo) anchor, driven pile, drilled pile, micropile, gravity anchor; drag embedment anchor is possible but less likely.
	Anchor materials	Steel or concrete; drilled piles and micropiles may use grout.
	Seabed footprint radius	160–8,500 feet (50–2,600 meters)
	Seabed contact area	0.05–75 acres (200–300,000 square meters)
OSSs	Number and type of OSSs	1–6
	OSS substructure type	Floating: semisubmersible, barge, TLP, spar Emerging technology: subsea substation[2]
	OSS seabed footprint radius	160–8,500 feet (50–2,600 meters)
	OSS seabed contact area	0.05–75 acres (200–300,000 square meters)

[2] Because subsea substations are considered an emerging technology without sufficient certainty to determine impacts, they are not discussed further in this PEIS.

Element	Project Design Element	Typical Range
Array cables	Total array cable length	0.5–2.7 nm (1–5 kilometers) average per WTG; individual cables may be up to 10.8–16.2 nm (20–30 kilometers) in some circumstances.
	Array cable diameter	5.5–9.8 inches (14–25 centimeters)
	Target array cable depth	At least 200 feet (60 meters) below water surface.
	Array cable configurations	Cables and mooring lines may be suspended in the water column, laid on the seabed, or buried; suspended configurations can include, but are not limited to, lazy wave, catenary, steep wave, or suspended U.
	Array cable installation methods	Cable lay vessel, possibly assisted by a remotely operated vessel (ROV) or construction support vessel.
	Cable protection types	Dynamic cables: accessories for cable protection may include bend stiffeners, dynamic bend restrictors, buoyancy modules, sleeves, seabed tethers, anchors or any other combination of protection means as determined by the site-specific design. Seabed: protection could include burial, rock dumping or mattresses.
Export cables	Number of export cables	2–8
	Total export cable route length	19–270 nm (35–400 kilometers) per cable (offshore)
	Export cable voltage	Up to 525 kilovolts direct current (DC) or 420 kilovolts alternating current (AC).
	Export cable diameter	4.7–14 inches (12–36 centimeters)
	Export cable configuration	Dynamic cable between a floating substation and the seabed, with a transition joint to static cable for remaining length; static cable between a subsea substation and cable landfall.
	Export cable seabed disturbance (width)	Up to 43 feet (13 meters), or cable diameter if not buried.
	Export cable spacing	2–3 times the water depth on at least one side of a cable to provide repair access; minimum 160–660 feet (50–200 meters) between adjacent cables.
	Target export cable burial depth	3–10 feet (1–3 meters), burial may not be required along full cable route depending on seabed conditions, vessel traffic and other factors considered in a cable burial risk assessment.
	Export cable installation methods	Trenchless: horizontal directional drilling (HDD) direct pipe, micro-tunnel, jack and bore. Trenched: open cut trench, direct burial. Tools and vessels: cable lay vessel, ROV, cable plow, hydro plow, jetting sled, vertical injector, tracked trencher.
	Cable protection types	Dynamic cables: accessories for cable protection may include bend stiffeners, dynamic bend restrictors, buoyancy modules, sleeves, seabed tethers, anchors, or any other combination of protection means as determined by the site-specific design. Seabed: burial, rock, concrete mattress (at crossings).

Element	Project Design Element	Typical Range
Onshore facilities	Transmission points of interconnection	Various potential points of interconnection may be considered.
	Ports	Potential staging and integration ports: Port of Humboldt, Port of Long Beach, Port of Los Angeles. Additional ports in California that could support component storage, laydown, fabrication, or O&M: the Ports of Stockton, Benicia, Richmond, Oakland, San Francisco, Redwood City, San Luis, Hueneme, and San Diego; the Crescent City Harbor District, the cities of Alameda, Pittsburg, and Morro Bay; Pillar Point Harbor; the Diablo Canyon Power Plant; Ellwood Pier. Ports outside California may also support component manufacturing, storage, or installation.

The following subsections describe all phases—construction, O&M, and decommissioning—of a representative project, based on the RPDE, informed by BOEM's experience with other offshore wind projects, and ongoing research in the development of floating offshore wind technology.

2.1.2.1 Construction

BOEM's issuance of a lease only grants the lessee the exclusive right to submit to BOEM a Site Assessment Plan (SAP) to conduct surveys.[3] A lessee may install meteorological measurement devices to characterize weather conditions and assess wind resources in a proposed lease area.[4] A lessee would collect this information to determine site suitability for commercial development. Following such assessment, a lessee would submit to BOEM a COP containing project-specific design parameters, including specificity about cable routes, onshore facilities, and proposed port usage.

BOEM's prospective approval of a COP would be a major federal action requiring project-level NEPA analysis, as well as state environmental review under the California Environmental Quality Act (CEQA) for any facilities in state waters and onshore. Construction in any leased area would not proceed until such environmental reviews are complete and BOEM has approved a COP.

The timing of construction is anticipated to vary for each lease area and would likely be subject to vessel and supply chain availability.

Onshore Activities and Facilities

Anticipated onshore elements of a representative project include export cable landfall sites, sea-to-shore transitions, onshore export cable routes, onshore substations or converter stations, and linkages

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[3] BOEM completed NEPA reviews of these leasing activities, which include assessments of environmental impacts of surveying activities. Refer to https://www.boem.gov/renewable-energy/state-activities/morro-bay-final-environmental-assessment-and-appendices and https://www.boem.gov/renewable-energy/state-activities/humboldt-wind-energy-final-ea.

[4] BOEM's Renewable Energy Modernization Rule, effective as of July 15, 2024, eliminated the requirement for a SAP to deploy meteorological buoys. An approved SAP is still required for meteorological towers or other facilities that are installed on the seabed using a fixed-bottom foundation (30 CFR Part 585, Subpart G).

to a point of interconnection (POI). Because this Draft PEIS is being prepared before any Humboldt or Morro Bay lessees have submitted a COP, specific locations of all such onshore facilities are unknown at this time. This Draft PEIS, therefore, describes the types of impacts anticipated or assumed from onshore components based on reasonable assumptions regarding corridors and buffers for export cable routes and landfall locations. The Draft PEIS includes such assumptions about onshore elements to support the evaluation of a complete project and to facilitate future tiering. Notably, BOEM's authority under the OCSLA extends only to activities on the OCS. Activities in state waters and onshore would be subject to appropriate federal, state, and local jurisdiction.

Offshore export cable(s) would come ashore at one or more landfall locations. Multiple installation methods can be used to make the sea-to-shore transition. These include open-cut (i.e., trenching) or trenchless methods such as HDD.

From the landfall location, onshore export cables would carry electricity to one or more onshore substations or converter stations. Onshore export cables are typically buried in a roadside trench and would typically follow existing ROWs where possible. Onshore substations would transform and prepare power received from export cables to be connected into the existing grid at the POI. Projects with large nameplate capacity or that include long transmission lines carrying very large power capacities may choose to use high-voltage direct current (HVDC) instead of high-voltage alternating current (HVAC). If HVDC is used, an onshore HVDC converter station could be necessary to convert power from the onshore export cables to HVAC to allow interconnection to the existing transmission infrastructure. Typically, either an overhead connection or an underground transmission line with an overhead tie-line may be used from the onshore substation/converter station to a POI at a nearby facility.

The transmission POI is the location where power generated by offshore wind would be connected to the existing electrical grid. This can be at new facilities (constructed for the project) or at existing facilities with any needed modifications. In consultation with lessees, the RPDE does not identify any specific POI locations, but instead notes that lessees are anticipated to consider locations all along the California coast.

Offshore Activities and Facilities

Offshore project area components include WTGs and their floating substructures (Figure 2-1), OSSs and their floating substructures, array cables, and offshore export cables. These components would be located on the OCS, except portions of offshore export cables that would traverse nearshore (i.e., state) waters to make landfall.

A single representative project is assumed to have between 30 and 200 WTGs. WTGs would be spaced at a minimum distance of 0.5 nm (920 meters) and up to 1.6 nm (3 kilometers). Floating wind turbines also have some range of motion, known as the watch circle, which is related to the mooring system's response to wind, waves, and currents. WTGs are assumed to have a watch circle radius up to 1,150 feet (350 meters), rotor diameter up to 1,000 feet (305 meters), and a total turbine height up to 1,100 feet (335 meters).

A single representative project is further assumed to include one to six floating OSSs that would serve as common collection points for power from WTGs, as well as the origin for the offshore export cables that would deliver power to shore. Lessees may use HVAC or HVDC technology to transmit power; different equipment would be required on each OSS depending on which technology is used. HVAC export cables are typically three-core cables between 220 and 420 kilovolts. HVDC circuits can be configured as an asymmetric monopole (one HVDC cable with a metallic return), a symmetric monopole (two HVDC cables), or a bipole (two HVDC cables and an optional metallic return). Although HVAC substations and HVDC converter platforms are established technologies for fixed-bottom offshore wind, floating versions of these platforms are still being developed. Current HVAC substations have a maximum capacity of 700 to 800 megawatts with a topside weight close to 4,000 tons. HVDC converter stations capacity can reach 2 GW, with topside weights of 8,000 tons or more.

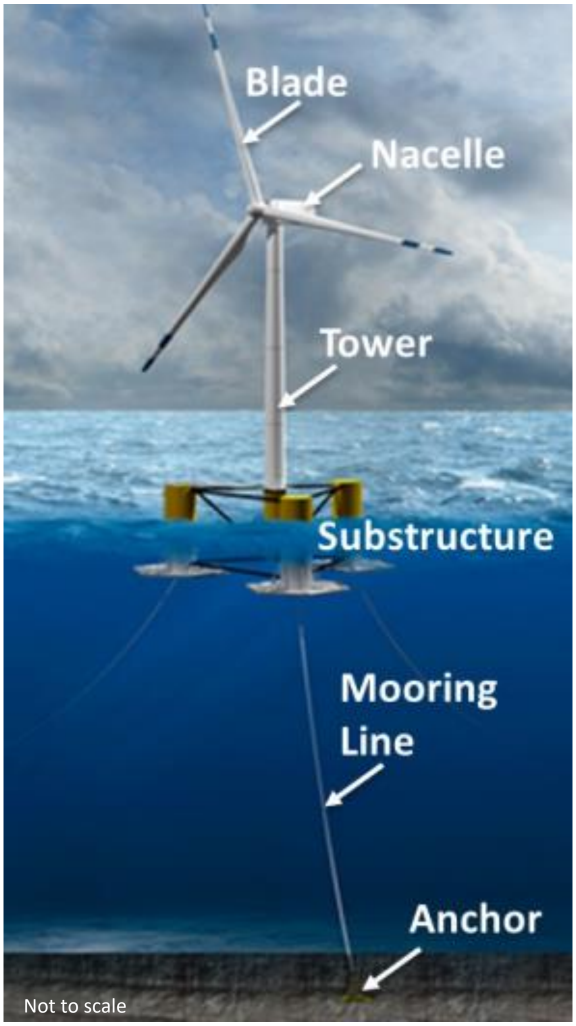

Figure 2-1. Representative floating wind turbine

Floating substructure types generally fall into four categories: semisubmersible, spar, TLP, and barge. Figure 2-2 shows schematics of all but the barge substructure. Worldwide in 2022, there were approximately 81 megawatts of operational floating offshore wind projects using semisubmersible substructures, 38 megawatts of operational offshore wind projects using spars, and 5 megawatts of operational offshore wind projects using barge-type substructures (Musial et al. 2023). There were no operational offshore wind TLPs in 2022, but they may be feasible for wind turbines in deep water. Semisubmersible and barge substructures appear feasible in California. The California coast does not have sheltered deep waters (such as fjords) suitable for spar designs that have been demonstrated in Europe; however, some designs have been proposed that would have a shallower draft in port and then tilt or deploy ballast to reach a deeper draft once in place of mooring.

Floating offshore WTGs and OSSs can be assembled at port and towed to destination lease areas. Alternatively, floating-to-floating assembly could take place at sea. However, this would require a vessel with sufficient crane capacity, as well as advanced motion compensation.

Floating offshore substructures would use moorings to maintain their position. Mooring lines can consist of steel chain, synthetic fiber rope, steel wire rope, or tendons made from steel or synthetic fibers (Figure 2-3). TLPs would use tendons, whereas other floating platform types would use rope or chain in taut, semi-taut, or catenary configurations. In the subject leased areas, catenary configurations are unlikely to be used due to their high weight, material requirements, and large footprint in deep water. Each floating platform may require between 3 and 12 mooring lines, depending on the number of connection points at the platform and the level of redundancy at each connection. Mooring lines for multiple wind turbines may connect to a single anchor in a shared-anchor configuration. Shared-mooring configurations, in which multiple wind turbines connect to a single mooring line, are also possible but less likely.

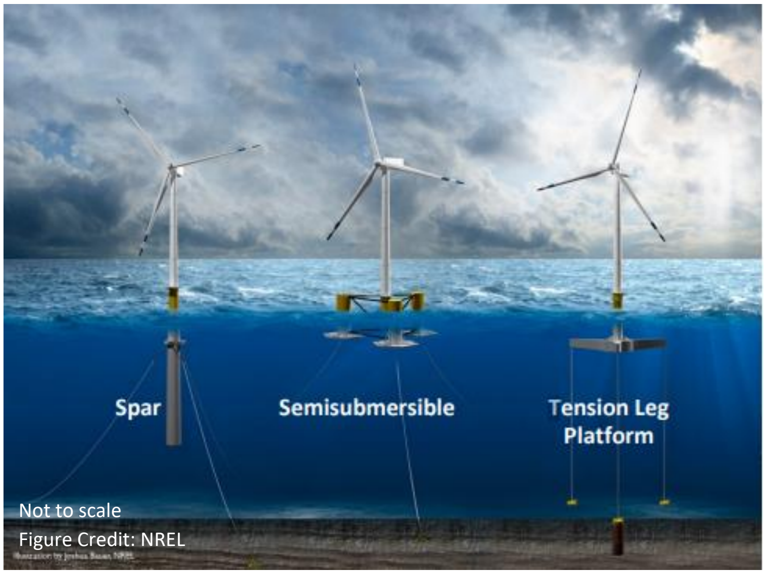

Figure 2-2. Floating platform types

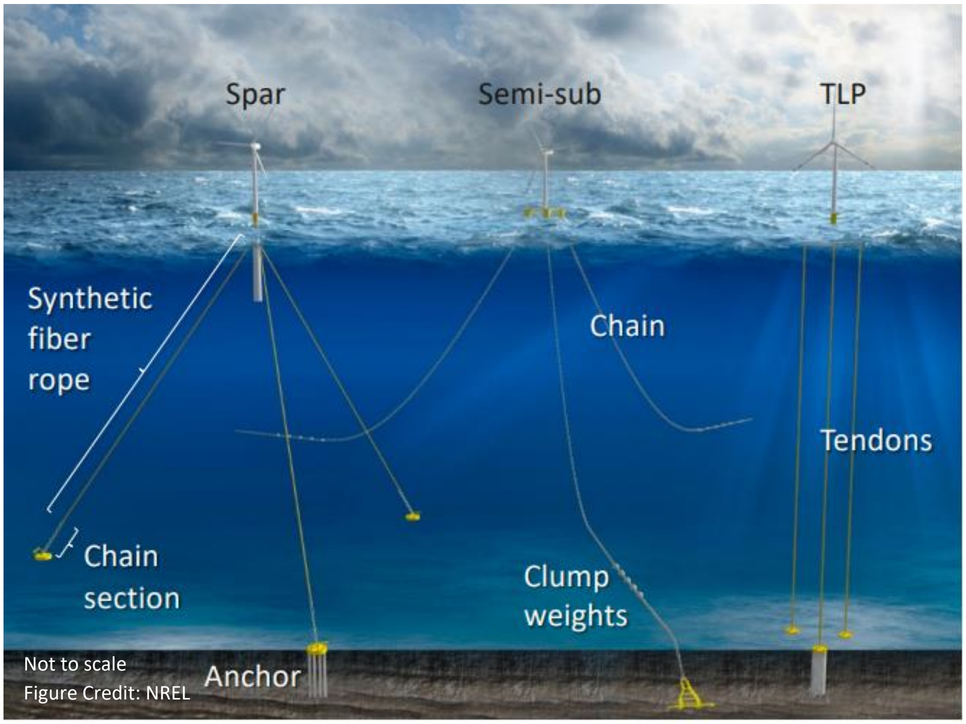

Figure 2-3. Floating wind mooring systems

Anchors would fix mooring lines to the seabed. Anchor types include drag embedment anchors, suction embedded plate anchors, caissons or piles, vertical load anchors, driven and/or drilled piles, and gravity or deadweight anchors. Multiple types of anchors would be feasible for most projects. The choice of anchor depends on local sediment type, mooring configuration, cost, and other factors such as supply chain availability. Moorings would require anchor handling tug service vessels.

WTGs and OSSs would be lit and marked in accordance with Federal Aviation Administration (FAA), U.S. Coast Guard (USCG), and BOEM guidelines to aid safe navigation.

Between two and eight export cables would be installed per project to deliver electricity from the OSSs to the landfall sites. The combined length of all export cables per project is assumed to be between 38 and 2,160 nm (70 to 4,000 kilometers) to reach anticipated landfall locations. Several cable installation methods are considered under the RPDE, including cable lay vessel, ROV, cable plow, hydro plow, jetting sled, vertical injector, tracked trencher, and HDD at landfall. Offshore export cables would have a target burial depth between 3 and 10 feet (1 and 3 meters). Burial may not be required along the full cable route depending on seabed conditions, vessel traffic and other factors considered in a cable burial risk assessment.

Array cables would be used to connect WTGs to OSSs. The RPDE assumes a single WTG would require on average up to 2.7 nm (5 kilometers) of array cables, set at a target depth of at least 200 feet (60 meters) below water surface. Individual cable segments may be shorter or longer (up to 10.8–16.2 nm [20–30 kilometers]) than this average length, depending on site-specific layout. A cable lay vessel with an ROV would install array cables.

Cable protection (for both export and array cables) would be required at any location where cables cross, as well as in any areas where target cable burial depth cannot be achieved. Array cable protection methods include bend stiffeners, dynamic bend restrictors, buoyancy modules, protective sleeves, seabed tethers, and anchors. Export cable protection methods include burial, rock dumping, and concrete mattresses.

Prior to cable installation, BOEM anticipates that lessees would complete site-preparation activities, including debris and boulder clearance, clearance of any unexploded ordnance (UXO), pre-lay grapnel runs, and pre-installation surveys. Such activities would help ensure export cable and burial equipment would not be affected by debris or other hazards during the burial process.

Cable installation processes are similar for floating and fixed-bottom wind farms, although the Pacific wave climate imposes more stringent requirements on cable lay vessel capabilities than in some other regions.

During construction, support vessels typically travel between the offshore project area and port facilities where equipment and materials are staged. The RPDE identified a number of ports along the West Coast that may be used to support offshore wind development (e.g., staging and integration, fabrication, O&M). BOEM has confined this programmatic analysis to the following five ports that have the greatest potential to be affected by the level of activity anticipated as a result of the development described in the RPDE. These and other ports in California may ultimately be used; in their COPs, lessees will identify which ports they will use for construction. Project-level environmental reviews will analyze accordingly.

- Port of Humboldt Bay (City of Eureka, Humboldt County)
- Port of San Luis (San Luis Obispo County)
- Port of Hueneme (City of Port Hueneme, Ventura County)
- Port of Long Beach (City of Long Beach, Los Angeles County)
- Port of Los Angeles (City of Los Angeles, Los Angeles County)

2.1.2.2 O&M

In this PEIS, BOEM assumes that each project would have an operating period of 35 years. The associated leases have operation terms of 33 years, commencing on the date of COP approval. Lessees would need to request and be granted up to 2-year extensions of their operations terms from BOEM under the regulations at 30 CFR 585.425 et seq. While the lessees have not, to date, made such a request, this PEIS uses the longer period to avoid underestimating any potential effects.

Onshore Activities and Facilities

Onshore O&M activities associated with a representative project are anticipated to include inspection and preventive maintenance of onshore substations and converter stations, onshore export cables, and grid POIs. Specific locations of all such onshore facilities have not yet been identified but are required as part of lessees' COPs.

Onshore substations and converter stations are typically designed to serve as unmanned stations and would not be expected to have an operator onsite. Onshore portions of export cables would require routine maintenance; any necessary maintenance would be accessed through manholes and completed within existing transmission infrastructure.

Offshore Activities and Facilities

Offshore operation and maintenance activities associated with a representative project are anticipated to include regularly scheduled inspections and maintenance of mechanical and electrical components. While lessees' COPs will include more specifics, the types and frequencies of such activities would likely be based on detailed original equipment manufacturer specifications. Annual maintenance activities would be needed for general upkeep (e.g., bolt tensioning, crack and coating inspection, safety equipment inspection, cleaning, high-voltage component service, and blade inspection) and replacement of consumable components (e.g., lubrication, oil changes). BOEM anticipates lessees would annually maintain OSSs, inclusive of both medium- and high-voltage systems, generators, and auxiliary and safety systems, as well as above-waterline structural inspections. Above-waterline portions of OSSs may require the reapplication of corrosion-resistant coating.

A lessee would be anticipated to regularly inspect WTG and OSS substructures, mooring lines, and anchors to check their condition and determine if maintenance is needed. O&M may be conducted using a service operations vessel or crew transfer vessel based at a nearby port. Major component replacements can be carried out either by towing a wind turbine to port for repair, or at sea using a specialized vessel or a crane mounted on the floating substructure. Tow-to-port repairs have been demonstrated, whereas the latter two concepts are emerging technologies.

2.1.2.3 Decommissioning

A lessee would be required to decommission the leased areas pursuant to 30 CFR Part 285. This would entail removing all facilities, projects, cables, pipelines, and obstructions and clearing the seabed of all obstructions created. Absent permission from BOEM, a lessee would have to achieve complete decommissioning within 2 years of termination of the lease and either reuse, recycle, or responsibly dispose of all materials removed. Additionally, a lessee would need to obtain separate and subsequent approval from the California State Lands Commission to retire in place any portion of a project within state waters.

To this end, a lessee would be required to submit a decommissioning application upon the earliest of the following dates: 2 years before the expiration of the lease, 90 days after completion of the commercial activities on the commercial lease, or 90 days after cancellation, relinquishment, or other termination of the lease (30 CFR 285.905). Upon completion of the technical and environmental reviews, the Bureau of Safety and Environmental Enforcement (BSEE) may approve, approve with conditions, or disapprove a lessee's decommissioning application. A lessee would need to obtain separate and subsequent approval from BSEE and BOEM to retire in place any portion of a project (30 CFR 285.909). Approval of such activities would require compliance under NEPA, as well as other federal statutes and implementing regulations. If BOEM approves a COP (with or without modifications), the lessee would have to submit a bond (or another form of financial assurance) that would be held by the U.S. Government to cover the cost of decommissioning the entire facility if such activity could not be completed by the lessee.

Onshore Activities and Facilities

At the time of decommissioning, some components of the onshore electrical infrastructure may still have substantial life expectancies. A lessee may propose to retire in place onshore export and transmission cables. However, if these cables need to be removed, BOEM anticipates a lessee would send them to repurposing or recycling facilities. Depending on the needs at the time, a lessee may leave in place other onshore facilities for possible future use or demolish them, recycling associated materials.

Offshore Activities and Facilities

Decommissioning of the WTGs and OSSs would typically follow a “reverse installation” process. Any buried offshore export cables and array cables would either be retired in place or removed from the seabed. The decision regarding whether to remove these cables and any overlying cable protection would be made in consultation with federal, state, and municipal resource agencies and would potentially be subject to additional environmental review.

2.1.3 Alternative C (Proposed Action) – Adoption of Mitigation Measures

Alternative C, the Proposed Action, is BOEM’s prospective adoption of a suite of program-level mitigation measures that could be applied to activities associated with Alternative B to reduce or avoid potential impacts. Alternative C’s design parameters and activities are identical to those of Alternative B. This alternative, therefore, analyzes the change in impacts from Alternative B. Table 2-3 summarizes the mitigation measures that make up the Proposed Action; for full wording of each measure, refer to Appendix E, *Mitigation.*

Table 2-3. Summaries of proposed mitigation measures (Alternative C)

Measure ID	Measure Summary
MM-1	Near real-time PAM monitoring and alert system for cetaceans
MM-2	Long-term PAM monitoring
MM-3	Marine Mammal and Sea Turtle entanglement avoidance/prevention
MM-4	Vessel Speed Limit
MM-5	Low Visibility Monitoring Plan
MM-6	Berm survey and report
MM-7	Vessel noise reduction guidelines
MM-8	Protected Species Observers
MM-9	Avoid the use of SF-6
MM-10	Reducing emissions from vessels, equipment, and vehicles engaged in activities on the OCS
MM-11	Vessel transit

Measure ID	Measure Summary
MM-12	Seasonal cut-in
MM-13	Avian and bat annual reporting
MM-14	Bird and bat monitoring plan
MM-15	Bird and bat tracking system
MM-16	Bird-deterrent devices and plan
MM-17	Light impact reduction for birds
MM-18	Bird and bat conservation strategy
MM-19	Anchoring Plan
MM-20	Sensitive Marine Species Characterization and Monitoring Plan
MM-21	Scour and cable protection plan
MM-22	Fisheries Compensatory Mitigation
MM-23	Fisheries Communication Plan and Liaison
MM-24	Fisheries Community Involvement
MM-25	Environmental Justice (EJ) Communications Plan
MM-26	Environmental Justice (EJ) Mitigation Plan
MM-27	Fisheries Mitigation–Potential Obstructions from Submarine Cable Installation and Decommissioning
MM-28	Marine cultural resources avoidance or additional investigation
MM-29	Terrestrial archaeological resource avoidance or additional investigation
MM-30	Section 106 mitigation fund
MM-31	Ancient submerged landform feature (ASLF) monitoring program and marine archaeological post-review discovery plan
MM-32	Shared transmission corridor
MM-33	Post-installation cable monitoring
MM-34	Electrical shielding on underwater cables
MM-35	High frequency (HF) radar interference mitigation agreement
MM-36	Oceanographic monitoring plan
MM-37	Monitoring on strategically placed WTGs
MM-38	Trailing suction hopper dredge mitigation
MM-39	Monitoring impacts on scenic and visual resources
MM-40	Regional and federal monitoring and survey program

2.2 Alternatives Considered but Not Analyzed in Detail

Several commenters during the PEIS scoping period suggested alternatives for consideration in this PEIS. BOEM considered these alternatives (summarized in Table 2-4) and excluded them from detailed analysis because they did not meet the purpose and need. Table 2-4 includes a brief discussion of the reasons for their elimination, as prescribed in CEQ regulations at 40 CFR 1502.14(a) and DOI regulations at 43 CFR 46.420(b-c).

In addition to meeting the purpose and need of the Proposed Action, alternatives analyzed in detail in this PEIS must be technically and economically feasible, have substantially different impacts from the other alternatives, and have sufficient scientific evidence to support an analysis.

Table 2-4. Alternatives considered but not analyzed in detail

Alternative Dismissed	Justification for Dismissal
Land-based energy alternatives: Various commenters during the PEIS scoping process suggested BOEM consider land-based energy production alternatives instead of offshore wind. The commenter was interested in how the energy production anticipated from the Proposed Action would compare to different types of onshore renewable energy. Variations on this theme from other commenters included suggestions that BOEM consider clean incinerators, microgrids, and thorium nuclear reactors.	The proposed alternative is outside of BOEM's jurisdiction. Onshore energy projects are being developed and permitted by other agencies with jurisdiction. Additionally, the proposed alternative does not meet the purpose and need for this PEIS, which is to analyze potential impacts of offshore wind development in the Humboldt and Morro Bay leased areas and application of programmatic mitigation measures. Based on the RPDE, the Proposed Action would have an estimated maximum generating capacity of between 3.75 GW and 11.5 GW.[5] For comparison, in 2019, the state of California had 14.1 GW of hydropower, 12.5 GW of utility-scale solar, 8 GW of customer solar, 6 GW of onshore wind, and 2.4 GW of nuclear (California Energy Commission 2022). A comparison of renewable energy based on land use intensity was not provided due to lack of readily accessible data and because land use requirements vary depending on the specific technology used and site-specific factors. However, for perspective, two of the larger solar facilities in California have a combined capacity of 0.8 GW and occupy approximately 6,000 acres.[6]
Demonstration wind farm: One commenter suggested that BOEM consider a demonstration wind farm alternative to better evaluate impacts and mitigation measures, prior to full build-out of the Humboldt and Morro Bay leased areas.	The purpose of this PEIS is not to approve any projects. BOEM will not decide to approve a COP until a lessee submits a COP and BOEM completes project-level NEPA review. Moreover, a demonstration wind farm does not address a specific environmental or socioeconomic concern.
Full build-out alternative: Commenters proposed the PEIS consider "full build-out" of wind energy offshore California/the west coast, potentially examining the Biden administration's goal of 30 GW offshore energy by 2030 and 15 GW floating offshore energy by 2035 and/or the State of California's goal of 5 GW of floating offshore generation by 2030.	Consideration of build-out scenarios beyond what is detailed in the RPDE are too speculative to be considered reasonably foreseeable due to many unknowns, including but not limited to tower height, spacing, generating capacity, onshore infrastructure, and other factors. Furthermore, consideration of such scenarios would not change the analysis in the PEIS or result in different mitigation measures.
A minimum footprint alternative: One commenter suggested a minimum footprint alternative that considers the minimum number of turbines necessary to achieve the state's goal of 25 GW by 2045. Another comment recommended that the	The intent of this PEIS is to analyze impacts of maximum site utilization in the five leased areas. This PEIS will not by itself support approval of any specific project. However, the PEIS may identify sensitive resources, as well as mitigation measures to avoid these resources where practicable. This

[6] The two solar facilities mentioned are the Aquamarine Solar Project (SCH# 2019059082) and the Mount Signal and Calexico Solar Project (SCH# 2011071066).

Alternative Dismissed	Justification for Dismissal
PEIS analyze alternative project sizes to reduce potential impacts.	will inform both lessee's COPs as well as BOEM's subsequent project-level NEPA review.
Turbine spacing alternative: A commenter suggested that BOEM analyze alternative spacing between turbines that might create vessel or fishing corridors, including vessel transit for emergencies, through the lease areas.	As lessees will not propose turbine until their COPs, this PEIS analyzes a representative project with a range of turbine spacing from 0.5–1.6 nm. Mitigation measures propose consistent turbine layouts across adjacent leased areas and increased spacing as ways to reduce potential impacts.
Alternative anchor and fill methods: A commenter suggested that BOEM analyze alternative anchor and fill methods that minimize impacts.	The PEIS analyzes several potential anchor types that may be used. Anchor types ultimately used will depend on mooring configuration, soil type, and other environmental factors.
Alternative export and interarray cable configurations: Two commenters suggested that BOEM analyze different configurations for export and interarray cables to avoid impacts.	The PEIS analyzes a range of export and interarray cable characteristics including cable length, diameter, configuration, burial depth, and installation methods. A mitigation measure will analyze the benefits of co-locating infrastructure and shared transmission infrastructure wherever practicable to reduce impacts.
Alternative OSS designs: A commenter suggested that BOEM analyze alternative designs for OSSs that include alternative cooling designs to the open loop cooling that was analyzed in the NY Bight Draft PEIS.	This PEIS provides a high-level analysis of several OSSs that may be used in the five leased areas. The COP-specific NEPA document will include a more detailed analysis of potential impacts resulting from the chosen OSS design.

2.3 Impact-Producing Factors

BOEM completed a study on the North Atlantic OCS of impact-producing factors (IPFs) to consider in an offshore wind development planned activities scenario (BOEM 2019). This document incorporates that study by reference. BOEM has reviewed these factors and determined that nearly all are relevant to all phases of prospective floating wind energy infrastructure for the Pacific OCS. Table 2-5 provides brief descriptions of the primary IPFs involved in this analysis, including examples of sources or activities that result in each IPF.

Table 2-5. Primary IPFs addressed in this analysis

IPF	Sources or Activities	Description
Accidental releases	• Mobile sources (e.g., vessels) • Construction and O&M of onshore or offshore stationary sources (e.g., WTGs, OSSs, transmission lines, and interarray cables)	Refers to unanticipated release or spills into receiving waters of a fluid or other substance, such as fuel, hazardous materials, suspended sediment, trash, or debris. Accidental releases or spills are distinct from routine discharges (e.g., effluents that are restricted via treatment and monitoring systems and permit limitations).
Air emissions	• Combustion-related stationary or mobile emission sources (e.g., generators [both on/offshore],	Refers to emission sources that emit regulated air pollutants (gaseous or particulate matter) into the atmosphere. Emissions can occur on- and offshore.

IPF	Sources or Activities	Description
	or support vessels, vehicles, and aircraft) • Non-combustion related sources, such as leaks from tanks and switchgears	
Anchoring	• Anchoring of floating offshore structures including WTGs, OSSs, scour/cable protection, and HVDC converter cooling systems • Anchoring of vessels	Refers to seafloor disturbances (anything below Mean Higher High Water [MHHW]) related to any offshore construction or maintenance activities. Refers to an activity or action that disturbs or attaches objects to the seafloor.
Cable installation and maintenance	• Dredging or trenching • Cable placement • Seabed profile alterations • Sediment deposition and burial • Cable protection of concrete mattress and rock placement	Refers to seafloor disturbances (anything below MHHW) related to the installation and maintenance of new offshore submarine cables. Cable placement methods include trenchless installation (such as HDD), direct pipe and auger bore), jetting, vertical injection, control flow excavation, trenching, and plowing.
Discharges/ intakes	• Vessels • Structures • Onshore point and non-point sources • Dredged material ocean disposal • Installation, operation, and maintenance of submarine transmission lines, cables, and infrastructure • HVDC converter cooling system	Refers to routine permitted operational effluent discharges of pollutants to receiving waters. Types of discharges may include bilge water, ballast water, deck drainage, gray water, fire suppression system test water, chain locker water, exhaust gas scrubber effluent, condensate, seawater cooling system intake and effluent, and HDD fluid. Water pollutants include produced water, manufactured or processed hydrocarbons, chemicals, sanitary waste, and deck drainage. Rainwater, freshwater, or seawater mixed with any of these constituents is also considered a pollutant. These discharges are restricted to uncontaminated or properly treated effluents that require best management practice or numeric pollutant concentration limitations as required through U.S. Environmental Protection Agency (USEPA) National Pollutant Discharge Elimination System (NPDES) permits or USCG regulations. Refers to the discharge of solid materials, such as the disposal of sediment at approved offshore disposal or nourishment sites and cable protection. Discharge of dredged or fill material in the territorial seas may be regulated through the Clean Water Act (CWA). Refers to entrainment/impingement as a result of intakes used by cable laying equipment and in HVDC converter cooling systems.
Electromagnetic fields and cable heat	• Substations • Power transmission cables • Interarray cables • Electricity generation	Power-generation facilities and cables produce electric fields (proportional to the voltage) and magnetic fields (proportional to flow of electric current) around the power cables and generators. Three major factors determine levels of the magnetic and induced electric fields from offshore wind energy

IPF	Sources or Activities	Description
		projects: 1) the amount of electrical current being generated or carried by the cable, 2) the design of the generator or cable, and 3) the distance of organisms from the generator or cable. Refers to thermal effects of the transmission of electrical power, dependent on cable design and burial depth.
Gear utilization	• Monitoring surveys • Site assessment and post-construction surveys (i.e., geophysical, geological)	Refers to capture, collection, and entanglement of marine species during monitoring surveys. Habitat impacts from biological/fisheries survey activities. Refers to entanglement and bycatch during monitoring surveys and site assessment and post-construction surveys.
Invasive species	• Mobile sources (e.g., vessels, ballast water)	Refers to unanticipated release of invasive species into receiving waters.
Land disturbance	• Vegetation clearance • Excavation • Grading • Placement of fill material	Refers to land disturbances (above MHHW) during onshore construction activities.
Lighting	• Vessels or offshore structures above or under water • Onshore infrastructure	Refers to lighting associated with offshore wind development and activities that use offshore vessels and that may produce light above the water onshore and offshore, as well as underwater.
Noise	• Aircraft • Vessels • Turbines • Geophysical and geotechnical (G&G) surveys • O&M • Onshore and offshore construction • Vibratory and impact pile driving • Drilling • Dredging and trenching • UXO detonations and deflagration • UXO surveys	Refers to noise from various sources, and includes sound pressure, particle motion, and substrate vibration effects. Commonly associated with construction activities, G&G surveys, and vessel traffic. May be impulsive (e.g., pile driving) or broad spectrum and continuous (e.g., from Project-associated marine transportation vessels). May also be noise generated from turbines themselves or interactions of the turbines with wind and waves.
Port utilization	• Expansion and construction • Maintenance • Use • Revitalization	Refers to activities or actions associated with port activity, upgrades, or maintenance that occur only as a result of a project from increased economic activity. Includes activities related to port expansion and construction, such as placement of dredged materials, dredging to deepen channels for larger vessels, and maintenance dredging.
Presence of structures	• Onshore structures including towers and transmission cable infrastructure	Refers to the post-construction, long-term, and permanent presence and operation of onshore or offshore structures.

IPF	Sources or Activities	Description
	• Floating offshore structures including WTGs, OSSs, HVDC converter cooling systems • Scour/cable protection	
Traffic	• Aircraft • Vessels (construction, O&M, surveys) • Vehicles • Towed arrays/equipment	Refers to marine and onshore vessel and vehicle use, including use in support of surveys such as geophysical and geotechnical, fisheries monitoring, and biological monitoring surveys. Refers to interaction of traffic with species.

2.4 Non-Routine Activities and Events

Alternatives B and C consider several non-routine activities and events to better analyze prospective impacts. Such activities or events could include corrective maintenance activities, collisions of vessels with other vessels or marine life, allisions (a vessel striking a stationary object) involving vessels and WTGs or OSSs, cable displacement or damage by anchors or fishing gear, chemical spills or releases, severe weather and other natural events, seismic activity, and terrorist attacks. These activities or events are impossible to predict with certainty. Table 2-6 provides a brief assessment of each of these potential events or activities.

Table 2-6. Non-routine activities and events

Non-Routine Activity or Event	Description
Corrective maintenance activities	These activities could be required as a result of low-probability events, or as a result of unanticipated equipment wear or malfunction. Key project components would typically be stored at a nearby O&M facility to allow for expeditious repairs.
Collisions and allisions	These could result in spills (described below) or injuries or fatalities to wildlife (addressed in Chapter 3, *Affected Environment and Environmental Consequences*). Collisions and allisions are anticipated to be unlikely based on the following factors. • USCG requirements for lighting on vessels • The lighting and marking plan that would be implemented • USCG requirement for aids to navigation, such as channel markers, safety signage, and buoys • NMFS vessel speed restrictions • The proposed spacing of WTGs and OSSs • The inclusion of proposed project components on navigation charts
Cable displacement or damage by vessel anchors or fishing gear	This could result in safety concerns and economic damage to vessel operators and may require corrective action by lessees such as the need for one or more cable splices to an export or array cable(s).

Non-Routine Activity or Event	Description
Chemical spills or releases	For offshore activities, these include inadvertent releases from refueling vessels, spills from routine maintenance activities, and any more significant spills resulting from a catastrophic event. All vessels would be certified to conform to vessel O&M protocols designed to minimize risk of fuel spills and leaks. Lessees would prepare an Oil Spill Response Plan (OSRP) and would be required to comply with USCG and BSEE regulations relating to prevention and control of oil spills. Onshore, releases could occur from construction equipment or HDD activities. All wastes generated onshore would comply with applicable state and federal regulations, including the Resource Conservation and Recovery Act and the Department of Transportation Hazardous Materials regulations.
Severe weather and natural events	The Humboldt and Morro Bay leased areas are subject to weather extremes, such as storms, which may impose hydrodynamic load and sediment scouring. The stability of the floating foundations and strength of the mooring systems would need to be sufficient to safely withstand storms and wave action to avoid damage or toppling of floating facilities. The engineering specifications of the WTGs and their ability to sufficiently withstand weather events is independently evaluated by a certified verification agent when reviewing the Facility Design Report and Fabrication and Installation Report according to international standards. One of these standards calls for the structure to be able to withstand a 50-year return interval event. An additional standard includes withstanding 3-second gusts of a 500-year return interval event, which would correspond to Category 5 hurricane windspeeds. If severe weather caused a spill or release, the actions outlined above would help reduce potential impacts. Severe flooding or coastal erosion could require repairs; impacts of such repairs would be expected to be similar to those associated with construction. While highly unlikely, structural failure of a WTG (i.e., loss of a blade or tower collapse) would result in temporary hazards to navigation, such as the need to avoid floating debris. Structural failure could also pose other risks similar to accidental releases of debris, including potential injury to species and debris washing up onshore.
Seismic activity	The Humboldt and Morro Bay leased areas are located along the California continental margin, which is tectonically active. Humboldt County is in the second-highest of five seismic zones specified by the California Uniform Building Code. The Cascadia Subduction Zone offshore Humboldt County is capable of producing earthquakes of magnitude 8 to 9 (Humboldt County 2017). Earthquakes have also been documented near the Morro Bay leased areas, including magnitude 5.8 and 6.0 earthquakes in 1969 and a magnitude 7 earthquake in 1927 (Walton et al. 2021). Due to strong seismic potential, the impact of seismic hazards such as earthquakes and tsunamis will be considered during design and construction to ensure floating foundations and mooring systems are designed to withstand such events. The prospective impacts of a major earthquake and associated tsunamis on floating wind turbines are unknown but could result in structural failure of a WTG. It is likely that anchors and export cable corridors would experience shaking and possible displacement. If anchors were to become dislodged, they would likely drag across the seafloor impacting benthic habitats and organisms.
Terrorist attacks	BOEM considers these unlikely, but impacts could vary depending on the magnitude and extent of any attacks. The actual impacts of this type of activity would be the same as the outcomes listed for severe weather and natural events. Therefore, terrorist attacks are not analyzed further.

2.5 Summary and Comparison of Impacts by Alternative

Table 2-7 summarizes and compares the impacts under the Proposed Action and other alternatives assessed in Chapter 3. Each Chapter 3 resource section describes anticipated impacts. For Alternatives B and C, impacts would be the same for one representative project in each region (Humboldt and Morro Bay) or for five projects, unless otherwise stated.

Table 2-7. Summary and comparison of impacts among alternatives

Resources	Alternative A – No Action	Alternative B – Development with No Mitigation Measures	Alternative C (Proposed Action – Adoption of Mitigation Measures
3.2.1 Air Quality and Greenhouse Gas Emissions	Existing environmental trends and ongoing activities would continue to affect air quality. Ongoing activities would continue to have regional air quality impacts primarily through air pollutant emissions, accidental releases, and climate change. Ongoing activities would likely result in impacts on air quality because of air pollutant emissions and GHGs.	Alternative B could have a net decrease in overall emissions for the region compared to emissions from conventional fossil-fuel power plants. Alternative B would result in air quality impacts during construction, maintenance, and decommissioning, but there would be a beneficial impact on air quality in the surrounding region to the extent that the wind energy produced would displace energy produced by fossil-fuel power plants.	Alternative C would result in the same impacts and beneficial impacts as Alternative B; however, emissions (related to construction) could be reduced through mitigation measures.
3.2.2 Water Quality	Water quality would continue to follow current regional trends and respond to ongoing environmental and commercial activities, including climate change. Ongoing activities would likely result in temporary impacts primarily through accidental releases and sediment suspension related to vessel traffic, port utilization, presence of structures, discharges/intakes, and land disturbance.	Alternative B would likely have impacts across several IPFs, including accidental releases, invasive species, and anchoring.	Alternative C would result in the same impacts as Alternative B; mitigation measures would reduce impacts of trash and debris, anchoring, sediment disturbance, and ballast water discharge.
3.3.1 Bats	Bats would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities would have temporary, long-term, and permanent impacts (disturbance, displacement, injury, and mortality) on bats primarily through noise, lighting, presence of structures, traffic, and climate change.	Alternative B would likely have impacts on bats. The most acute risk would be from operation of the offshore WTGs, which could lead to long-term impacts (injury and/or mortality). Impacts are anticipated to be more likely during spring and fall migration when higher numbers of bats have been documented offshore. However, there is currently insufficient data on bat presence, abundance, and behavior in the OCS to quantify these impacts.	Alternative C would result in the same impacts as Alternative B; however, mitigation measures under Alternative C may reduce impacts on bats in the offshore environment, though the extent of any reduction would depend on project-level detail not available at the programmatic stage.

Resources	Alternative A – No Action	Alternative B – Development with No Mitigation Measures	Alternative C (Proposed Action – Adoption of Mitigation Measures
3.3.2 Benthic Resources	Ongoing activities such as repetitive channel deepening, dredging, trawling for commercial fisheries, and the ongoing installation and maintenance of submarine cables would continue to have short- and long-term impacts. Impacts on species would be unavoidable but are not expected to result in population-level effects, especially if sensitive habitats are avoided and disturbances are temporally and spatially distributed.	Alternative B would likely have impacts on benthic resources. Beneficial impacts are expected for species that are able to colonize the newly added hard surfaces and those attracted by new food sources or shelter.	Alternative C would result in the same impacts as Alternative B; however, mitigation measures may benefit benthic communities, especially sensitive species. Beneficial impacts are also expected for species that would colonize the newly added hard surfaces and benefit from the fish aggregation device. This may, in turn, benefit species attracted to these areas for food sources and shelter, increasing the reef effect.
3.3.3 Birds	Birds would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities would continue to have temporary and permanent impacts (disturbance, displacement, injury, mortality, habitat degradation, habitat alteration) primarily through construction and climate change.	Alternative B would have impacts on birds depending on the offshore lighting scheme, the duration and timing of construction activities, and affected species. Operation of the offshore WTGs would pose the largest risk and could lead to long-term impacts (mortality and displacement). Alternative B could also result in increased foraging opportunities for some marine birds.	Alternative C would result in the same impacts as Alternative B; however, mitigation measures could reduce potential impacts on birds. Alternative C could also result in increased foraging opportunities for some marine birds.
3.3.4 Coastal Habitat, Fauna, and Wetlands	Ongoing activities would continue to have temporary, long-term, and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on coastal habitat and fauna. Land disturbance from onshore development would cause temporary and permanent loss of wetlands. Permanent wetland impacts would likely occur, requiring compensatory mitigation because climate change is predicted to affect coastal habitat and fauna.	Alternative B would have impacts on coastal habitat, fauna, and wetlands, depending on the amount and quality of coastal habitat altered or removed and the area/type of wetlands affected (if any) and duration of impact. Any identified wetland impacts would be subject to mitigation requirements set forth in the Clean Water Act Section 404(b)(1) guidelines of avoidance, minimization, and compensatory mitigation, likely reducing such impacts.	Alternative C would result in the same impacts as Alternative B; however, mitigation measures could reduce some impacts associated with cable installation and maintenance, EMFs and cable heat, and noise. Impacts on wetlands would remain similar and remain subject to Clean Water Act requirements/associated minimization and mitigation.

Resources	Alternative A – No Action	Alternative B – Development with No Mitigation Measures	Alternative C (Proposed Action – Adoption of Mitigation Measures
3.3.5 Fishes, Invertebrates, and Essential Fish Habitat	Ongoing activities would continue to have temporary and permanent impacts on fishes, invertebrates, and EFH primarily through climate change, commercial fishing activities, dredging, anthropogenic noise, new cable installation, invasive species, port improvements, and the presence of structures.	Alternative B would result in impacts, depending on the IPF and which leased areas would be developed. Alternative B would result in the potential loss of HAPCs in leased areas. For both project scenarios, beneficial impacts are expected for species that can colonize newly added hard surfaces.	Alternative C would result in the same impacts as Alternative B; although mitigation measures would reduce impacts. For both project scenarios, beneficial impacts are also expected for species that can colonize newly added hard surfaces.
3.3.6 Marine Mammals	Ongoing activities such as climate change would continue to affect marine mammal foraging and reproduction through changes to the distribution and abundance of marine mammal prey.	Alternative B would have impacts on mysticetes, odontocetes, pinnipeds, and fissipeds, with potentially beneficial impacts on odontocetes and pinnipeds though such benefits may be offset by increased entanglement risk with WTG structures/moorings.	Alternative C would result in the same impacts as Alternative B; however, mitigation measures would reduce impacts for mysticetes, odontocetes, pinnipeds, and fissipeds. Potentially beneficial impacts would occur for odontocetes and pinnipeds.
3.3.7 Sea Turtles	Sea turtles would continue to be affected by existing environmental trends and ongoing activities. In addition to climate change, BOEM expects a range of sea turtle impacts (disturbance, displacement, injury, mortality, and reduced foraging success).	Alternative B would result in impacts on sea turtles. Beneficial impacts are expected from the presence of structures primarily due to an increase in foraging opportunity due to the reef effect. These beneficial effects could be offset by increased risk of entanglement due to derelict fishing gear on the structures.	Alternative C would result in the same impacts as Alternative B; however, mitigation measures would reduce some impacts. Impacts under Alternative C would not affect the continued viability of any sea turtle populations. Beneficial impacts are expected from the presence of structures/reef effect.
3.4.1 Commercial Fisheries and For-Hire Recreational Fishing	Ongoing activities would continue to have temporary to long-term impacts on commercial fisheries and for-hire recreational fishing. The extent of impacts would vary by fishery due to differing target species, gear type, and location.	Alternative B would result in impacts on commercial fisheries and for-hire recreational fishing overall. Beneficial impacts on for-hire recreational fishing may also occur based on the potential bolstering of for-hire recreational fishing opportunities due to the reef effect. Such benefits would depend on the ability of fore-hire vessels to safely fish around structures and would be limited to for-hire vessels capable of making longer trips that	Alternative C would result in the same impacts as Alternative B; however, mitigation measures would reduce impacts although impacts on commercial fisheries and for-hire recreational fishing would be similar, overall. Under Alternative C, beneficial impacts on for-hire recreational fishing may also occur based on the potential bolstering of for-hire recreational fishing opportunities due to the reef effect.

Resources	Alternative A – No Action	Alternative B – Development with No Mitigation Measures	Alternative C (Proposed Action – Adoption of Mitigation Measures
		would be required to reach the leased areas.	
3.4.2 Cultural Resources	Cultural resources would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities would continue to have temporary, long-term, and permanent impacts (marine, terrestrial, and visual) on cultural resources in the Affected Environment through seabed, terrestrial, and visual disturbance.	Alternative B would likely result in impacts on cultural resources because the increased amount of development increases the likelihood that impacts would be physically damaging or cause permanent setting changes, and that such impacts would occur on a greater number of cultural resources.	Alternative C would result in the same impacts as Alternative B. Adoption of mitigation measures could enable a more consistent process, allowing the future COP-specific NEPA and NHPA reviews, consultations, and plans to be focused on project-specific impacts. However, at this programmatic stage, more conclusive determinations of the effectiveness of mitigation are not possible; therefore, their impact on cultural resources have yet to be determined.
3.4.3 Demographics, Employment, and Economics	Tourism, recreation, and ocean-based industries such as marine transportation would continue to be important components of the regional economies. Ongoing activities would continue to have impacts on demographics, employment, and economics in the Affected Environment. Beneficial impacts on demographics, employment, and economics would occur from the continued operation of existing sectors in the ocean economy.	Alternative B would result in impacts on demographics, employment, and economics through job creation and increased business revenue. Effects could be offset by beneficial effects on regional economies from increased economic activity and employment associated with the development of offshore wind energy in the regions of greatest port and manufacturing activity.	Under Alternative C, impacts on demographics, employment, and economics would likely remain the same as Alternative B, i.e., impacts through job creation and increased business revenue.
3.4.4 Environmental Justice	Numerous ongoing activities, both on- and offshore, would continue to affect environmental justice communities in the Affected Environment. Additional impacts would be driven by the effects of climate change and the ability for coastal communities to readily adapt to population migration (housing	Alternative B would have impacts on environmental justice communities. Alternative B may also result in beneficial impacts from port expansion/use resulting from positive contributions to employment and revenue from offshore wind energy development activities. In addition, the potential long-term health	Under Alternative C, impacts on environmental justice communities would be slightly reduced compared to Alternative B as a result of mitigation, including the measure intended to lessen impacts on commercial and for-hire recreational fishing.

Resources	Alternative A – No Action	Alternative B – Development with No Mitigation Measures	Alternative C (Proposed Action – Adoption of Mitigation Measures
	disruptions), sea level rise, and storm surge threats.	benefits associated with displacement of energy produced by fossil-fueled power plants would have beneficial health effects to the extent that current health issues are related to fossil-fuel power plants.	
3.4.5 Tribal Values and Concerns Analysis	Ongoing activities would continue to have temporary, long-term, and permanent impacts on resources of Tribal value and concern in the prospective Affected Environment through seabed, terrestrial, and visual disturbances and intrusions.	Alternative B would result in impacts with the degree or extent of impacts anticipated to be greater in proportion to the level of development. Greater economic activity in ports could have beneficial impacts on Tribal communities and, in turn, resources of Tribal value and concern. Impacts of one or five representative projects would be due to the extent of onshore and offshore development that could introduce physical and visual impacts on resources of Tribal value and concern.	Under Alternative C, adherence to mitigation measures could lessen impacts on resources of Tribal value and concern, but given numerous uncertainties about the location, nature, and extent of such resources, impacts would, at this programmatic stage, remain the same as Alternative B— impacts with the potential for beneficial economic impacts for either one or five representative projects.
3.4.6 Land Use and Coastal Infrastructure	Land use and coastal infrastructure would continue to be affected by existing environmental trends and ongoing activities, as well as climate change.	Alternative B would likely have impacts because of increased onshore land disturbance and infrastructure, as well as beneficial impacts from port utilization.	Alternative C would result in the same impacts and beneficial impacts as Alternative B. The mitigation measure that would be implemented under Alternative C may slightly reduce overall impacts on land use by minimizing temporary construction impacts.
3.4.7 Navigation and Vessel Traffic	Navigation and vessel traffic would continue to be affected by existing socioeconomic trends and ongoing activities. Under the No Action Alternative, ongoing activities would continue to have short- and long-term impacts on navigation and vessel traffic, primarily through the IPFs of anchoring, cable	Alternative B would result in impacts. Needed port upgrades for offshore wind development would contribute to baseline traffic levels. Impacts on vessels not associated with developed leased areas include changes in navigation routes, delays in ports, degraded radar signals, and increased difficulty of offshore search	Alternative C would result in the same impacts as Alternative B, including anchoring and the remaining IPFs, as impacts cannot be fully avoided. The mitigation measures that would be implemented under Alternative C could reduce impacts associated with cable installation, presence of structures, and

Resources	Alternative A – No Action	Alternative B – Development with No Mitigation Measures	Alternative C (Proposed Action – Adoption of Mitigation Measures
	installation and maintenance, port utilization, and vessel traffic.	and rescue or surveillance missions in each of the lease areas, all of which would increase navigational safety risks. Commercial deep-draft vessels would choose to avoid the leased areas altogether, leading to potential funneling of vessel traffic along leased-area borders. In addition, increased potential for marine accidents, which may result in injury, loss of life, and property damage, could produce disruptions for ocean users.	vessel traffic depending on project-level details.
3.4.8 Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)	Other uses would continue to be affected by existing environmental trends and activities. Existing operations nearshore and on the OCS could increase vessel traffic and navigational complexity of the region.	Alternative B would result in impacts on other uses. The construction of WTGs would result in increased navigational complexity and increased allision risk. The presence of WTGs in the line of sight could interfere with radar systems. The seafloor footprint of WTG anchors and the presence of offshore export cables would affect existing cables and pipelines. Scientific research and surveys would be affected, particularly for NOAA surveys supporting commercial fisheries and protected-species research programs.	Alternative C would result in the same impacts as Alternative B. The mitigation measures that would be implemented under Alternative C would reduce impacts on radar systems relative to Alternative B.
3.4.9 Recreation and Tourism	Under the No Action Alternative, recreation and tourism would continue to be affected by existing environmental trends and ongoing activities. Under Alternative A, impacts of ongoing activities would continue to have effects on recreation and tourism in the Affected Environment. The extent of impacts on recreational fisheries would vary by fishery	Alternative B would have impacts due to increased anchoring, cable installation and maintenance, and presence of structures.	Alternative C would result in the same impacts as Alternative B. Mitigation measures could reduce impacts on recreation and recreational fishing by ensuring environmental cleanliness and navigational safety, ensuring minimal habitat disruption, and minimizing nighttime visual disturbances.

Resources	Alternative A – No Action	Alternative B – Development with No Mitigation Measures	Alternative C (Proposed Action – Adoption of Mitigation Measures
	due to different target species, gear type, and location of activity. These effects would primarily stem from climate change, with fisheries-management agencies expected to adjust to shifting distributions and other climate-related factors.		
3.4.10 Scenic and Visual Resources	Under the No Action Alternative, regional trends and activities would continue, and scenic and visual resources would continue to be affected by natural and human-caused IPFs. The coastal landscape's character would change in the short and long terms through natural processes and ongoing activities that would continue to shape onshore features, character, and viewer experience.	Alternative B would result in impacts, due to view distances; minor to moderate FOVs; strong, moderate, and weak visual contrasts; clear-day conditions; and nighttime lighting. Due to distance, extensive FOVs, strong contrasts, large scale of change, and level of prominence, as well as heretofore undeveloped ocean views, the representative projects would affect the open ocean character unit and viewer boating and cruise ship experiences.	Alternative C would result in the same impacts as Alternative B. Mitigation has potential to avoid or reduce these impacts by grouping transmission infrastructure and developing and adhering to a visual monitoring plan.

GHGs = greenhouse gases; EMFs = electromagnetic fields; EFH = essential fish habitat; HAPCs = Habitat Areas of Particular Concern; NHPA = National Historic Preservation Act; FOVs = fields of view

Chapter 3

Affected Environment and Environmental Consequences

This chapter describes the existing environmental baseline (or Affected Environment) for each resource area (Sections 3.2.1 through 3.4.10). Each section discloses impacts from Alternatives A, B, and C as described in Chapter 2, *Proposed Action and Alternatives*, including cumulative impacts, i.e., the combined impact of the Proposed Action and alternatives when added to other past, present, or reasonably foreseeable planned activities. Refer to the methodology and assumptions in Chapter 1, *Introduction*, and Appendix C, *Planned Activities Scenario*.

3.1 Impact Analysis Terms and Definitions

Based on previous environmental reviews, subject-matter expert input, consultation efforts, and public involvement, BOEM has identified the resources addressed in Sections 3.2, *Physical Resources*; 3.3, *Biological Resources*; and 3.4, *Socioeconomic Conditions and Cultural Resources*, as those potentially affected by the Proposed Action and alternatives. Each resource section includes descriptions and maps of the Affected Environment, as well as descriptions of impacts.

3.1.1 Activities Terminology

This Draft PEIS uses the following categories of activities and environmental stressors.

- **Non-offshore wind:** Non-offshore wind includes (1) undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); (2) tidal energy projects; (3) dredging and port improvement projects; (4) marine minerals use and ocean-dredged material disposal; (5) military use; (6) marine transportation; (7) fisheries use, management, and monitoring surveys; (8) global climate change; (9) oil and gas activities; (10) prospective designation of a national marine sanctuary; and (11) onshore development activities. Appendix C describes these activities in greater detail.
- **Offshore wind:** Planned offshore wind includes activities not part of the Proposed Action or action alternatives that have an executed renewable energy lease but no approved COP or similar approvals at the time of publication of this Draft PEIS.[1]

As of the publication date of this PEIS, there are no *ongoing* offshore wind activities in the Pacific OCS or in state waters.

3.1.2 Impact Terminology

Overall determinations consider the context, intensity (i.e., severity), directionality (adverse or beneficial), and duration of the effects. The Draft PEIS assumes that potential construction effects generally diminish once construction ends. However, O&M activities could result in additional impacts

[1] BOEM and western states (particularly California and Oregon) are in early stages of considering further offshore wind energy development in the Pacific OCS and in state waters. As of the publication of this Draft PEIS, all such activity is considered speculative, except for site assessment activity associated with two WEAs off Brookings and Coos Bay, Oregon, for which BOEM published a draft EA in April 2024. Please refer to the draft EA for a discussion of associated environmental effects: https://www.boem.gov/renewable-energy/state-activities/commercial-wind-lease-issuance-pacific-outer-continental-shelf.

during the anticipated 35-year life[2] of future Humboldt and Morro Bay offshore wind projects. Additionally, Humboldt and Morro Bay lessees would have up to an additional 2 years to complete decommissioning activities (i.e., removal of WTGs and related infrastructure).

When considering duration of impacts under NEPA, this Draft PEIS uses the following terms.

- **Short-term effects:** Effects lasting less than the duration of construction (up to 3 years).[3] Examples of such effects include road closures or traffic delays during onshore cable installation. Once construction is complete, these effects would end.
- **Long-term effects:** Effects lasting longer than the duration of construction (3 years) but less than the life of the Humboldt and Morro Bay offshore wind projects (35 years). An example of such effects is an anchorage or cable installation within the seabed, which could lead to loss of habitat. On removal of such features during decommissioning, habitat, could likely return over time.
- **Permanent effects:** Effects lasting the life of the Humboldt and Morro Bay offshore wind projects and beyond. An example would be the conversion of land to support new onshore facilities.

The analysis in this Draft PEIS focuses only on those resources that are likely to be affected by the alternatives under consideration and resulting in significant or important effects (30 CFR 1502.16(a)). Some impacts of the Humboldt and Morro Bay offshore wind projects may not be measurable at the programmatic level, such as beneficial impacts on benthic resources due to artificial habitat or climate change due to a reduction in greenhouse gas (GHG) emissions.

The Draft PEIS uses the following definitions to describe the impacts of the Proposed Action and each alternative in relation to ongoing and planned activities.

- **Undetectable:** The impact contributed is so small that it is difficult or impossible to discern or measure.
- **Noticeable:** The impact, while evident and measurable, is still relatively small in proportion to the impacts from the Proposed Action or alternatives when combined with ongoing and planned activities.
- **Appreciable:** The impact is measurable and constitutes a relatively large portion of the impacts from the Proposed Action or alternatives when combined with ongoing and planned activities.

This Draft PEIS also considers the potential for beneficial impacts. A beneficial impact could occur in the following circumstances for physical, biological, and cultural resources.

- Improvement in ecosystem health.
- Favorable increase in the extent and quality of habitat for both special-status species and species common to the Humboldt and Morro Bay project area.

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[2] For analysis purposes, BOEM assumes that the Humboldt and Morro Bay offshore wind projects would have an operating period of 35 years (33 years from COP approval plus a 2-year extension).

[3] For the purpose of analysis, BOEM assumes a 3-year construction period for each lease area.

- Favorable increase in populations of species common to the Humboldt and Morro Bay project area.
- Improvement in air or water quality.
- Limited spatial extent or short-term duration of improved protection of physical cultural resources.

Beneficial impacts could occur in the following circumstances for socioeconomic resources.

- Improvement in human health.
- Increase in employment (job creation and workforce development).
- Improvements to infrastructure/facilities and community services.
- Favorable economic improvement (increase in local business expenditures, gross domestic product, labor income, property values, supply chain needs, and tax revenue).
- Increase in tourism.
- Improvements for individuals or communities that result from enhanced protection of cultural resources.
- Equitable access for underserved communities to beneficial effects.

3.2 Physical Resources

3.2.1 Air Quality and Greenhouse Gas Emissions

This section discusses potential impacts on air quality from the Proposed Action, alternatives, and ongoing and planned activities in the Affected Environment.

The Affected Environment (Figure 3.2.1-1) spans the lease areas, anticipated ports, and dispersion characteristics of emissions from marine vessels and equipment anticipated to be used to support offshore wind development. This includes the airsheds within 25 nm (46.3 kilometers) of the Humboldt and Morro Bay WEAs and within 15 nm (27.8 kilometers) of potential onshore construction areas and activities at anticipated ports/construction areas outside the OCS permit area. Given the dispersion characteristics of emissions from marine vessels, equipment, vehicles, and other similar emission sources that would be used during proposed construction activities, the maximum potential air quality impacts would likely occur within a few miles of the emissions sources. For onshore areas, BOEM selected the 15-nm (27.8-kilometer) distance to ensure that the locations of maximum potential air quality impact would be considered.

The RPDE identified several ports along the west coast that may be used to support offshore wind development. BOEM has confined its analysis for the Draft PEIS to the following five ports that have the greatest potential to be affected by the level of activity anticipated as a result of the development described in the RPDE: Port of Humboldt Bay, Port of San Luis, Port of Hueneme, Port of Long Beach, and Port of Los Angeles. Figure 3.2.1-1 shows these ports. The Affected Environment includes the area BOEM anticipates would be subject to San Luis Obispo Air Pollution Control District review[1] as part of OCS air permitting under the Clean Air Act (CAA) (42 USC 7409) for prospective Morro Bay projects.

[1] USEPA has delegated air quality permitting authority to the San Luis Obispo Air Pollution Control District.

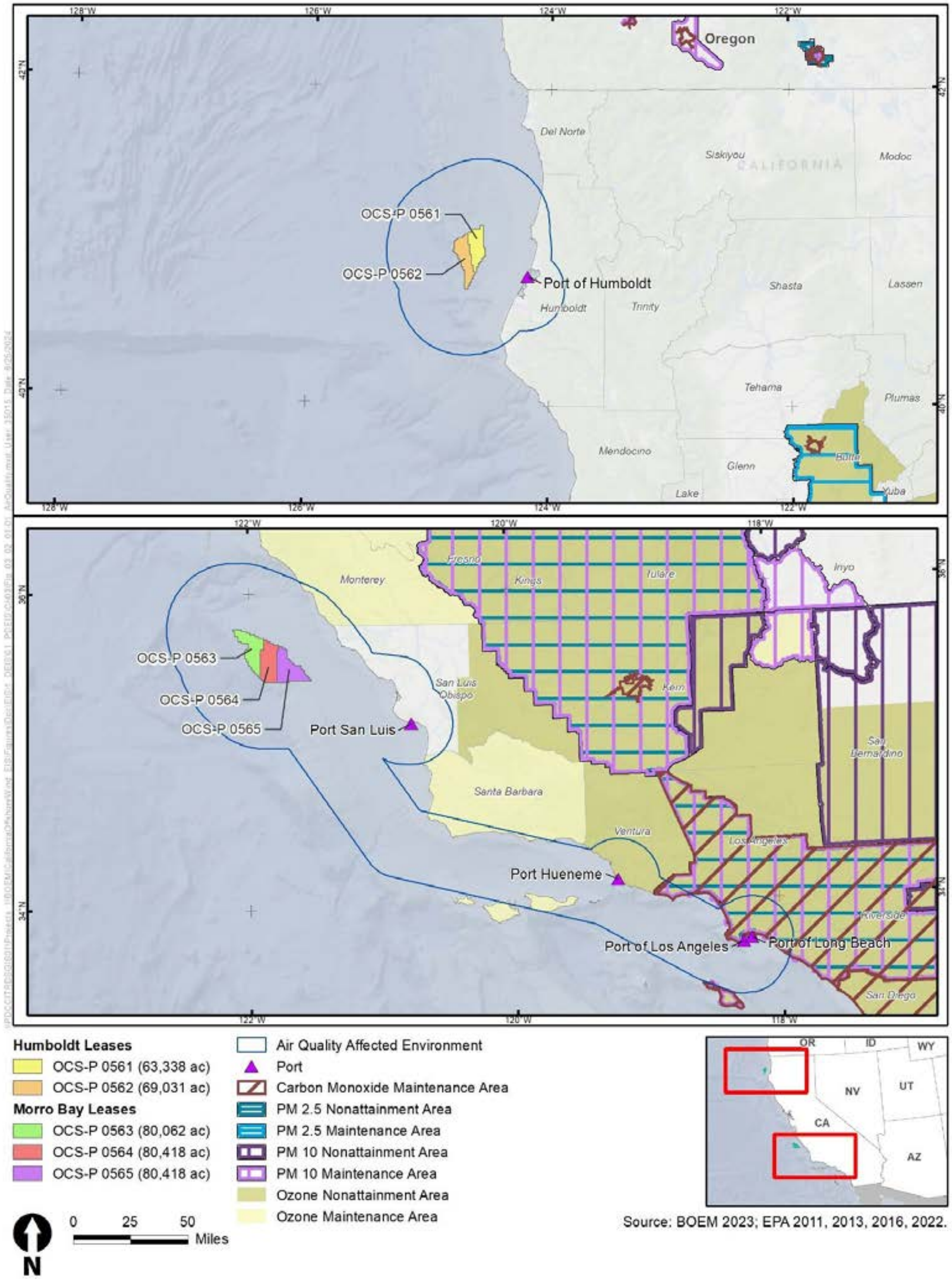

Figure 3.2.1-1. Air quality Affected Environment

3.2.1.1 Description of the Affected Environment and Baseline Conditions

The Affected Environment includes the air above the Humboldt and Morro Bay lease areas and adjacent OCS area, potential offshore and onshore export cable routes, potential sites for onshore features and activities (substations, converter stations, construction staging areas, etc.), ports anticipated to be used to support construction and O&M activities, and vessel transit routes between the ports and the lease areas. Appendix M, *Supplemental Information,* provides information on climate and meteorological conditions in the regions of the Humboldt and Morro Bay lease areas.

Regional air quality is measured in comparison to the NAAQS. To protect human health and welfare, USEPA established NAAQS (pursuant to the CAA [42 USC 7409]) for several common pollutants, known as criteria pollutants.[2] The criteria pollutants are carbon monoxide (CO), lead, nitrogen dioxide, ozone (O_3), particulate matter (PM) with diameter of 10 microns and smaller (PM_{10}), particulate matter with diameter of 2.5 microns and smaller ($PM_{2.5}$), and sulfur dioxide (SO_2). Table M.1-16 in Appendix M shows the NAAQS.[3] USEPA has not established NAAQS for hazardous air pollutants (HAP) but regulates them through emissions standards. The primary HAPs relevant to offshore wind energy development are 1,3-butadiene, acetaldehyde, acrolein, benzene, diesel particulate matter (DPM), ethylbenzene, formaldehyde, naphthalene, and polycyclic organic matter (FHWA 2023).

A component of PM that is of concern is DPM/diesel exhaust (DE) organic gases. DPM/DE is a complex mixture of hundreds of constituents in either a gaseous or particle form. Gaseous components of DE include CO_2, oxygen, nitrogen, water vapor, CO, nitrogen compounds, sulfur compounds, and numerous low-molecular-weight hydrocarbons. Among the gaseous hydrocarbon components of DE that are individually known to be of toxicological relevance are several carbonyls (e.g., formaldehyde, acetaldehyde, acrolein), benzene, 1,3-butadiene, polycyclic aromatic hydrocarbons (PAH), and nitro-PAHs. DPM is composed of a center core of elemental carbon and adsorbed organic compounds, as well as small amounts of sulfate, nitrate, metals, and other trace elements. DPM consists primarily of $PM_{2.5}$, including a subgroup with a large number of particles having a diameter less than 0.1 micrometer. Collectively, these particles have a large surface area, which makes them an excellent medium for adsorbing organic compounds. Also, their small size makes them highly respirable and able to reach deep into lung tissue. Several potentially toxicologically relevant organic compounds—including PAHs, nitro-PAHs, and oxidized PAH derivatives—are on the particles. On-road mobile sources, such as automobiles and trucks, emit DE along with off-road mobile sources (e.g., diesel locomotives, marine vessels, construction equipment). DPM is directly emitted from diesel-powered engines (primary PM) and can be formed from the gaseous compounds emitted by diesel engines (secondary PM).

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[2] California has established state ambient air quality standards (CAAQS) that are similar to the NAAQS.
[3] Emissions of lead from representative project sources would be negligible because lead is not a component of liquid or gaseous fuels; accordingly, this PEIS does not analyze lead. O_3 is not emitted directly but is formed in the atmosphere from precursor chemicals, primarily nitrogen oxides (NO_X) and volatile organic compounds (VOC), in the presence of sunlight. Potential impacts of a project on O_3 levels are evaluated in terms of NO_X and VOC emissions.

Acute or short-term (e.g., episodic) exposure to DE can cause acute irritation (e.g., eye, throat, bronchial), neurophysiological symptoms (e.g., lightheadedness, nausea), and respiratory symptoms (e.g., cough, phlegm). Evidence also exists for an exacerbation of allergic responses to known allergens and asthma-like symptoms. Information from available human studies is inadequate for a definitive evaluation of possible non-cancer health effects from chronic exposure to DE. However, based on extensive animal evidence, DE poses a chronic respiratory hazard to humans. USEPA has determined that DE is likely to be carcinogenic to humans by inhalation and that this hazard applies to environmental exposures.

USEPA designates all areas of the country as attainment, nonattainment, maintenance, or unclassifiable for each criteria pollutant. An *attainment* area is an area where all criteria pollutant concentrations are within all NAAQS. A *nonattainment* area does not meet the NAAQS for one or more pollutants. *Unclassifiable* areas are those where attainment status cannot be determined based on available information and are regulated as attainment areas. An area can be in attainment for some pollutants and nonattainment for others. If an area was designated as nonattainment at any point in the last 20 years but currently meets the NAAQS, then the area is designated a *maintenance* area. Nonattainment and maintenance areas are required to prepare a State Implementation Plan, which describes the region's program to attain and maintain compliance with the NAAQS. The USEPA Green Book (USEPA 2023a) and 40 CFR 81 describe the NAAQS attainment status of an area. California issues similar designations for the CAAQS, available from the California Air Resources Board (CARB 2023). Attainment status for criteria pollutants is determined through evaluation of air quality data from a network of monitors.

The nearest onshore designated area to the Humboldt lease area is in western Humboldt County. This area, including the Port of Humboldt, which BOEM anticipates would be used by representative projects in the Humboldt Bay lease area, is an attainment area. The nearest onshore designated areas to the Morro Bay lease areas are in southwestern Monterey County, western San Luis Obispo County, and western Santa Barbara County. Monterey County and Santa Barbara County are designated maintenance for the O_3 NAAQS. San Luis Obispo County, including Port San Luis, which representative projects in the Morro Bay lease areas could use, is designated attainment for all NAAQS. Ports that the representative projects in the Morro Bay lease areas could use include Port Hueneme in Ventura County, which is designated nonattainment for the O_3 NAAQS; the Port of Los Angeles; and the Port of Long Beach. The Ports of Los Angeles and Long Beach are in Los Angeles County, which is designated nonattainment for O_3 and maintenance for PM_{10}, $PM_{2.5}$, and CO. Figure 3.2.1-1 displays nonattainment and maintenance areas[4] in the Affected Environment.

The CAA amendments directed USEPA to establish requirements to control air pollution from the Pacific OCS. The OCS Air Regulations (40 CFR 55) establish the applicable air pollution control requirements including provisions related to permitting, monitoring, reporting, fees, compliance, and enforcement for

[4] The O_3 nonattainment area shown in Figure 3.2.1-1 also includes the nonattainment area for the 1979 1-hour O_3 NAAQS, which USEPA has revoked; however, this area still must meet the provisions of the former State Implementation Plan for the 1-hour O_3 standard.

facilities subject to the CAA. These regulations apply to OCS sources that are beyond state waters boundaries. Projects within 25 nm (46.3 kilometers) of a state waters boundary must comply with the air quality requirements of the nearest or corresponding onshore area, including applicable permitting requirements.

The CAA defines Class I areas as certain national parks and wilderness areas where little degradation of air quality is allowed. Class I areas consist of national parks larger than 6,000 acres (2,428 hectares) and wilderness areas larger than 5,000 acres (2,023 hectares) in existence before August 1977. Projects subject to federal permits are required to notify the federal land manager responsible for designated Class I areas within 62 miles (100 kilometers) of a project.[5] The federal land manager identifies appropriate air quality–related values for the Class I area and evaluates the impact of a project on air quality–related values. Table 3.2.1-1 lists Class I areas within 62 miles (100 kilometers) of each WEA and the associated ports.

Table 3.2.1-1. Class I areas within 62 miles (100 kilometers) of each WEA and associated ports

Class I Area	Distance (miles) from Nearest WEA or Port
Humboldt WEA	
Redwood National Park	25
Marble Mountain Wilderness	61
Morro Bay WEA	
Ventana Wilderness	26
San Gabriel Wilderness	36
San Rafael Wilderness	39
Cucamonga Wilderness	45
Pinnacles Wilderness	60

3.2.1.2 Impact Background for Air Quality

Table 3.2.1-2 lists issues and indicators used to assess air quality impacts. Accidental releases and air emissions are contributing IPFs to impacts on air quality. Refer to Section 3.1.2, *Impact Terminology,* for descriptions of beneficial impacts.

[5] The 62-mile (100-kilometer) distance applies to notification and is not a threshold for use in evaluating impacts. Impacts at Class I areas at distances greater than 62 miles (100 kilometers) may need to be considered for larger emission sources if there is reason to believe that such sources could affect the air quality in the Class I area (USEPA 1992).

Table 3.2.1-2. Issues and indicators to assess impacts on air quality

Issue	Impact Indicator
Compliance with NAAQS	Emissions (U.S. tons per year) during construction, operation, and decommissioning from marine vessels, vehicles, and equipment activity within 25 nm of the outer edge of the Humboldt and Morro Bay lease areas, and within 15 nm of the vessel routes, ports, and onshore construction areas. The significance thresholds for criteria pollutants are the NAAQS.
Greenhouse gas emissions	GHG emissions (metric tons per year) during construction, operation, and decommissioning; operational GHG emissions reductions due to displacement of fossil-fuel power plants by wind energy. There are currently no significance thresholds for GHG emissions.

3.2.1.3 Impacts of Alternative A – No Action – Air Quality

When analyzing the impacts of the No Action Alternative on air quality, BOEM considers the impacts of past and ongoing trends and activities on the baseline conditions for air quality.

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative on existing baseline trends, including other planned activities, which are described in Appendix C, *Planned Activities Scenario*.

3.2.1.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. Ongoing activities in the Affected Environment that can impact air quality are generally associated with existing onshore land uses, including residential, commercial, industrial, and transportation activities as well as onshore construction activities.

California has adopted many policies and plans regarding renewable energy as a means to lessen pollutant emissions; the effects of these efforts are ongoing. The 2006 Global Warming Solutions Act required the state to reduce GHG emissions to 1990 levels by 2020 (Assembly Bill 32, Nunez). The state met this target in 2016, 4 years early. Since 2016 there have been several legislative and policy activities, including an update to the Global Warming Solutions Act in 2016 that set a new emission reduction target of 40 percent below 1990 levels by 2030 (Senate Bill [SB] 32, Pavley). SB 100 (De León), the 100 Percent Clean Energy Act of 2018, requires 100 percent of energy procured by the state to come from eligible renewable energy and zero-carbon resources by the end of 2045. The SB 100 Joint Agency Report (California Energy Commission 2021) estimated that the production of new solar and wind capacity in California must triple in order to meet SB 100 goals, and battery storage must increase by nearly eightfold. Advancements in wind and wave energy, solar power, and battery storage capabilities have made these technologies more economically competitive with fossil fuel energy, but the pace of deployment and grid-connected installations must accelerate for the state to achieve the SB 100 requirement on time (California State Lands Commission 2021).

3.2.1.3.2 Cumulative Impacts of the No Action Alternative

Air emissions: Planned activities that could contribute to air quality impacts include construction or repair of undersea transmission lines, gas pipelines, and other submarine cables; military use; marine transportation; oil and gas activities; and onshore development activities (Appendix C). Onshore development activities could include port improvements and O&M facilities at several ports to support the offshore wind energy industry. Example onshore port improvements and O&M facilities include the Humboldt Bay Offshore Wind Heavy Lift Multipurpose Marine Terminal Project, Port of Long Beach Pier Wind Project, and potential O&M facilities at the Port of Hueneme and Port of San Luis. These planned activities have the potential to affect air quality through their emissions. Impacts associated with climate change due to GHG emissions could affect ambient air quality through increased formation of O_3 and PM associated with increasing air temperatures.

In April 2024, BOEM published a draft environmental assessment (EA) associated with the site characterization and site assessment activities for the prospective leasing of two Oregon WEAs (off Brookings and Coos Bay). Please refer to the draft EA for a discussion of the potential environmental effects associated with air quality for site characterization and site assessment activities.[6]

Accidental releases: Ongoing and planned activities could release air toxics or HAPs because of accidental chemical spills. Section 3.2.2, *Water Quality*, includes a discussion of anticipated releases. A spill or release could result in release to the atmosphere of contaminants such as fuel or other petroleum products and solvents or other volatile chemicals. All planned activities, including site assessment and characterization activities associated with the Oregon WEAs, would be required to comply with regulatory requirements related to preventing and controlling accidental spills administered by USCG and the BSEE. OSRPs or construction Spill Prevention, Control, and Countermeasures Plans are required for every project and would provide for rapid spill response, cleanup, and other measures that would help to minimize potential air quality impacts from spills. BOEM expects air quality impacts from accidental releases would be short term and limited to the area near the accidental release location. Accidental spills would occur infrequently over a project lifetime, with a higher probability of spills during project construction, but they are not expected to contribute appreciably to cumulative impacts on air quality.

3.2.1.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue to affect air quality. High-emission, fossil-fuel power plants would be kept in service to meet future power demands. BOEM expects ongoing activities would continue to have regional air quality impacts primarily through air pollutant emissions, accidental releases, and

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[6] Commercial Wind Lease Issuance on the Pacific Outer Continental Shelf Offshore, Oregon. Draft Environmental Assessment. Available: https://www.boem.gov/renewable-energy/state-activities/commercial-wind-lease-issuance-pacific-outer-continental-shelf.

climate change. Ongoing activities would likely result in impacts on air quality because of air pollutant emissions and GHGs.

Cumulative impacts of the No Action Alternative. Planned activities may also contribute to impacts on air quality because air pollutant and GHG emissions could increase through construction and operation of new energy generation facilities to meet future power demands. Continuation of current regional trends in energy development could include new power plants that could contribute to air quality and GHG impacts. BOEM expects the combination of ongoing and planned activities to result in impacts on air quality, primarily driven by recent market and permitting trends indicating future fossil-fueled electric generating units would most likely include natural-gas-fired facilities (California Energy Commission 2021; BOEM 2017, 2021a).[7]

3.2.1.4 Impacts of Alternative B – Development with No Mitigation Measures – Air Quality

3.2.1.4.1 Impacts of One Representative Project in Each WEA

Construction, O&M, and decommissioning of one representative project in each of the Humboldt and Morro Bay WEAs may generate emissions and affect air quality in the California coastal region and nearby coastal waters. Onshore emissions would occur at port facilities, in the onshore export cable corridors, and at POIs. One representative project would release offshore emissions over the OCS and state waters. Offshore emissions would occur in the WEAs, along vessel routes to and from port facilities, and along the offshore export cable corridors.

BOEM has estimated emissions and air quality impacts from one representative project in each WEA based on estimates of vessel, equipment, and vehicle activity for construction, O&M, and decommissioning. Such activity estimates are based on similar data from the BOEM New York Bight Programmatic EIS (NY Bight PEIS), as discussed further herein (BOEM 2024). Notably, the NY Bight PEIS estimated emissions associated with fixed-bottom offshore wind installations. However, due to the lack of available emissions estimates from floating offshore wind installations, such comparisons to fixed-bottom installations were used as the best information currently available to illustrate the potential magnitude of emissions in this programmatic analysis. BOEM anticipates that floating offshore wind installations would require different onshore and offshore infrastructure, vessel types, and vessel quantities compared to fixed-bottom wind installations. Furthermore, because the analysis in this Draft PEIS is being prepared before lessees have submitted COPs, emissions estimates herein are only provided to illustrate potential emissions and should not be considered predictive. As such, there is considerable uncertainty in the emissions estimates.

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[7] Natural gas power plants provide about 75 percent of the flexible capacity of the grid (the ability to quickly ramp energy production up or down to match supply and demand). While some natural gas power plants are retiring, others are still needed to maintain grid reliability as more renewable power enters the system (California Energy Commission 2021).

The following types of sources would generate emissions. including:

- Construction and assembly of the WTGs in ports.
- Work vessels used for offshore construction of mooring systems and electrical cable installation, including transits between ports and lease areas (likely the largest emissions source).
- Vessels and support vessels for transporting WTGs from ports to lease areas and connecting to mooring systems and interarray cables.
- Onshore project construction activities including cable installation, construction of new substations (as applicable), improvements to existing substations (as applicable), and construction of new or upgraded transmission lines.

BOEM has not quantified emissions from raw material extraction, materials processing, and manufacturing of components, i.e., full life-cycle analysis. However, recently published studies have analyzed the life-cycle impacts of offshore wind (Ferraz de Paula and Carmo 2022; Rueda-Bayona et al. 2022; Shoaib 2022). These studies concluded that the materials that have the greatest impact on life-cycle emissions generally are steel and concrete. Furthermore, material recycling rates have a large influence on life-cycle emissions. NREL harmonized approximately 3,000 life-cycle assessment studies with around 240 published life-cycle analyses of land-based and offshore wind technologies (NREL 2021). Although wind has higher upstream emissions than many other generation methods, its life-cycle GHG emissions are orders of magnitude lower. NREL (2021) estimated that the central 50 percent of GHG estimates reviewed were in the range of 9.4 to 14 grams of carbon dioxide equivalent (CO_2e) per kilowatt-hour, while life-cycle GHG estimates for coal and natural gas are on the scale of 1,000 grams of CO_2e per kilowatt-hour (Dolan and Heath 2012) and 480 grams of CO_2e per kilowatt-hour (O'Donoughue et al. 2014), respectively.

One representative project in each WEA would provide beneficial regional air quality impacts to the extent that energy produced by WTGs would displace energy produced by fossil-fueled power plants. These beneficial impacts would consist of reductions in air pollutant concentrations, which would lead to reduced adverse regional effects on human health.

Air emissions – construction: Fuel combustion and solvent use would cause construction-related emissions. The air pollutants would include criteria pollutants, VOCs, and HAPs, as well as GHGs. During the construction phase, the activities of additional workers, increased traffic congestion, additional commuting miles for construction personnel, and increased air-polluting activities of supporting businesses also could have impacts on air quality.

BOEM used its Wind Tool model (BOEM 2021) to estimate the construction emissions for one project in each WEA based on estimates of vessel, equipment, and vehicle activity data from the NY Bight PEIS. Therefore, based on activity data from the NY Bight PEIS, one representative project in each WEA is projected to generate an average of up to 51 vessels operating at any given time during construction (BOEM 2024). To estimate transit emissions associated with one project in the Humboldt WEA, the modeling assumed one-way vessel trip lengths of 40 nm (74 kilometers) from the Port of Humboldt. To estimate the vessel transit emissions associated with one project in the Morro Bay WEA, the modeling assumed one-way vessel trip lengths of 300 nm (556 kilometers) from the Port of Long Beach. BOEM assumed the onsite vessel operating times in each WEA to be equal.

Table 3.2.1-3 summarizes total estimated construction emissions for one representative project in each WEA.[8]

Table 3.2.1-3. Total construction emissions (U.S. tons, except GHGs in metric tons) for one representative project

Location	Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2	CH_4	N_2O	CO_2e[1]
Humboldt WEA	Total	2,674	12,617	255	244	493	363	738,335	4.6	36	749,188
Morro Bay WEA	Total	5,566	26,155	528	505	1,015	756	1,537,001	9.6	75	1,559,593

[1] CO_2e values were calculated using the 100-year Global Warming Potential values from the Intergovernmental Panel on Climate Change's Fourth Assessment Report (Forster et al. 2007).
CH_4 = methane; N_2O = nitrous oxide

Offshore Construction

Emissions would vary throughout construction of offshore components, including mooring systems, offshore cables, WTGs, and substation/converter stations. Offshore construction-related emissions also would come from diesel-fueled generators used to temporarily supply power to the WTGs and substation/converter stations so that workers could operate lights, controls, and other equipment before cabling is in place. Emissions from vessels and helicopters used to transport workers, supplies, and equipment to and from the construction areas would result in additional air quality impacts. A representative project may need to use emergency generators at times, potentially resulting in increased emissions for limited periods.

Air quality impacts are anticipated to be small relative to larger emission sources in the region, such as industry, transportation, and fossil-fuel power plants. BOEM anticipates the largest air quality impacts during construction, with smaller and more infrequent impacts anticipated during decommissioning.

The majority of air pollutant and GHG emissions from one representative project in each WEA would occur during construction associated with marine vessels (main engines, auxiliary engines, and auxiliary equipment). Transit emissions generated by vessels have the potential to affect onshore locations due to potential transport of air pollutants from offshore release sites to onshore locations. The potential for transit emissions to affect onshore locations is primarily influenced by wind direction, pollutant dispersion, and proximity of vessel routes to onshore locations.[9]

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[8] BOEM assumes that construction of each project would start in 2028 at the earliest.

[9] Further regulatory processes would occur during COP reviews and permitting. Emissions from the OCS source, as defined in the CAA, would be allowed as part of the OCS permit for which each project must apply. An offshore wind project must demonstrate compliance with the NAAQS and CAAQS and must demonstrate no adverse impact on air quality–related values. The OCS air permitting process includes air dispersion modeling of emissions to demonstrate compliance with the NAAQS and CAAQS. As part of the air quality–related values analysis, an offshore wind project must demonstrate that significant visibility degradation at a Class I area would not occur as a result of increased haze or plumes.

Onshore Construction

Onshore activities of one representative project in each WEA would consist of tunneling/ drilling/excavation for cable installation, duct bank construction, cable-pulling operations, and substation or converter station construction. Onshore construction emissions would be primarily from operation of diesel-powered equipment and vehicle activity such as bulldozers, excavators, and diesel trucks, and fugitive particulate emissions from excavation and hauling of soil.

Compared to fixed-bottom offshore wind installations, floating offshore wind construction could result in lower levels of offshore emissions but higher levels of onshore emissions. This is because some construction tasks that would be performed at sea for fixed-bottom installations would instead take place onshore. For example, assembly of floating tower sections, generator nacelles, and blades might be performed in port before the completed WTG is towed to its offshore location. Such onshore emissions could potentially affect nearby sensitive receptors. Port activities would be required to comply with all permit and mitigation requirements of the applicable municipality and the applicable air quality management district.

Onshore construction emissions would be highly variable and limited in spatial extent at any given period and would result in impacts that are less than the NAAQS and CAAQS, as they would be temporary in nature. Fugitive particulate emissions would vary depending on the spatial extent of the excavated areas, soil type, soil moisture content, and magnitude and direction of surface winds.

Air emissions – O&M: BOEM anticipates O&M air quality impacts to be smaller in magnitude than those of construction and decommissioning. Offshore O&M activities would consist of WTG operations, planned maintenance, and unplanned emergency maintenance and repairs. WTG operations would have no pollutant emissions. WTGs and substations/converter stations are assumed to include permanently installed emergency generators. Such generators would operate only during emergencies or testing, so emissions from these sources would be small and transient. Pollutant emissions from O&M would be mostly associated with ocean vessels and helicopters. Crew transfer vessels and helicopters would transport crews to the WEAs for inspections, routine maintenance, and repairs. Larger support vessels would travel infrequently to the WEAs for significant maintenance and repairs or to tow WTGs back to port for major repairs. Based on vessel activity data from the NY Bight PEIS, one representative project is projected to generate an average of up to eight vessel trips per day during operations (BOEM 2024). Table 3.2.1-4 summarizes annual estimated O&M emissions for one project in each WEA.

Table 3.2.1-4. Operations and maintenance emissions (U.S. tons, except GHGs in metric tons) from one representative project

Location	Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2	CH_4	N_2O	CO_2e[1]
Humboldt WEA	Annual	14	63	1.3	1.2	2.4	1.4	3,743	0.03	0.2	3,793
	Lifetime (35 years)	491	2,197	44	42	85	50	130,992	1.0	5.6	132,764
Morro Bay WEA	Annual	52	229	4.6	4.4	8.9	5.4	13,921	0.1	0.6	14,901
	Lifetime (35 years)	1,828	8,008	161	155	311	187	487,240	3.7	21	493,831

[1] CO_2e values were calculated using the 100-year Global Warming Potential values from the Intergovernmental Panel on Climate Change's Fourth Assessment Report (Forster et al. 2007).

Depending on wind conditions, it is likely that not all emissions generated offshore would reach land. BOEM anticipates that air quality impacts from O&M would be less than the NAAQS and CAAQS, occurring for short periods of time several times per year during the projects' operational lifetimes.

During O&M, GHG emissions can include sulfur hexafluoride (SF_6). SF_6 is a synthetic gas that has been used as an anti-arcing insulator in electrical systems for 70 years and is the most potent GHG known. Emissions are the result of leaks in switchgear that contains SF_6. Offshore wind projects typically, though not always, use switchgear containing SF_6.

Onshore, O&M emissions would occur during periodic use of vehicles and equipment. Onshore O&M activities would include occasional inspections and repairs to substations/converter stations and splice vaults, which would require minimal use of worker vehicles and construction equipment. BOEM anticipates that air quality impacts due to onshore O&M would be intermittent and would occur for short periods.

One representative project in each WEA would produce GHG emissions that contribute to climate change; however, their contributions would be less than the avoided emissions from energy sources powered by fossil fuels on the grid during operation of the representative projects. To the extent that the WTGs displace energy generated from fossil fuel combustion, one representative project in each WEA would have an overall net beneficial impact on criteria pollutant and O_3 precursor emissions as well as GHGs compared to similarly sized fossil-fueled power plants or to the generation of the same amount of energy by the existing grid.

Increases in renewable energy could lead to reductions in emissions from fossil-fuel power plants. BOEM used its Wind Tool model (BOEM 2021b) to estimate the emissions avoided as a result of one representative project (200 WTGs per the RPDE). Once operational, the 200 WTGs from one project would result in annual avoided emissions of 956 tons of NO_X, 149 tons of $PM_{2.5}$, 205 tons of SO_2, and 3,487,502 metric tons of CO_2.[10] The avoided CO_2 emissions are equivalent to the emissions generated by about 760,000 passenger vehicles in a year (USEPA 2020). The emissions benefits would diminish over time as the grid becomes cleaner and the emissions displaced by wind energy become less (on a per-megawatt-hour basis) than at the time one representative project would begin operation.

The avoided emissions of one representative project in either the Humboldt WEA or the Morro Bay WEA are the same; however, the construction, operational, and decommissioning emissions are higher for the Morro Bay WEA compared to the Humboldt WEA due to increased vessel transit distances from the modeled onshore port location for the Morro Bay WEA. Accounting for construction emissions and assuming conceptually that decommissioning emissions would be the same, and including emissions from future operations, one project in the Humboldt WEA would offset emissions related to its construction and decommissioning as follows: NO_X would be offset in approximately 26 years of operation, $PM_{2.5}$ in 3 years, SO_2 in 5 years, and CO_2 in 5 months. Similarly, one project in the Morro Bay

[10] These estimates are for one representative project. For the total avoided emissions from one representative project in each WEA, double these estimates of avoided emissions.

WEA would offset emissions related to its construction and decommissioning in different time periods of operation depending on the pollutant: $PM_{2.5}$ would be offset in approximately in 7 years of operation, SO_2 in 10 years, and CO_2 in 11 months. NO_X would not be offset within the project lifetime. Without inclusion of emissions from future operations and decommissioning, the times required for emissions to "break even" would be shorter. From that point, one project would have lower emissions than fossil-fuel sources on the grid might generate.

Estimations and evaluations of potential health and climate benefits from offshore wind activities for specific regions and project sizes rely on information about air pollutant emission contributions of existing and projected mixes of power generation sources, and generally estimate the annual health benefits of an individual commercial scale offshore wind project to be valued in the hundreds of millions of dollars (Kempton et al. 2005; Buonocore et al. 2016). The potential health benefits of avoided emissions can be evaluated using USEPA's CO-Benefits Risk Assessment (COBRA) health impacts screening and mapping tool (USEPA 2021a). COBRA is a tool that estimates the health and economic benefits of clean energy policies. BOEM used COBRA to analyze the avoided emissions that were calculated for one project in either the Humboldt or Morro Bay WEA. Table 3.2.1-5 presents the results.

Table 3.2.1-5. COBRA estimate of annual avoided health effects with one representative project

Discount Rate[1] (2023)	Monetized Total Health Benefits (million U.S. dollars/year)		Avoided Mortality (cases/year)	
	Low Estimate[2]	High Estimate[2]	Low Estimate[2]	High Estimate[2]
3%	$120	$180	7.5	12
7%	$110	$160	7.5	12

[1] COBRA uses the discount rate to express future economic values in present terms. Not all health effects and associated economic values occur in the year of analysis. Therefore, COBRA accounts for the "time value of money" preference (i.e., a general preference for receiving economic benefits now rather than later) by discounting benefits received later (USEPA 2021b).
[2] COBRA derives the low and high estimates using two sets of assumptions about the sensitivity of adult mortality and non-fatal heart attacks to changes in ambient $PM_{2.5}$ levels. Specifically, the high estimates are based on studies that estimated a larger effect of changes in ambient $PM_{2.5}$ levels on the incidence of these health effects (USEPA 2021b).

The overall impacts of GHG emissions can be assessed using "social costs." The "social cost of carbon," "social cost of nitrous oxide," and "social cost of methane"—together, the "social cost of greenhouse gases" (SC-GHG)—are estimates of the monetized damages associated with incremental increases in GHG emissions in a given year. NEPA does not require monetizing costs and benefits but allows the use of the social cost of carbon, SC-GHG, or other monetized costs and benefits of GHGs in weighing the merits and drawbacks of alternative actions. In January 2023, CEQ issued interim guidance (CEQ 2023) on consideration of GHGs and climate change within NEPA. This guidance recommends agencies provide context for GHG emissions, including through the use of SC-GHG estimates, to translate climate impacts into the more accessible metric of dollars. Multiple estimates of SC-GHG are available. The Interagency Working Group (IWG) on SC-GHG recommends that agencies "use their professional judgment to determine which estimates of the SC-GHG reflect the best available evidence, are most appropriate for particular analytical contexts, and best facilitate sound decision-making" (IWG 2023).

For federal agencies, the best currently available estimates of SC-GHG are the interim estimates of the social costs of CO_2, CH_4, and N_2O developed by the IWG and published in its Technical Support Document (IWG 2021). IWG based its SC-GHG estimates on complex models describing how GHG emissions affect global temperatures, sea level rise, and other biophysical processes; how these changes affect society through, for example, agricultural, health, or other effects; and monetary estimates of the market and nonmarket values of these effects. One key parameter in the models is the discount rate, which is used to estimate the present value of the stream of future damages associated with emissions in a particular year. The discount rate accounts for the "time value of money," i.e., a general preference for receiving economic benefits now rather than later, by discounting benefits received later. A higher discount rate assumes that future benefits or costs are more heavily discounted than benefits or costs occurring in the present (i.e., future benefits or costs are less valuable or are a less-significant factor in present-day decisions). Please refer to IWG's Technical Support Document for additional information regarding SC-GHG estimates (IWG 2021).

Table 3.2.1-6 and Table 3.2.1-7 present the SC-GHG associated with estimated emissions from one project in the Humboldt WEA and Morro Bay WEA, respectively. These estimates represent the present value of future market and nonmarket costs associated with CO_2, CH_4, and N_2O emissions. In accordance with IWG's recommendation, BOEM calculated four estimates based on IWG estimates of social cost per metric ton of emissions for a given emissions year and estimates of emissions from one representative project in each year. In Table 3.2.1-6 and Table 3.2.1-7, negative values represent social benefits of avoided GHG emissions. The negative values for net SC-GHG indicate that the impact of one project on GHG emissions and climate would be a net benefit in terms of SC-GHG. The estimates follow the IWG recommendations.

Table 3.2.1-6. Estimated SC-GHG associated with one representative project in the Humboldt WEA

Description	SC-GHG (2020$)[1,2]			
	Average Value, 5% Discount Rate	Average Value, 3% Discount Rate	Average Value, 2.5% Discount Rate	95th Percentile Value, 3% Discount Rate [4]
SC-CO_2				
Construction, Operation, and Decommissioning	$16,319,000	$66,249,000	$102,166,000	$201,271,000
Avoided Emissions	-$1,177,545,000	-$4,974,989,000	-$7,707,528,000	-$15,241,263,000
Net SCC-CO_2	-$1,161,226,000	-$4,908,740,000	-$7,605,362,000	-$15,039,992,000
SC-CH_4				
Construction, Operation, and Decommissioning	$5,000	$15,000	$20,000	$38,000
Avoided Emissions	-$3,536,000	-$10,285,000	-$14,261,000	-$27,406,000
Net SCC-CH_4	-$3,531,000	-$10,270,000	-$14,241,000	-$27,368,000
SC-N_2O				
Construction, Operation, and Decommissioning	$323,000	$1,224,000	$1,882,000	$3,256,000
Avoided Emissions	-$3,658,000	-$14,445,000	-$22,311,000	-$38,556,000
Net SCC-N_2O	-$3,335,000	-$13,221,000	-$20,429,000	-$35,300,000

Description	SC-GHG (2020$)[1,2]			
	Average Value, 5% Discount Rate	Average Value, 3% Discount Rate	Average Value, 2.5% Discount Rate	95th Percentile Value, 3% Discount Rate [4]
Total SC-GHG[3]				
Construction, Operation, and Decommissioning	$16,647,000	$67,488,000	$104,068,000	$204,565,000
Avoided Emissions	-$1,184,739,000	-$4,999,719,000	-$7,744,100,000	-$15,307,225,000
Net SC-GHG	-$1,168,092,000	-$4,932,231,000	-$7,640,032,000	-$15,102,660,000

[1] BOEM assumed the following calendar years in calculating SC-GHG: construction 2028–2030 (3 years), operation 2031–2065 (35 years), and decommissioning 2066–2068 (3 years).
[2] Negative cost values indicate benefits.
[3] SC-GHG is the sum of the social costs for CO_2, CH_4, and N_2O.
Estimates are over the lifetime of one representative project. Estimates are rounded to the nearest $1,000.

Table 3.2.1-7. Estimated SC-GHG associated with one representative project in the Morro Bay WEA

Description	SC-GHG (2020$)[1,2]			
	Average Value, 5% Discount Rate	Average Value, 3% Discount Rate	Average Value, 2.5% Discount Rate	95th Percentile Value, 3% Discount Rate [4]
SC-CO_2				
Construction, Operation, and Decommissioning	$36,041,000	$146,657,000	$226,227,000	$445,778,000
Avoided Emissions	-$1,177,545,000	-$4,974,989,000	-$7,707,528,000	-$15,241,263,000
Net SCC-CO_2	-$1,141,504,000	-$4,828,332,000	-$7,481,301,000	-$14,795,485,000
SC-CH_4				
Construction, Operation, and Decommissioning	$12,000	$33,000	$45,000	$86,000
Avoided Emissions	-$3,536,000	-$10,285,000	-$14,261,000	-$27,406,000
Net SCC-CH_4	-$3,524,000	-$10,252,000	-$14,216,000	-$27,320,000
SC-N_2O				
Construction, Operation, and Decommissioning	$709,000	$2,692,000	$4,140,000	$7,160,000
Avoided Emissions	-$3,658,000	-$14,445,000	-$22,311,000	-$38,556,000
Net SCC-N_2O	-$2,949,000	-$11,753,000	-$18,171,000	-$31,396,000
Total SC-GHG[3]				
Construction, Operation, and Decommissioning	$36,762,000	$149,382,000	$230,412,000	$453,024,000
Avoided Emissions	-$1,184,739,000	-$4,999,719,000	-$7,744,100,000	-$15,307,225,000
Net SC-GHG	-$1,147,977,000	-$4,850,337,000	-$7,513,688,000	-$14,854,201,000

[1] BOEM assumed the following calendar years in calculating SC-GHG: construction 2028–2030 (3 years), operation 2031–2065 (35 years), and decommissioning 2066–2068 (3 years).
[2] Negative cost values indicate benefits.
[3] SC-GHG is the sum of the social costs for CO_2, CH_4, and N_2O.
[4] 95th percentile of damages estimated is a low-probability but high-damage scenario and represents an upper bound of damages within the 3-percent discount rate model.
Estimates are over the lifetime of one representative project. Estimates are rounded to the nearest $1,000.

Table 3.2.1-8 presents the annual emissions, avoided emissions, and net emissions of CO_2 over the operational lifetime of one project in each WEA, as estimated by the BOEM Wind Tool model (BOEM 2021b). Net emissions are the project emissions minus the avoided emissions for each project. The avoided emissions, 3,487,502 metric tons per year of CO_2 (Table 3.2.1-8), would be equivalent to about 760,000 additional passenger vehicles per year. These estimates are relative to the 2019 grid configuration, but BOEM expects the actual annual quantity of avoided emissions attributable to this proposed facility to diminish over time if the electric grid becomes lower-emitting due to the addition of other renewable energy facilities and retirement of high-emitting generators.

Table 3.2.1-8. Net Emissions of CO_2 for one representative project

Alternative	CO_2 Emissions (metric tons)[1,2]					
	Construction	Operation				Construction + Operation
	Construction (Total)	O&M Emissions (Annual)	Avoided Emissions (Annual)	Net Emissions (Annual)	Operational Lifetime Net Emissions (Total)	Total Lifetime Net Emissions
No Action	0	0	0	0	0	122,062,563[3]
Alternative B: One Humboldt WEA Project	738,335	3,743	-3,487,502	-3,462,664	-121,193,236	-120,454,900
Alternative B: One Morro Bay WEA Project	1,537,001	13,921	-3,487,502	-3,429,666	-120,038,323	-118,501,322

[1] Positive values are emissions increases; negative values are emissions decreases.
[2] Does not include emissions from decommissioning.
[3] Represents emissions from the grid in the absence of one project.

One project would produce GHG emissions that contribute to climate change; however, its contribution would be less than the emissions reductions from fossil-fueled sources during project operation. Because GHG emissions disperse and mix within the troposphere, the climatic impact of GHG emissions does not depend upon the source location. Therefore, regional climate impacts are largely a function of global emissions. Nevertheless, one project would have an overall net beneficial impact on criteria pollutant and O_3 precursor emissions as well as GHGs, compared to a similarly sized fossil-fuel power plant or to the generation of the same amount of energy by the existing grid.

Climate change can make ecosystems, resources, and communities more susceptible and reduce resilience to other environmental impacts apart from climate change. In some instances, this may exacerbate the environmental effects of a project. Although one representative project in each WEA would produce criteria pollutant emissions, the predicted impacts would be within applicable standards and would be unlikely to contribute substantially to increasing susceptibility or decreasing resilience of ecosystems. Similarly, foreseeable climate change would be unlikely to contribute substantially to increasing the impacts of criteria pollutant emissions from one representative project in each WEA.

Air emissions – decommissioning: BOEM did not quantify emissions from decommissioning, but emissions are expected to be less than for construction. Each representative project might pursue a separate OCS Air Permit for decommissioning activities because the lessee might assume that marine vessels, equipment, and construction technology will change substantially over the project lifetime and in the future will have lower emissions than current vessels and equipment. BOEM anticipates temporary air quality impacts due to decommissioning.

Accidental releases: One representative project in each WEA could release VOCs or HAPs because of accidental chemical spills. Accidental releases, including spills from vessel collisions and allisions, may lead to short-term periods of VOC and HAP emissions through evaporation. VOC emissions would be a precursor to O_3 formation. Air quality impacts would be short term (hours to days)[11] and limited to the local area at and around the accidental release location. BOEM anticipates that a major spill is very unlikely due to vessel and offshore wind energy industry safety measures, as discussed in Section 3.2.2, as well as the distributed nature of the material.

Similarly, a catastrophic failure of switchgear could release SF_6. Such a failure would be extremely unlikely and no such release is expected.

3.2.1.4.2 Impacts of Five Representative Projects

With five total representative projects in the Humboldt and Morro Bay WEAs, total emissions described for one representative project would be multiplied by as much as two for the Humboldt WEA and three for the Morro Bay WEA. BOEM anticipates that air quality impacts from construction, operation, and decommissioning of five representative projects would not cause an exceedance of the NAAQS or CAAQS. However, to the extent that project activities overlap, impacts at any particular time or place could be greater than for one representative project in each WEA. If projects do not overlap, then impacts may not be greater in magnitude than for one representative project in each WEA but would occur over a longer time or larger area.

Air emissions – construction: The estimated construction emissions from one representative project in each WEA would be multiplied by as much as two for the Humboldt WEA and three for the Morro Bay WEA. Construction and operation of representative projects could overlap in time, and potentially in space if common port facilities or cable corridors are used. Several factors could influence the amount of overlap, such as availability of vessels and port facilities and the rate of progress of baseline surveys. Most emissions with five representative projects would occur from diesel-fueled construction equipment, vessels, and commercial vehicles. The magnitude of the emissions and the resulting air quality impacts would vary spatially and temporally during the construction phases.

Air emissions – O&M: The types of O&M activities, vessels, and equipment with five representative projects would be the same as those for one representative project in each WEA. However, with five representative projects, O&M emissions described for one representative project in each WEA would be multiplied by as much as two for the Humboldt WEA and three for the Morro Bay WEA. Air quality

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[11] For example, small diesel fuel spills (500–5,000 gallons) usually will evaporate and disperse within a day or less (NOAA 2006).

impacts during O&M are anticipated to be smaller in magnitude compared to those of construction and decommissioning.

Increases in renewable energy could lead to reductions in emissions from fossil-fuel power plants. Emissions avoided with five representative projects would be greater than with one representative project in each WEA. The USEPA Avoided Emissions and Generation Tool (known as AVERT) model (USEPA 2023b) was used to estimate the emissions avoided by five representative projects. Estimated annual avoided emissions during operation of five representative projects would be 4,946 tons of NO_X, 821 tons of $PM_{2.5}$, 840 tons of SO_2, 277 tons of VOCs, and 17,486,735 metric tons of CO_2. As with one representative project, these emissions benefits would diminish over time as the grid becomes cleaner and the emissions displaced by wind energy become less (on a per-megawatt-hour basis) than at the time five representative projects would begin operation. Five representative projects would contribute enough energy to the grid to affect decisions by grid operators to reduce output of some power plants or take plants offline in response, thus potentially influencing emissions avoidance.

Five representative projects' avoided emissions would have greater potential health benefits than for one in each WEA. Five representative projects would have impacts on climate change and an overall net beneficial impact on criteria pollutant and O_3 precursor emissions as well as GHGs, compared to the generation of the same amount of energy by the existing grid.

COBRA was used to analyze potential health benefits of avoided emissions, assuming five representative projects with maximum generating capacity of 15,000 MW (15 GW). Table 3.2.1-9 presents estimated monetized health benefits and avoided mortality.

Table 3.2.1-9. COBRA estimate of annual avoided health effects with 15 GW reasonably foreseeable offshore wind power (five representative projects)

Discount Rate[1] (2023)	Monetized Total Health Benefits (million U.S. dollars/year)		Avoided Mortality (cases/year)	
	Low Estimate[2]	High Estimate[2]	Low Estimate[2]	High Estimate[2]
3%	$610	$920	39	61
7%	$550	$820	39	61

[1] COBRA uses the discount rate to express future economic values in present terms. Not all health effects and associated economic values occur in the year of analysis. Therefore, COBRA accounts for the "time value of money" preference (i.e., a general preference for receiving economic benefits now rather than later) by discounting benefits received later (USEPA 2021b).

[2] COBRA derives the low and high estimates using two sets of assumptions about the sensitivity of adult mortality and non-fatal heart attacks to changes in ambient $PM_{2.5}$ levels. Specifically, the high estimates are based on studies that estimated a larger effect of changes in ambient $PM_{2.5}$ levels on the incidence of these health effects (USEPA 2021b).

A known impact of offshore wind facilities on meteorological conditions is the wind wake effect. A WTG extracts energy from the free flow of wind, creating turbulence downstream of the WTG. Under certain conditions, offshore wind farms can also affect temperature and moisture downwind of the facilities. Appendix M, Section B.1.4, *Potential General Impacts of Offshore Wind Facilities on Meteorological Conditions*, provides further information on these effects. For large numbers of WTGs in a single region, these effects can be large enough to have potential local climate impacts. Akhtar et al. (2022) used a high-resolution regional climate model to investigate the impact of large-scale offshore wind farms that are proposed for the North Sea on the lower atmosphere. Their results showed local decreases in wind speed, local increases in precipitation, a significant reduction in air-sea heat flux, and a local, annual mean net cooling of the lower atmosphere in the wind farm areas. There is also an increase in temperature below hub height that is on the order of up to 10 percent of the climate change signal at the end of the century, but much smaller than temperature changes due to interannual climate variability. In contrast, wind speed changes resulting from wind farms were larger than projected mean wind speed changes due to climate change. Based on the modeling results, the authors suggest that the impacts of large clustered offshore wind farms should be considered in climate change impact studies.

Air emissions – decommissioning: BOEM anticipates that each of the five representative projects would pursue a separate OCS Air Permit for decommissioning activities. BOEM further assumes that marine vessels, equipment, and construction technology will change substantially over the projects' lifetimes and in the future will have lower emissions than current vessels and equipment. BOEM anticipates temporary air quality impacts from five representative projects due to decommissioning.

Accidental releases: The total potential volume and number of spills releasing VOCs or HAPs would be greater than with one representative project in each WEA. As with one representative project in each WEA, air quality impacts would be short term and limited to the local area at and around the accidental release location.

3.2.1.4.3 Cumulative Impacts of Alternative B

Air emissions – construction: Five representative projects would contribute a noticeable increment to the cumulative air quality impacts associated with construction, which would be more severe during offshore construction than during onshore construction.

Air emissions – O&M: O&M of five representative projects would contribute a noticeable increment to cumulative impacts. Cumulative GHG impacts would be beneficial from the net decrease in GHG emissions to the extent that fossil-fueled power plants would reduce operations as a result of increased energy generation from offshore wind projects. The GHG emissions benefits would diminish over time as the grid becomes cleaner and the emissions displaced by wind energy become less (on a per-megawatt-hour basis) than at the time five representative projects would begin operation.

Air emissions – decommissioning: Decommissioning of five representative projects would contribute a noticeable increment to the cumulative air quality impacts. Emissions related to decommissioning activities would be widely dispersed and transient, occurring in locations similar to those of construction activities but at lower intensity than for construction activities.

Accidental releases: Five representative projects would contribute an undetectable increment to the cumulative accidental release impacts on air quality due to the short-term nature and localized potential effects.

3.2.1.4.4 Conclusions

Impacts of Alternative B. One representative project in each WEA and five total representative projects would result in a net decrease in overall emissions (larger decrease for five representative projects than for one representative project in each WEA) for the region compared to emissions from the existing regional grid (to the extent that offshore wind energy would displace energy generated by fossil-fuel power plants). Although construction, maintenance, and decommissioning could result in some short-term air quality impacts, emissions would be limited in duration. Alternative B would result in air quality–related health effects avoided in the region due to the reduction in emissions associated with fossil-fuel energy generation. Considering all IPFs together, air quality impacts would likely be anticipated for a limited time during construction, maintenance, and decommissioning, but there would be a beneficial impact on air quality in the surrounding region to the extent that the wind energy produced would displace energy produced by fossil-fuel power plants (greater beneficial impact for five representative projects than for one representative project in each WEA). Because of the limited amount of emissions being spread out over time and over a large geographic area (throughout the lease areas and the vessel routes from the onshore facilities), air pollutant concentrations associated with five representative projects are not expected to exceed the NAAQS or CAAQS.

Cumulative Impacts of Alternative B. The incremental impacts contributed by five representative projects to the cumulative impacts on air quality would range from undetectable to noticeable, with noticeable beneficial impacts. The main driver for this impact is emissions related to construction activities increasing commercial vessel traffic, air traffic, and truck and worker vehicle traffic. Combustion emissions from construction equipment and fugitive emissions would be greater during overlapping construction activities but short term in nature, as the overlap would be limited in time to the construction period. Although emissions would incrementally increase ambient pollutant concentrations, BOEM does not expect the concentrations to exceed the NAAQS or CAAQS.

Five representative projects would benefit air quality in the region surrounding the five representative projects to the extent that the energy produced would displace energy produced by fossil-fuel power plants. Although the benefit is regional, BOEM anticipates a beneficial impact because the magnitude of the potential reduction in emissions from displacing fossil-fuel-generated power would be small relative to total energy generation emissions in the region.

3.2.1.5 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Air Quality

Alternative C, the Proposed Action, is the adoption of mitigation measures to avoid or reduce the potential impacts described in Alternative B. The analysis for this alternative illustrates the change in impacts from those discussed under Alternative B. The mitigation measures proposed under Alternative C are analyzed for one representative project in each WEA and for five representative projects. Appendix E, *Mitigation,* identifies the mitigation measures that make up the Proposed Action. Table 3.2.1-10 summarizes the proposed air quality mitigation measure.

Table 3.2.1-10. Summary of mitigation measures for air quality and GHG emissions

Measure ID	Measure Summary
MM-9	This measure requires that lessees use a substitute insulator gas rather than SF_6 in the switchgear and transmission systems, if feasible.
MM-10	This measure encourages the lessee to use zero-emissions technologies in vessels, equipment, and vehicles when feasible, and to replace diesel fuel and marine fuel oil with alternative fuels to the extent that use of such alternative fuels is feasible and provides emissions reductions.

3.2.1.5.1 Impacts of One Representative Project in Each WEA

The implementation of the mitigation measures under Alternative C could reduce impacts on air quality and GHG emissions compared to Alternative B for the air emissions IPF. Impacts for the accidental releases IPF would remain the same as described under Alternative B.

Air emissions: BOEM proposes MM-9 to address SF_6 emissions, which could result from leaks in switchgear. Non-SF_6 switchgear is available; however, it tends to be more costly and require more space compared to conventional switchgear and its use must be evaluated on a project-specific basis. Use of non-SF_6 switchgear would reduce GHG emissions compared to Alternative B. BOEM expects that over time the availability and feasibility of non-SF_6 switchgear will increase. BOEM would require that each project proponent evaluate the feasibility of using non-SF_6 switchgear. If non-SF_6 switchgear is determined to be technically infeasible, BOEM may consider requirements for SF_6 monitoring and leak detection. For MM-9, BOEM would require that lessees evaluate the feasibility of this mitigation measure and provide written justification to BOEM if the measure is determined to be infeasible.

BOEM proposes MM-10 to address exhaust emissions from vessels, equipment, and vehicles operating on the OCS. Lessees would be encouraged to use zero-emissions technologies when feasible, and to replace diesel fuel and marine fuel oil with alternative fuels such as natural gas, propane, or hydrogen, to the extent that use of such alternative fuels is feasible and provides emissions reductions.

Implementation of MM-9 and MM-10 could reduce air pollutant and GHG emissions.

3.2.1.5.2 Impacts of Five Representative Projects

Implementation of the mitigation measures could result in the same reduction in GHG emissions from five representative projects as described for one representative project in each WEA, except that the amount of emissions reduction could be greater because the mitigation measures would apply to more representative projects.

3.2.1.5.3 Cumulative Impacts of Alternatives C

In context of reasonably foreseeable environmental trends, Alternative C's incremental contributions to overall air quality impacts would be similar to those of Alternative B. With application of the mitigation measures, the same types of air quality and GHG impacts would occur as without the mitigation measures, but emissions could be lower.

3.2.1.5.4 Conclusions

Impacts of Alternative C. As with Alternative B, development of one representative project in each WEA with application of the mitigation measures under Alternative C would result in a net decrease in overall emissions over the region compared to the emissions from conventional energy sources powered by fossil fuels. Impact ratings under Alternative C would be the same as expected with Alternative B; however, the amount of emissions could be less with Alternative C because of the reductions achieved by implementation of the mitigation measures. Overall, for one representative project in each WEA and five representative projects, BOEM anticipates air quality impacts for a limited time during construction, O&M, and decommissioning, with **beneficial** impacts.

Cumulative Impacts of Alternative C. As with Alternative B, the incremental impacts contributed by five representative projects to the cumulative impacts on air quality with Alternative C would range from undetectable to noticeable, with noticeable beneficial impacts. These impacts are the same as expected with Alternative B; however, air quality and GHG impacts could be less with Alternative C because of the emission reductions achieved by implementation of the mitigation measures.

3.2 Physical Resources

3.2.2 Water Quality

This section describes the Affected Environment for water quality and discusses potential impacts from the Proposed Action, alternatives, and ongoing and planned activities. As shown on Figure 3.2.2-1, the Affected Environment includes a 10-mile (16.1-kilometer) radius around the California lease areas and representative ports, from the seafloor to the surface of the water column. This encompasses areas where the Proposed Action could affect localized turbidity, sediment suspension (via water mass transport), water temperature gradients, and concentrations of nutrients and dissolved oxygen (DO).

3.2.2.1 Description of the Affected Environment and Baseline Conditions

Table 3.2.2-1 identifies key parameters that characterize water quality, several of which are accepted proxies for ecosystem health (e.g., DO, nutrient levels). This discussion is informed by USEPA's National Coastal Conditions Report for ocean waters and CWA Section 303(d) for inland waters.

States assess a variety of water quality parameters (e.g., bacteria, metals, total suspended solids) per requirements of CWA Section 303(d). If a waterbody exceeds one or more water quality parameters, Section 303(d) considers the waterbody *impaired*. Section 303(d) also requires states to adopt water quality standards to protect designated beneficial uses (e.g., wildlife habitat, marine habitat, recreation).

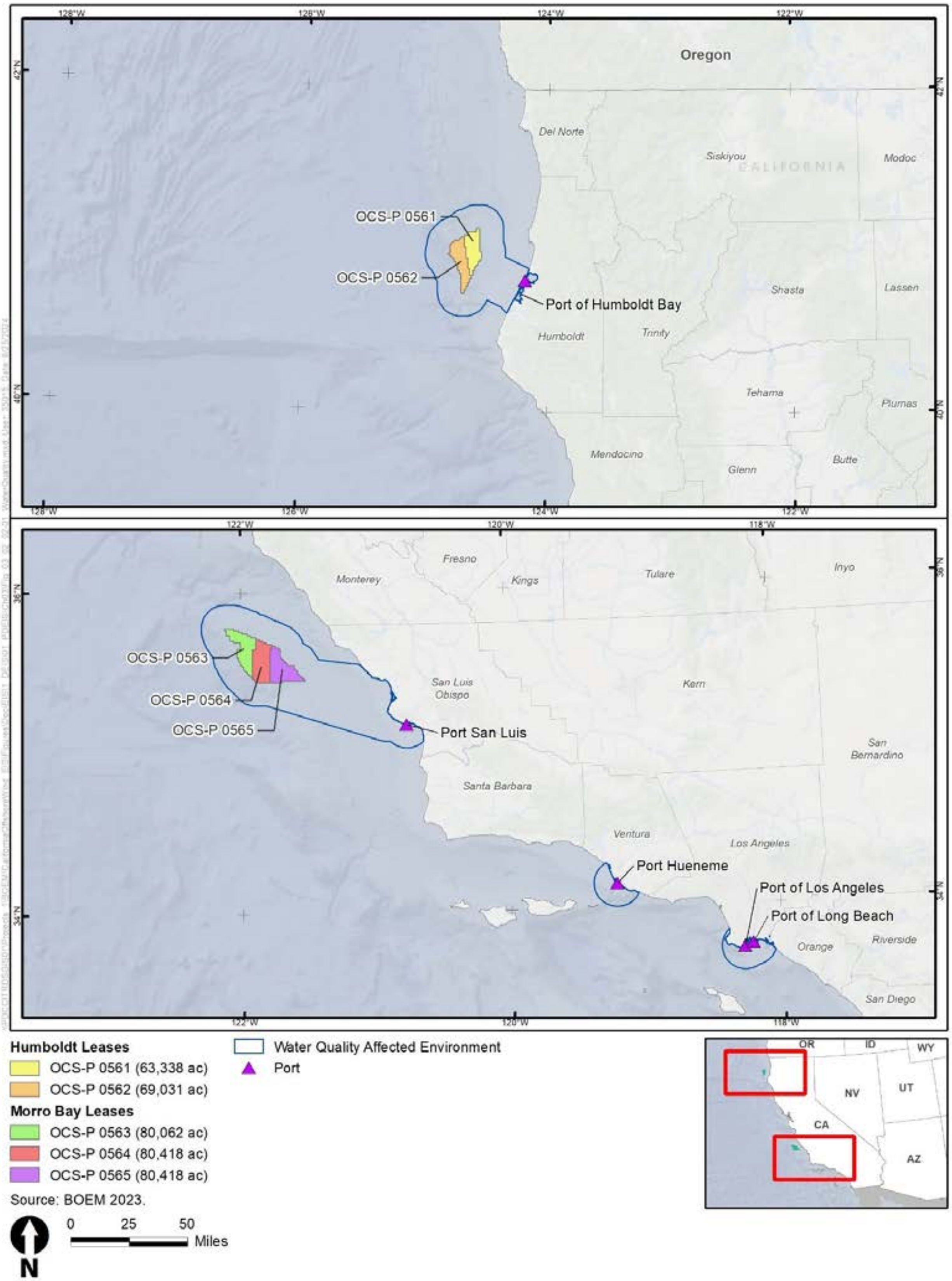

Figure 3.2.2-1. Water Quality Affected Environment

Table 3.2.2-1. Water quality parameters with characterizing descriptions

Parameter	Characterizing Description
Temperature	Water temperature affects species distribution in the ocean with large-scale changes affecting seasonal phytoplankton blooms. Elevated temperature waste discharges shall comply with limitations necessary to ensure protection of beneficial uses. The maximum temperature of waste discharges shall not exceed the natural temperature of the receiving waters by more than 20°F (State Water Board 1975).
Salinity	Salinity is a measure of the dissolved salts in water and affects species distribution. Salinity in ocean waters has seasonal patterns (Bingham et al. 2010).
Dissolved oxygen	DO concentrations should be above 5 milligrams per liter (mg/L) to support aquatic life (marine and inland saline water habitat) requirements; lower levels may affect sensitive organisms (North Coast RWQCB 2018).
Chlorophyll-*a*	Chlorophyll-*a* is an indicator of primary productivity. USEPA considers estuarine and marine levels of chlorophyll less than 5 micrograms per liter (µg/L) to be good, 5 to 20 µg/L to be fair, and more than 20 µg/L to be poor (USEPA 2021).
Turbidity	Turbidity is a measure of water clarity. High turbidity reduces light penetration, reduces ecological productivity, and provides attachment places for other pollutants (USGS 2018). Turbidity should not increase more than 20 percent above naturally occurring background levels (North Coast RWQCB 2018).
Nutrients	Phytoplankton (the foundation of the marine food web) and their associated growth rates depend on availability of nutrients (e.g., nitrogen, phosphorus, manganese) in water. Excess nutrients can cause algal blooms that lower DO concentrations in ambient waters. Nutrient materials shall not cause objectionable aquatic growths or degrade indigenous biota (State Water Board 2019).

Ocean depth can affect water quality. The ocean's surface layers are usually saturated with DO; DO concentrations generally decrease with depth. Upwelling—the wind-driven movement of deep cooler and nutrient-rich water toward the ocean surface—also determines water quality off the California coast. During strong upwelling conditions, surface DO concentration may be less than 50 percent of the saturation concentration; this low oxygen concentration is associated with deeper water that is advected to the surface (USEPA 1995). Refer to Section 3.3.2, *Benthic Resources,* for more background on upwelling.

Turbidity levels are typically higher closer to shore, particularly during spring runoff/storm events. River inputs to bays and estuaries also contribute to suspended sediments, which can affect water clarity and primary production (USEPA 1995).

Trends in temperature, chlorophyll, and nutrients such as nitrate are also important in assessing water quality. Between 2018 and 2023, sea surface temperatures experienced a downward trend. In the same period, there was a significant upward trend in chlorophyll-*a*. However, during the same time period, the vertical transport of nitrate in the Southern California Bight or in Central/Northern California did not exhibit the same trend (NOAA 2023).

Table 3.2.2-2 summarizes USEPA's assessment of water quality for the West Coast region, which includes samples collected from the Affected Environment. Overall water quality for the West Coast region was assessed on an index derived from four water quality parameters: nutrient concentrations (as indicated by nitrogen and phosphorus), chlorophyll-*a*, water clarity, and DO. The latest National Coastal Conditions Report IV rated the overall water quality of the West Coast region as good, with 19 percent of the coastal area rated fair and 2 percent rated poor (USEPA 2012).

Table 3.2.2-2. West Coast region water quality and coastal health conditions

Parameter	Condition	Water Quality Threshold[1]
Dissolved Inorganic Nitrogen	96% (good), 3% (fair), 1% (poor)	< 0.5 mg/L = Good; 0.5–1.0 mg/L = Fair; > 1 mg/L = Poor
Dissolved Inorganic Phosphorus	80% (good), 11% (fair), 9% (poor)	< 0.07 mg/L = Good; 0.07–0.1 mg/L = Fair; > 0.1 mg/L = Poor
Chlorophyll-*a*	69% (good, 25% (fair), 6% (poor)	< 5 µg/L = Good; 5–20 µg/L = Fair; > 20 µg/L = Poor
Water Clarity	95% (good), 3% (fair), 2% (poor)	Nearshore waters with naturally high turbidity: > 10% light at 1 meter = Good; 5–10% light at 1 meter = Fair; < 5% light at 1 meter = Poor Sites in nearshore waters with normal turbidity: > 20% light at 1 meter = Good; 10–20% light at 1 meter = Fair; < 10% light at 1 meter = Poor
Dissolved Oxygen	78% (good), 20% (fair), 2% (poor)	> 5 mg/L = Good; 2–5 mg/L = Fair; < 2 mg/L = Poor
Sediment Quality[2]	89%; (good); 1% (fair); 10% (poor)	None of the individual component indicators[3] are rated poor = Good; None of the component indicators are rated poor = Fair; One or more of the component indicators is rated poor = Poor
Benthic Condition[2]	87% (good), 6% (fair); 7% (poor)	Benthic index score is more than 90% of the lower limit (lower 95% confidence interval) of expected mean diversity for a specific salinity = Good; Benthic index score is between 75% and 90% of the lower limit of expected mean diversity for a specific salinity = Fair; Benthic index score is less than 75% of the lower limit of expected mean diversity for a specific salinity = Poor
Fish Tissue Contaminants[2]	86% (good); 5% (fair); 9% (poor)	Contaminant concentrations[4] in fish tissue fall below the range of the USEPA advisory guidance values for risk-based consumption associated with four 8-ounce meals per month = Good; For at least one contaminant, concentration in fish tissue falls within the range of the USEPA advisory guidance values for risk-based consumption associated with four 8-ounce meals per month = Fair; For at least one chemical, contaminant concentrations in fish tissue exceeds the maximum value in the range of the USEPA advisory guidance values for risk-based consumption associated with four 8-ounce meals per month = Poor

Source: USEPA 2012.

[1] Water quality thresholds were determined based on the region from literature review and expert opinion from state water quality managers and consultation with other experts. Thresholds were also evaluated by government scientists, academic scientists, and others. Types of data included in the assessment include coastal ocean data collected offshore including the western U.S. continental shelf, offshore fisheries data, advisory data, and coastal monitoring data.

[2] Measures of coastal health related to water quality include sediment quality (toxicity, contaminants, and total organic carbon), benthic health, and fish tissue contaminants.

[3] Sediment toxicity, sediment contaminants, and sediment total organic carbon.

[4] Arsenic, cadmium, mercury (methylmercury), selenium, chlordane, dichlorodiphenyltrichloroethane (DDT), dieldrin, endosulfan, endrin, heptachlor epoxide, hexachlorobenzene, lindane, toxaphene, polycyclic aromatic hydrocarbons (benzo[a] pyrene), and polychlorinated biphenyl (PCB).

< = less than; > = greater than

3.2.2.1.1 Humboldt WEA

Offshore and Nearshore Water Quality

Offshore water quality can be affected by a variety of land and water uses, including recreation, industrial enterprises, agriculture, mariculture, fishing, dredging, shipping, and urban development. Water quality generally improves from nearshore to offshore locations, as onshore contaminants more commonly affect nearshore waters; contaminants originating from onshore sources are diluted when transported into the ocean.

Chemicals released to ocean water may be deposited into sediments, bioaccumulate in the marine food web, or undergo in-situ chemical and biological transformation (Kaplan et al. 2010). In the Humboldt region, sediment quality indicators (sediment contaminants and sediment total organic carbon) were rated good for nearshore waters; however, the sediment quality indicator of sediment toxicity was rated poor (USEPA 2012).

Nearshore waters are also influenced by particulate inputs from land. As a result, nearshore waters generally have higher turbidities than open ocean waters. Wastewater dischargers, river runoff, and resuspension of small particles by waves and currents are the major contributors to nearshore turbidity. Nearshore turbidity values tend to increase during the spring runoff season due to increased sediment loading from river waters. USEPA periodically monitors an area approximately 3 nm offshore Humboldt Bay as part of the Humboldt Open Ocean Disposal Site for the disposal of dredged material. Suspended sediments and phytoplankton are the main factors affecting water clarity in this area (USEPA 1995).

Inshore and Bay Region Water Quality

Humboldt Bay is a 16,000-acre semi-enclosed bay with an opening to the ocean south of Eureka. 6,000 of the bay's acres are intertidal mudflats. Humboldt's regional drainage basin includes freshwater and sediment input from the Elk River, Jacoby Creek, Eureka Slough, McDaniel Slough, Mad River Slough, and other smaller sloughs and creeks. Water quality parameters within Humboldt Bay depend on tidal stage, wind regimes, and patterns of temperature and salinity. Tidal patterns cause fluctuation in the presence of both nearshore and bay waters. Tides and flushing characteristics vary within the bay, with some areas sufficiently isolated from nearshore waters, resulting in distinct water quality characteristics. Only waters nearest the bay mouth at low tide more closely resemble the characteristics of the nearshore environment. Tidal movements result in water mixing. Gradients are seen in temperature, salinity, and nutrient and chlorophyll concentrations. During low tide, water near the bay mouth is more similar to nearshore water quality compared to water quality at high tide (Barnhart et al. 1992).

Bay water quality is shaped by natural and human factors. Because bay water is over mudflats, oxygen levels are near saturation. Nutrients come from runoff, ocean water, and sediment fluxes, with runoff-related nutrient inputs peaking in late fall and winter. Phosphate concentrations are higher at low tide and increase from the nearshore to the upper bay waters, likely due to historical wastewater practices. This makes bay sediments a potential phosphate source. In contrast, nitrate concentrations decrease from the nearshore to the upper bay waters, with the bay acting as a nitrate sink. Nutrient surges lead to increased chlorophyll, especially in early spring when nearshore waters stratify. Chlorophyll generally decreases by mid-summer. Humboldt Bay waters are turbid due to suspended sediments and phytoplankton. The bay's sediments originate from runoff (via the Eel River), oceanic input, and biological activity, with the majority entering the bay mouth through oceanic inputs during flood tides (Barnhart et al. 1992). Sediment disturbances can affect water quality by increasing turbidity or releasing accumulated contaminants. The bay can deposit sediment onto the continental shelf during high-runoff events, such as winter storms.

Pollutants include petroleum and antifouling paints from fishing and shipping. Trace metals have been found in local oysters (Barnhart et al. 1992). Table 3.2.2-3 summarizes Humboldt Bay's water quality impairments.

Table 3.2.2-3. 303(d) water quality impairments: Humboldt Bay Affected Environment

Waterbody	Listed Impairment	Potential Source	USEPA TMDL Report Completion
Humboldt Bay and Eureka Slough	Dioxin Toxic Equivalents	Source Unknown, Industrial Point Sources, Waste Storage/Storage Tank Leaks (above ground)	Est. 2031
	PCBs	Source Unknown	Est. 2025
Lower Elk River and Martin Slough	Indicator Bacteria	Source Unknown	Est. 2025
	Sediment	Logging Road Construction/ Maintenance; Road Construction; Silviculture	04/04/2018
Freshwater Creek	Aluminum	Source Unknown	Est. 2031
	Sedimentation/Siltation	Source Unknown	Est. 2017
Jacoby Creek watershed	Aluminum	Source Unknown	Est. 2031
	Sediment	Source Unknown	Est. 2019

Source: State Water Board 2022.
Est. = estimated completion date

Groundwater Quality

For the Humboldt WEA, the Affected Environment for groundwater quality includes several groundwater basins: the Eureka Plain, the Mad River Valley - Mad River Lowland, and Eel River Valley.

Groundwater quality in these basins is generally acceptable for most uses. However, concentrations of dissolved iron may exceed USEPA's secondary drinking-water recommendation of 300 µg/L. Tidal reaches of the Eel River are sources of chloride in groundwater as far as 4 miles inland. Shallow wells in the dune sands are also prone to seawater intrusion (USGS 1995). Groundwater impairments in the Eureka Plain groundwater basin include localized high boron, iron, manganese, and phosphorus (DWR 2004).

3.2.2.1.2 Morro Bay WEA

Offshore and Nearshore Water Quality

Water quality near Morro Bay is influenced by oceanographic processes, contaminant discharge, and freshwater inflow. USEPA rates West Coast waters, including Morro Bay, as good (USEPA 2012). Only two chemicals exceeded "low" levels, with DO concentrations deemed fair (Nelson et al. 2008). The Central California Current System brings high-nutrient, low-oxygen, and low-temperature waters to the Morro Bay nearshore (Ryan et al. 2009; Brown and Nelson 2015). Nearshore waters typically have higher turbidity than offshore, especially during storms, due to sediment resuspension and storm runoff. While sediment quality indicators were rated good, sediment toxicity was rated poor (USEPA 2012).

Similar to the Humboldt WEA, water quality generally improves from nearshore to offshore locations. Land is the primary source of most water pollution off the Central California coast. Increased nutrients, trace metals, synthetic organic contaminants, and pathogens in offshore waters and sediments can be traced to petroleum-development activities (on- and offshore), agricultural uses, commercial and recreational vessels, natural hydrocarbon seeps, river runoff, municipal wastewater outfalls, and industrial outfalls (California State Lands Commission 2021; CSU Long Beach 2023). Chemicals found here can also come from atmospheric deposition (i.e., following storms), runoff, sediment flux, or other water masses, or be produced in situ. Furthermore, chemicals can originate from natural or anthropogenic sources, including point and nonpoint sources (Kaplan et al. 2010).

Inshore and Bay Region Water Quality

Morro Bay is a 2,300-acre semi-enclosed estuary bordered to the west by a 4-mile vegetated natural sand spit separating it from the Pacific Ocean. USEPA designated the southern portion of Morro Bay as an Estuary of National Significance in 1995. The estuary environment encompasses the lower reaches of Chorro and Los Osos Creeks, a wide range of wetlands, salt and freshwater marshes, intertidal mudflats, eelgrass beds, and other subtidal habitats.

Table 3.2.2-4 summarizes 303(d) impairments for receiving waterbodies. Recreation, industrial activities, agriculture, mariculture, fishing, dredging, shipping, and urban development are common activities that can all affect water quality.

Because of polluted runoff and the critical need for protection of coastal zone watershed areas, the California Coastal Commission (CCC) designated Morro Bay, Chorro Creek, and Los Osos Creek as Critical Coastal Areas (San Luis Obispo County Flood Control and Water Conservation District 2020). In response to elevated pollutant levels, the State Water Resources Control Board adopted pollutant-specific Total Maximum Daily Loads for various waterbodies in the area including Morro Bay (including the Morro Bay Estuary), Chorro Creek, and Los Osos Creek (State Water Board 2022).

The Affected Environment also includes several Southern California ports (San Luis, Hueneme, Los Angeles, and Long Beach). The ports of Long Beach and Los Angeles together form one of the busiest harbors on Earth. Pollution from ships, port terminals, and the Los Angeles River are ongoing sources of concern. Water quality near all of these ports is also affected by ongoing activities, weather/natural events, global climate change, terrestrial runoff and point-source discharges, and a number of water-borne sources (e.g., marine vessel discharge, fisheries uses, dredging).

Table 3.2.2-4. 303(d) water quality impairments in the Morro Bay Affected Environment

Waterbody	County	Listed Impairment	Potential Source	USEPA TMDL Report Completion
Pacific Ocean at Estero Bay	San Luis Obispo	DDT	No Source Analysis Available	Est. 2035
		Mercury	No Source Analysis Available	Est. 2035
Pacific Ocean, Pt. Buchon to Pt. San Luis	San Luis Obispo	Mercury	No Source Analysis Available	Est. 2035
Morro Bay	San Luis Obispo	Arsenic	No Source Analysis Available	Est. 2035
		DO	No Source Analysis Available	Est. 2035
		Sedimentation/Siltation	Agriculture, Erosion/Siltation, Grazing-Related Sources, Habitat Modification, Highway/Road/Bridge Construction, Land Development	01/20/2004
Chorro Creek	San Luis Obispo	Benthic Community Effects	No Source Analysis Available	Est. 2035
		Chloride	Source Unknown	Est. 2027
		Chromium	No Source Analysis Available	Est. 2035
		Nickel	No Source Analysis Available	Est. 2035
		Nutrients	Agriculture, Domestic Animals/ Livestock, Flow Alteration/ Regulation/Modification, Minor Municipal Point Source-dry and/or wet weather discharge, Natural Sources, Nonpoint Source	07/19/2007
		Sedimentation/Siltation	Agriculture, Channel Erosion, Erosion/Siltation, Grazing-Related Sources, Highway/Road/Bridge Construction, Land Development	01/20/2004
		Sodium	Municipal Point Sources	07/19/2007
		Total Dissolved Solids	Municipal Point Sources	07/19/2007
		Toxicity	No Source Analysis Available	Est. 2035
Port San Luis	San Luis Obispo	Arsenic	Source Unknown	Est. 2027
		Dieldrin	Source Unknown	Est. 2027
		Polycyclic Aromatic Hydrocarbons (PAH)	No Source Analysis Available	Est. 2035
		PCBs	Source Unknown	Est. 2027
Pacific Ocean at Avila Beach (San Luis Obispo Creek mouth)	San Luis Obispo	Enterococcus	No Source Analysis Available	Est. 2035
		Total Coliform	Source Unknown	Est. 2027
		PCBs	Source Unknown	Est. 2027

Waterbody	County	Listed Impairment	Potential Source	USEPA TMDL Report Completion
Pacific Ocean at Avila Beach (Avila Pier)	San Luis Obispo	Total Coliform	Source Unknown	Est. 2027
Pacific Ocean at Pismo State Beach (San Luis Obispo County), Wadsworth Ave	San Luis Obispo	Total Coliform	Source Unknown	Est. 2027
Pacific Ocean at Pismo Beach (San Luis Obispo County)	San Luis Obispo	Fecal Coliform	Source Unknown	Est. 2027
		Total Coliform	Source Unknown	Est. 2027
Pacific Ocean at Pismo State Beach (San Luis Obispo County), south of Pismo Pier	San Luis Obispo	Fecal Coliform	Source Unknown	Est. 2027
Pacific Ocean at Pismo State Beach (San Luis Obispo County), Park Ave	San Luis Obispo	Total Coliform	Source Unknown	Est. 2027
San Buenaventura Beach	Ventura	Indicator Bacteria	Source Unknown	Est. 2019
Ventura Marina Jetties	Ventura	DDT	Source Unknown	Est. 2019
		PCBs	Source Unknown	Est. 2019
Ventura Harbor: Ventura Keys	Ventura	Arsenic	Source Unknown	Est. 2027
		Coliform Bacteria	Source Unknown	Est. 2019
		Dieldrin	Source Unknown	Est. 2027
		Indicator Bacteria	Source Unknown	Est. 2027
		PCBs	Source Unknown	Est. 2027
Peninsula Beach	Ventura	Indicator Bacteria	Source Unknown	Est. 2019
Santa Clara River Estuary	Ventura	Ammonia	Source Unknown	Est. 2027
		ChemA	Source Unknown	09/21/2011
		Indicator Bacteria	Source Unknown	01/31/2012
		Toxaphene	Source Unknown	09/21/2011
		Toxicity	Source Unknown	Est. 2019
McGrath Beach	Ventura	Indicator Bacteria	Nonpoint Source	11/20/2003
Hobie Beach (Channel Islands Harbor)	Ventura	Indicator Bacteria	Natural Sources, Nonpoint Source, Urban Runoff/Storm Sewers	12/18/2008
Port Hueneme Harbor (Back Basins)	Ventura	Arsenic	Source Unknown	Est. 2027
		DDT	Source Unknown	Est. 2019
		Dieldrin	Source Unknown	Est. 2027
		PAHs	Source Unknown	Est. 2027
		PCBs	Source Unknown	Est. 2019
Port Hueneme Pier	Ventura	PCBs	Source Unknown	Est. 2019
Hueneme Beach Park	Ventura	Indicator Bacteria	Source Unknown	Est. 2023

Waterbody	County	Listed Impairment	Potential Source	USEPA TMDL Report Completion
Ormond Beach Wetlands	Ventura	Indicator Bacteria	Source Unknown	Est. 2027
		pH	Source Unknown	Est. 2027
		Trash	Source Unknown	Est. 2027
Ormond Beach	Ventura	Indicator Bacteria	Source Unknown	Est. 2019
Calleguas Creek Reach 1	Ventura	Chlordane (tissue)	Nonpoint Source	01/01/2005
		Copper	Nonpoint Source, Point Source	03/23/2007
		DDT (tissue and sediment)	Nonpoint Source	01/01/2005
		Dieldrin	Source Unknown	03/14/2006
		Endosulfan (tissue)	Agriculture-storm runoff	03/24/2006
		Mercury	Nonpoint Source, Point Source	03/26/2007
		Nickel	Nonpoint Source, Point Source	03/23/2007
		Nitrogen	Nonpoint Source, Point Source	06/20/2003
		PCBs (tissue)	Nonpoint Source, Point Source	01/01/2005
		Sedimentation/Siltation	Agriculture, Natural Sources	01/01/2007
		Toxaphene	Source Unknown	03/14/2006
		Toxicity	Nonpoint Source, Point Source	01/01/2005
		Zinc	Source Unknown	03/23/2007
Point Mugu Beach	Ventura	Indicator Bacteria	Source Unknown	Est. 2023
Santa Monica Bay Offshore/Nearshore	Los Angeles	Arsenic	Source Unknown	Est. 2027
		DDT	Source Unknown	03/26/2012
		Mercury	Source Unknown	Est. 2027
		PCBs	Source Unknown	03/26/2012
		Trash	Source Unknown	03/20/2012
Point Vicente Beach	Los Angeles	Indicator Bacteria	Nonpoint Source	06/19/2003
Long Point Beach	Los Angeles	DDT	Source Unknown	03/26/2012
		PCBs	Source Unknown	03/26/2012
Abalone Cove Beach	Los Angeles	DDT	Source Unknown	03/26/2012
		PCBs	Source Unknown	03/26/2012
Inspiration Point Beach	Los Angeles	DDT	Source Unknown	03/26/2012
		Indicator Bacteria	Nonpoint Source	06/19/2003
		PCBs	Source Unknown	03/26/2012
Portuguese Bend Beach	Los Angeles	DDT	Source Unknown	03/26/2012
		PCBs	Source Unknown	03/26/2012
Palo Verde Shoreline Park Beach	Los Angeles	Pathogens	Nonpoint Source	06/19/2003
		Pesticides	Source Unknown	03/26/2012

Waterbody	County	Listed Impairment	Potential Source	USEPA TMDL Report Completion
Royal Palms Beach	Los Angeles	DDT	Source Unknown	03/26/2012
		PCBs	Source Unknown	03/26/2012
Whites Point Beach	Los Angeles	DDT	Source Unknown	03/26/2012
		Indicator Bacteria	Nonpoint Source	06/19/2003
		PCBs	Source Unknown	03/26/2012
Point Fermin Park Beach	Los Angeles	DDT	Source Unknown	03/26/2012
		PCBs	Source Unknown	03/26/2012
Cabrillo Beach (Outer)	Los Angeles	DDT	Source Unknown	03/26/2012
		PCBs	Source Unknown	03/26/2012
Los Angeles Harbor - Inner Cabrillo Beach Area	Los Angeles	DDT	Source Unknown	03/23/2012
		Indicator Bacteria	Source Unknown	01/01/2004
		PCBs	Source Unknown	03/31/2013
Los Angeles Harbor - Cabrillo Marina	Los Angeles	Benzo(a)pyrene	Source Unknown	03/23/2012
		DDT	Source Unknown	03/23/2012
		PCBs	Source Unknown	03/23/2012
Los Angeles/Long Beach Outer Harbor (inside breakwater)	Los Angeles	DDT	Source Unknown	03/23/2012
		PCBs	Source Unknown	03/23/2012
		Toxicity	Source Unknown	08/31/2011
Los Angeles/Long Beach Inner Harbor	Los Angeles	Benthic Community Effects	Source Unknown	03/23/2012
		Benzo(a)pyrene	Source Unknown	03/23/2012
		Chrysene	Source Unknown	03/23/2012
		Copper	Source Unknown	03/23/2012
		DDT	Source Unknown	03/23/2012
		PCBs	Source Unknown	03/23/2012
		Toxicity	Source Unknown	03/23/2012
		Zinc	Source Unknown	03/23/2012
Los Angeles Harbor - Fish Harbor	Los Angeles	Benzo(a)anthracene	Source Unknown	03/23/2012
		Benzo(a)pyrene	Source Unknown	03/23/2012
		Chlordane	Source Unknown	03/23/2012
		Chrysene	Source Unknown	03/23/2012
		Copper	Source Unknown	03/23/2012
		DDT	Source Unknown	03/23/2012
		Dibenz[a,h]anthracene	Source Unknown	03/23/2012
		Lead	Source Unknown	03/23/2016
		Mercury	Source Unknown	03/23/2012
		PAHs	Source Unknown	03/23/2012
		PCBs	Source Unknown	03/23/2012

Waterbody	County	Listed Impairment	Potential Source	USEPA TMDL Report Completion
		Phenanthrene	Source Unknown	03/23/2012
		Pyrene	Source Unknown	03/23/2012
		Toxicity	Source Unknown	03/23/2013
		Zinc	Source Unknown	03/23/2012
San Pedro Bay Near/Off Shore Zones	Los Angeles	Chlordane	Source Unknown	03/23/2012
		PCBs	Source Unknown	03/23/2012
		Total DDT	Source Unknown	03/23/2012
		Toxicity	Source Unknown	03/23/2012
Los Angeles River Estuary (Queensway Bay)	Los Angeles	Chlordane	Source Unknown	03/23/2012
		DDT (sediment)	Source Unknown	03/23/2012
		PCBs (sediment)	Source Unknown	Est. 2019
		Toxicity	Source Unknown	Est. 2019
		Trash	Nonpoint Source, Surface Runoff, Urban Runoff/Storm Sewers	07/24/2008
Alamitos Bay	Los Angeles	Indicator Bacteria	Source Unknown	Est. 2019
		DO	Source Unknown	Est. 2027
Long Beach City Beach	Los Angeles	Indicator Bacteria	Source Unknown	03/26/2012
San Gabriel River Estuary	Los Angeles and Orange	Copper	Source Unknown	03/27/2007
		Dioxin	Source Unknown	Est. 2021
		Indicator Bacteria	Source Unknown	06/14/2016
		Nickel	Source Unknown	Est. 2021
		DO	Source Unknown	Est. 2021
Seal Beach (Orange County)	Orange	Indicator Bacteria	Source Unknown	Est. 2019
		PCBs	Source Unknown	Est. 2019
Anaheim Bay	Orange	Nickel	Source Unknown	Est. 2019
		PCBs	Source Unknown	Est. 2019
		Toxicity	Source Unknown	Est. 2019
Bolsa Chica State Beach	Orange	Copper	Source Unknown	Est. 2019
		Nickel	Source Unknown	Est. 2019

Source: State Water Board 2022.
Est. = estimated completion date

Groundwater Quality

Groundwater quality near Morro Bay is influenced by several basins, including the Oxnard and West Coast Subbasins. The Oxnard Subbasin has high concentrations of total dissolved solids and sulfate, exceeding state-recommended limits in 35 percent and 22 percent of the primary aquifer system, respectively. High concentrations of iron and manganese are found in 44 percent of the system, with moderate levels of arsenic, boron, and vanadium in 38 percent (Burton et. al. 2011). The West Coast

Subbasin's groundwater is generally suitable for most uses, with high total dissolved solids in 2 percent of the system and moderate levels in 47 percent. Iron and manganese are present at high and moderate concentrations in 19 percent and 15 percent of the system, respectively (Fram et al. 2012). Chloride levels meet USEPA standards (USGS 1995).

3.2.2.2 Impact Background for Water Quality

As outlined in Table 3.2.2-5, accidental releases, anchoring, cable installation and maintenance, discharges/intakes, land disturbance, port utilization, and presence of structures may all affect water quality. Refer to Section 3.1.2, *Impact Terminology*, for background on beneficial impacts.

Table 3.2.2-5. Issues and indicators to assess water quality impacts

Issue	Impact Indicator	Relevant IPFs
Runoff, sedimentation, sediment movement, suspension or resuspension, changes to stratification or mixing patterns, or release of contaminants	Changes to turbidity, nutrients, DO, temperature, salinity, or chlorophyll-*a*. Introduction of new contaminants/oil or changes to sediments, or changes in flows.	Accidental releases, anchoring, cable installation and maintenance, discharges/intakes, land disturbance, port utilization, presence of structures
Disturbance or seepage to groundwater resources	Changes to turbidity, nutrients, DO, temperature, salinity, or chlorophyll-*a*. Introduction of new contaminants/oil or changes to sediments, or changes in flows.	Accidental releases, land disturbance, port utilization

3.2.2.3 Impacts of Alternative A – No Action – Water Quality

When analyzing the impacts of the No Action Alternative on water quality, BOEM considers the impacts of ongoing activities on the baseline conditions for water quality.

The cumulative impacts of the No Action Alternative consider the impacts of the No Action Alternative on existing baseline trends, including other planned activities, which are described in Appendix C, *Planned Activities Scenario*.

3.2.2.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, water quality would continue to follow regional trends and respond to ongoing environmental and societal activities. Such activities typically relate to or include stormwater runoff, ground disturbance, erosion, point- and nonpoint-source discharges, and atmospheric deposition.

Ongoing activities, including but not limited to urban development, mariculture, vessel discharge, and increasing vessel traffic, are expected to continue affecting regional water quality. Pollutant accumulation in surface waters can result in exceedances of water quality standards that can affect its beneficial uses. Federal and state statutes, regulations, and permitting requirements would avoid or minimize many impacts; many others would be temporary, but some water quality issues are expected to persist.

Additionally, climate change contributes to ocean acidification, warming sea temperatures, rising sea levels, and changes in ocean circulation patterns, all of which can affect water quality. Local impacts from climate change would likely be incremental and difficult to discern from effects of other actions such as urban development, mariculture, shipping, vessel discharges, and dredging.

3.2.2.3.2 Cumulative Impacts of the No Action Alternative

Other planned activities that affect water quality include onshore land use development (which can span from urbanization to agricultural and forestry practices), marine transportation-related discharges, dredging and port improvement projects, commercial fishing, military use, and new submarine cables and pipelines.

Dredging, as well as other harbor/port operations, would likely result in localized and temporary impacts. Similar to ongoing activities, discharging contaminated runoff into surface waters and groundwater can result in exceedances of water quality standards for certain uses. BOEM expects ongoing and planned activities to affect water quality through the following IPFs.

Accidental releases: Accidental releases of contaminants including grease or paints could occur due to vessel activity or chemical release from maintenance activities, use of heavy equipment, and trash or debris. Ongoing plus planned activities may increase the potential for accidental releases.

Vessel collisions (from ongoing and planned vessel activities) could result in small- or large-volume spills. Preventive measures, such as onboard containment measures and OSRPs/SPCC plans, would reduce the probability of fuel spills. Planned port improvements would use heavy equipment, which would increase spill risk. All such activities would be required to comply with federal and state requirements to prevent/minimize spills (such as OSRPs or construction SPCC plans).

Water quality impacts of fuel spills depend on weather and ocean conditions, as well as spill response effectiveness. Hazardous materials like fuels and oils tend to float, typically enabling adequate responses. Rapidly sinking or dissolving chemicals can dilute to non-toxic levels, causing temporary water quality effects.

Should an accidental release occur, it would likely have localized effects and would not result in a long-term exceedance of water quality standards. Previous fuel spill analysis determined a spill less than 1–13 barrels (bbl)[1] would be localized and temporary. A fuel spill less than 1 bbl could persist for up to 30 hours while a 13-bbl fuel spill could persist for up to 2 days (BOEM 2014). In the unlikely event a large spill occurred, water quality impacts would be short to long term depending on the type and volume of material released, the specific conditions at the spill location, and the effectiveness of spill response

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[1] One barrel (bbl) equals 42 U.S. gallons.

measures. There is no evidence that the anticipated accidental release volumes and extents combined with cleanup measures would have measurable permanent water quality impacts.

Anchoring: Anchoring would temporarily increase suspended sediment and turbidity levels and reduce water clarity by resuspension of sediments at anchoring sites. Suspension of sediment would be localized and temporary. Accordingly, sediment-suspension effects would unlikely affect areas beyond the anchorage.

The overall impact of increased sediment and turbidity from vessel anchoring is anticipated to be localized, and it would not result in degradation of ambient water quality due to the current ambient conditions and the localized area of disturbance around individual anchors.

Cable installation and maintenance: Planned undersea cables would likely use HDD at entry/exit points. Cable installation and maintenance, from telecommunications projects, would likely use HDD at entry and exit points, resulting in temporary water quality impacts.

Infrequent maintenance of offshore cables may disturb bottom sediments, leading to temporary turbidity and sediment resuspension. These localized disturbances are confined to cable repair areas within existing corridors. Most water quality impacts can be avoided. Sediment displacement would be minimal, with suspended sediments quickly returning to background levels.

Cable-related sediment concentration, deposition, and influence areas depend on current speeds, burial depths, and the amounts of sediment disturbed. Coarse particles (medium sand and up) would not suspend; finer sand would settle within a minute, with potential to travel depending on currents (Tetra Tech 2022; HT Harvey & Associates 2020). A study (USGS 2013) found fine sediment disperses rapidly from release sites. Turbidity from sediment disturbance can be extensive but dissipates within hours or days. Given current water quality, localized disturbances, and water column variability, increased sediments and turbidity from cable installation and maintenance are expected to be localized and short term without degrading ambient water quality.

Discharges/intakes: Potential discharges include drilling fluids (especially with HDD) and biological materials from ballast water discharge. Implementation of BMPs during directional boring activities would minimize the potential of an inadvertent release of HDD fluid entering a waterbody and avoid water quality impacts.

Vessel discharges (bilge, ballast water, wastewater) would concentrate in areas of higher vessel traffic, such as ports and shipping lanes. Associated permitted discharges (uncontaminated bilge water and treated waste) would be staggered over time and localized. Short-term and localized impacts on nearshore and offshore waters from vessel discharges by the introduction of total suspended solids, nutrients, organics, and oil and grease would be expected to diffuse rapidly in the water column without settling to the seafloor.

Ballast water discharges can contain a variety of biological materials including plants, animals, viruses, and bacteria, including invasive species (discussed below). BOEM assumes all vessels operating in the area would comply with pertinent discharge regulations (including but not limited to the CWA, NPDES permits, the USEPA Vessel General Permit, and USCG ballast water regulations[2]). The designation of the Chumash Heritage National Marine Sanctuary in late 2024/early 2025 would further restrict allowable discharges into the waters near the Morro Bay WEA, likely enhancing overall water quality over time.

Based on the foregoing, BOEM expects water quality impacts from vessel discharges would not result in degradation of water quality in exceedance of water quality standards. Adherence to applicable permits and regulatory requirements for vessel discharges by local authorities, the State of California, USCG, and USEPA would minimize discharges. Based on the above, the level of impact on water quality from planned activities would be similar to existing conditions and would not be expected to appreciably contribute to cumulative water quality impacts.

Gear utilization: Ongoing commercial and recreational fishing and scientific research would continue in the Affected Environment. Coring and collection of bottom samples associated with geotechnical surveys or benthic sampling would cause localized seafloor disturbance, temporarily increasing turbidity and reducing water clarity by resuspension of sediments. Collection of bottom samples is estimated to affect up to 10 m^2 (108 square feet) per sample, although the core or grab sample extraction area may be much smaller (BOEM 2014). Upon completion of sampling, suspended sediment would settle to the seafloor with water quality returning to ambient conditions. The overall impact of increased sediment and turbidity from gear utilization is anticipated to be localized, and it would not result in degradation of ambient water quality.

Invasive species: Invasive species can be unintentionally introduced or spread, particularly through marine vessel discharges or hull biofouling. Such species can establish locally, affecting water quality by reducing nutrient transport and affecting bank stability onshore, leading to increased erosion and nutrient-rich runoff, or eutrophication. Decomposition of excess organic material from invasive species can produce CO_2, lowering water pH and DO levels. All ongoing and planned activities would be subject to regulations, including NOAA and USCG standards, and CWA, USEPA Vessel General Permit, and USCG ballast water regulations, which prevent and control such discharges.

Port utilization: Planned port improvements are likely to involve dredging or deepening activities, increasing the potential for increased turbidity, sedimentation, and accidental releases. All such projects would be expected to undergo CEQA and NEPA review and obtain/comply with all applicable permit requirements. Vessels would adhere to all USCG and MARPOL 73/78 Annex V requirements and, as applicable, the NPDES VGP. Given how such port projects would be spread in time and space, all such impacts are expected to be localized and short to long term, resulting in little to no degradation of water quality.

Land disturbance: Onshore construction can generate stormwater runoff, sedimentation, and accidental spills of fuels and lubricants, potentially contributing to water quality impacts if such materials are introduced into waterways. BOEM assumes that each project would avoid or minimize such impacts

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[2] USEPA 2013 VGP and USCG regulation 33 CFR 151.10.

through BMPs, OSRPs/SPCC plans, stormwater pollution prevention plans (SWPPPs), and compliance with applicable permit requirements. Such measures would be expected to reduce potential impacts to a minor level; no degradation in water quality in exceedance of water quality standards would be expected, and such impacts would be limited to periods of onshore construction.

3.2.2.3.3 Conclusions

Impacts of the No Action Alternative. Water quality would continue to follow current regional trends and respond to current environmental and commercial activities, including climate change. BOEM expects ongoing activities to likely have temporary impacts primarily through accidental releases and sediment suspension related to vessel traffic, port utilization, presence of structures, discharges/intakes, and land disturbance.

Cumulative Impacts of the No Action Alternative. The additional consideration of planned activities—including installation of new undersea transmission lines and pipelines, onshore development, marine surveys, and port improvements—would incrementally contribute to cumulative impacts. Any potential detectable cumulative impacts are not anticipated to exceed water quality standards.

3.2.2.4 Impacts of Alternative B – Development with No Mitigation Measures – Water Quality

3.2.2.4.1 Impacts of One Representative Project in Each WEA

Accidental releases: Accidental releases of contaminants (including fuels, oils, and chemicals) could occur due to vessel activity, offshore structures, and stormwater runoff during all phases of offshore wind development. A fuel spill's water quality impact would depend on weather and ocean conditions as well as spill response effectiveness. The risk of a spill from an offshore structure would be low, and any effects would likely be localized. Released contaminants may dilute to non-toxic levels, causing temporary water quality effects that would not result in a long-term exceedance of water quality standards.

All phases of offshore wind development would increase vessel activity and thus increase the potential for allisions/collisions and fuel spills. Many factors would reduce such risks including, but not limited to, USCG vessel lighting requirements (USCG 2015), NOAA vessel speed restrictions (NOAA 2024), WTG and OSS lighting and marking, and the inclusion of new structures on navigation charts.

In the unlikely event of a large spill, water quality impacts would be short to long term depending on the type and volume of material released and ocean/weather conditions. The probability of an oil or chemical spill large enough to affect water quality is extremely low, but the degree of impact would depend on spill volume. This risk and impact would be localized; no permanent degradation of water quality in exceedance of water quality standards is expected.

All phases of offshore wind development have the potential to result in increased accidental releases of trash and debris from vessels. There is a likelihood of accidental releases from nearshore project activities (e.g., transmission cable installation, transport of equipment and personnel from ports). BOEM assumes all vessels would comply with laws and regulations to properly dispose of marine debris and to minimize releases. BMPs to minimize marine trash and debris including recovery of marine trash and debris and reporting would be implemented, per federal and state requirements, to reduce impacts. In the event of a release, it would be expected to be an accidental, localized event; therefore, project-related marine debris would only have a short-term effect on water quality. BOEM anticipates that the impacts from accidental releases on water quality would result in temporary water quality impacts.

Anchoring: Vessel and WTG/OSS anchoring would disturb seabed areas, resuspending and depositing sediments. Vessel anchoring's precise impacts during all phases of offshore wind development cannot be predicted, but it is assumed that anchoring impacts disturbing sediment would be localized (Dernie et al. 2003). Water quality impacts from one representative project in each WEA due to vessel anchoring would be temporary.

WTGs and OSSs would be anchored to the seafloor, connected by mooring lines. Anchor selection would depend on sediment type, mooring configuration, and platform type. A single WTG or OSS could require up to 12 mooring lines and thus a seabed footprint of up to 75 acres (300,000 m^2). Therefore, the maximum seabed footprint for a single representative project (up to 200 WTGs and six OSSs) would be 15,450 acres (6,252 hectares). However, subsurface currents are more important in determining the impacts from seafloor disturbance activities such as anchoring. Subsurface currents could result in intermittent, short-term effects on water quality.

Cable installation and maintenance: Cable installation could involve various tools (such as cable plows, hydro plows, jetting sleds, vertical injectors, or tracked trenchers), which can temporarily increase turbidity and sediment resuspension. Export cable installation for a single representative project would disturb up to 270 linear miles (400 kilometers), with an estimated maximum width of 43 feet (13 meters) of seabed. Other projects using similar installation methods observed minor water quality impacts due to the localized nature of the disturbance (Latham et al. 2017). A study in California nearshore waters found that fine-grained sediment dispersed quickly from release sites, had negligible amounts of accumulation in shallow waters, and remained temporarily suspended; turbidity levels generally returned to background levels within hours to days (USGS 2013). Water quality impacts would thus be short term.

Discharges/intakes: Potential discharge and intake sources include vessel traffic and HVDC converters. All phases of a single representative project would generate vessel traffic at or near involved ports. Various vessel types (jack-up vessels, support vessels such as crew transport vessels, and tugs) would be deployed through all phases, with activity peaking during construction. This increase in vessel traffic would increase levels of discharge. Vessel traffic would be localized near affected ports and offshore activity areas.

All vessels in the Affected Environment must adhere to federal, state, and local permits for discharges. Small vessels must comply with the USEPA 2013 VGP and USCG regulations at 33 CFR 151.10 for ballast water discharge. BSEE, BOEM, USEPA, and USCG share jurisdiction over OCS pollution prevention. BSEE coordinates water quality oversight on the OCS with these agencies per MOUs from 2021 and 2012, and associated Memoranda of Agreement. BSEE enforces environmental requirements for water quality under the OCSLA and verifies compliance through field inspections. Compliance with these requirements would reduce vessel discharge impacts.

If used, HVDC systems would entail use of offshore components that could affect water quality. Offshore HVDC converters include cooling systems that intake sea water and discharge warmer water back into the ocean. Chemicals such as bleach (sodium hypochlorite) would be used to prevent growth in the system and keep pipes clean. The warm water discharged is generally considered to have a minimal effect, as it will be mixed by the surrounding water and returned to ambient temperatures over time. Even though localized effects on water quality from the discharge of warmer water could take place in the area immediately surrounding the outlet pipe, overall impacts are expected to be minimal with no degradation to water quality. CWA Section 316(b) requires NPDES permits to ensure that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available to minimize adverse environmental impacts. Moreover, typical BMPs and compliance with federal requirements would further protect offshore waters from any potential thermal pollution impacts. As a part of CWA Section 402, the NPDES permit sets and enforces standards for the discharge of effluents, including thermal pollution.

Land disturbance: Onshore elements of a representative project include export cable landfall sites, sea-to-shore transition, onshore export cable routes, one or more onshore substations or converter stations, and linkage to one or more POIs. Construction of such features would occur under typical erosion and sedimentation control BMPs to avoid/minimize the potential for construction to result in increased erosion, turbidity, or siltation. BOEM assumes a SWPPP would be developed and implemented and an appropriate NPDES permit obtained. HDD is expected to be used at landfall sites to minimize land disturbance near the shoreline. It is possible that potential limited sediment releases could occur during HDD, but impacts would be localized and not long lasting. As such, impacts from land disturbance are anticipated to be temporary, lasting only the duration of construction.

Port utilization: The ports most likely to support the Humboldt and Morro Bay lease areas, summarized in Table 2-2, either already have sufficient existing infrastructure or have separate plans in the works toward developing such infrastructure (as described in Chapter 2, *Alternatives*). In the event that a COP indicates the need for additional specific port improvements, any such improvements would be considered in project-level environmental reviews.

For this PEIS, it is assumed that a single representative project would generate vessel traffic at involved ports and their approaching waterways. Multiple authorities regulate water quality impacts from port activities.

Presence of structures: A single representative project would add up to 200 WTGs and up to six OSSs. Floating WTGs would include a disturbance width of up to 43 feet (13 meters) per export cable. Floating WTGs and OSSs would be anchored to the seafloor, each entailing up to 12 mooring lines.

Scouring could occur around anchors and other hard structures, dependent on water currents, wave action, and water depths. Depending on local hydrologic conditions, water quality impacts could occur through alteration of mixing patterns and upwelling processes; however, impacts would be localized.

Information submitted with specific lease area COPs is expected to provide further detail about scour potential in lease areas and along cable routes. Low current speeds and minimal seabed mobility are good indicators that significant scour would not occur. Moreover, cable burial depths and the inclusion of scour protection around anchors would minimize scour potential.

Offshore wind structures, primarily of steel, are susceptible to corrosion. Corrosion-protection systems, often in direct contact with seawater, are essential for maintaining structural integrity. These systems, such as coatings and cathodic protections, can release metals or organic compounds into the marine environment. Effects of leaching or weathering of these systems may increase with more offshore wind projects (Kirchgeorg et al. 2018). Toxins introduced from structure corrosion would be localized. Preemptive measures, including the development of new materials and methods with lower water quality risks, would be implemented to prevent biofouling and corrosion. Therefore, the risk of chemicals leaching from structures and affecting water quality is considered low (Farr et al. 2021; Copping et al. 2016). Impressed current cathodic protection (ICCP) systems may also generate changes in EMFs greater than those from submarine cables, but the potential environmental consequences of these systems are not well understood. Based on the foregoing, water quality impacts from the presence of structures would be reoccurring.

3.2.2.4.2 Impacts of Five Representative Projects

Five representative projects would increase the potential for impacts due to the greater amount of offshore and onshore development. Primary factors include increased vessel activity (which would increase the potential for accidental releases and discharges/intakes) and more anchoring and cable installation (which would increase sediment resuspension and deposition). With five representative projects, the maximum seabed footprint area would be 77,250 acres (31,262 hectares). This larger area would increase the potential for both scour and hydrodynamic impacts from WTGs and OSSs. However, due to the anticipated low currents and the use of scour protection, as well as the geographic separation of the two WEAs, potential sediment transport would be minimized.

Large-scale offshore wind development could result in increased turbulent mixing of seasonal stratification of the water column. However, floating offshore wind facilities would minimize the potential for stratification (Carpenter et al. 2016). If multiple projects are being constructed near each other at the same time, the extent and intensity of water quality impacts would increase. However, multiple authorities regulate water quality through permits and regulations that would still apply to five representative projects.

Vessel activity would also increase port utilization, but water quality impacts are not anticipated. The increase in vessel activity would be small relative to existing port traffic; multiple authorities regulate water quality impacts.

3.2.2.4.3 Cumulative Impacts of Alternative B

Alternative B would contribute cumulative impacts primarily through increased turbidity and sedimentation (from anchoring and cable installation), and increased sedimentation during O&M due to the presence of structures. Cumulative impacts associated with anchoring are dependent on subsurface conditions such as water currents; however, water quality effects related to water currents would be short term. In context of reasonably foreseeable environmental trends and planned activities, if multiple projects are constructed during the same timeframe, incremental impacts of Alternative B would range from undetectable to noticeable. If construction timeframes of the five representative projects overlapped, there would be greater potential for impacts. Assuming offshore wind activities comply with all applicable regulatory requirements and permit conditions, measurable cumulative impacts for all IPFs except for accidental releases would be small and water quality would recover. In contrast, accidental release impacts could be more severe given potential (albeit low probability) of a large release.

3.2.2.4.4 Conclusions

Impacts of Alternative B. Whether one or five representative projects, Alternative B would have impacts on water quality, depending on the IPF, with the unlikely event of a large accidental release potentially causing a more severe impact.

Cumulative Impacts of Alternative B. Considering all the IPFs together, BOEM anticipates that the impacts associated with Alternative B combined with ongoing and planned activities and reasonably foreseeable environmental trends would likely result in cumulative impacts. A large-volume accidental release would result in a more severe impact; however, this is a low-probability event.

3.2.2.5 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Water Quality

Alternative C, the Proposed Action, is the adoption of mitigation measures such that the potential impacts described for Alternative B may be avoided or reduced. The analysis for this alternative is presented as the change in impacts from those discussed for Alternative B. Appendix E, *Mitigation,* identifies the mitigation measures that make up the Proposed Action. Table 3.2.2-6 provides a summary of the mitigation measures that are proposed to avoid or reduce water quality impacts.

Table 3.2.2-6. Summary of mitigation measures

Measure ID	Measure Summary
MM-10	This measure encourages the use of zero-emissions technologies and replacement of diesel fuel and marine fuel oil with alternative fuels such as natural gas, propane, or hydrogen.
MM-19	This measure requires submittal and approval of an anchoring plan to reduce or avoid impacts from turbidity and anchor placement.
MM-36	This measure requires development of an Oceanographic Monitoring Plan. Components of the plan include coordination with relevant regulatory agencies and neighboring lessees, monitoring strategies for pre-construction, construction, post-construction, and decommissioning phases; and appropriate physical and biochemical measurements (e.g., ocean temperature, salinity, pH, current velocity, biogeochemistry, and nutrients).

3.2.2.5.1 Impacts of One Representative Project in Each WEA

Several mitigation measures would help avoid or reduce water quality impacts. These include measures to avoid or minimize release of diesel and marine fuel (MM-10), turbidity resulting from anchoring (MM-19), and monitoring physical and biochemical parameters prior to, during, and after construction (MM-36).

The effectiveness of these measures depends on many factors that cannot be reasonably quantified in the absence of COP-specific levels of detail. While these measures would avoid or minimize local water quality impacts from debris, turbidity, and discharges, impacts for the purposes of this programmatic analysis would remain the same as described under Alternative B.

3.2.2.5.2 Impacts of Five Representative Projects

With five representative projects, increased offshore activities are expected to increase the likelihood of water quality impacts. However, with implementation of mitigation measures, impacts related to debris, turbidity, and discharge would be similar to those for a single representative project in each WEA.

3.2.2.5.3 Cumulative Impacts of Alternative C

Contributions to cumulative impacts would arise primarily through increased turbidity and sedimentation (from anchoring, cable installation, and the presence of structures). Cumulative impacts associated with anchoring or the presence of structures are dependent on subsurface conditions such as water currents. However, water quality effects related to water currents would be short term. Alternative C would help avoid or minimize sedimentation impacts, reducing offshore wind-related contributions to an undetectable level.

In context of reasonably foreseeable environmental trends, the incremental contribution of Alternative C would range from undetectable to noticeable.

3.2.2.5.4 Conclusions

Impacts of Alternative C. Mitigation measures would reduce impacts of trash and debris, anchoring, sediment disturbance, and ballast water discharge when compared to Alternative B.

Cumulative Impacts of Alternative C. BOEM anticipates that Alternative C would have cumulative water quality impacts with the unlikely event of a large accidental release potentially causing a more severe impact. In context of reasonably foreseeable environmental trends, Alternative C's incremental contribution would be undetectable. Mitigation measures would lessen the extent of impacts when compared to Alternative B.

3.3 Biological Resources

3.3.1 Bats

This section discusses the Affected Environment and potential impacts on bats from the offshore components of the Proposed Action, alternatives, and ongoing and planned activities in the region. Figure 3.3.1-1 shows the Affected Environment for bats, which includes the California coastline and extends 100 miles (161 kilometers) offshore to encompass the bat species that may be affected while migrating or foraging through the Humboldt and Morro Bay WEAs.

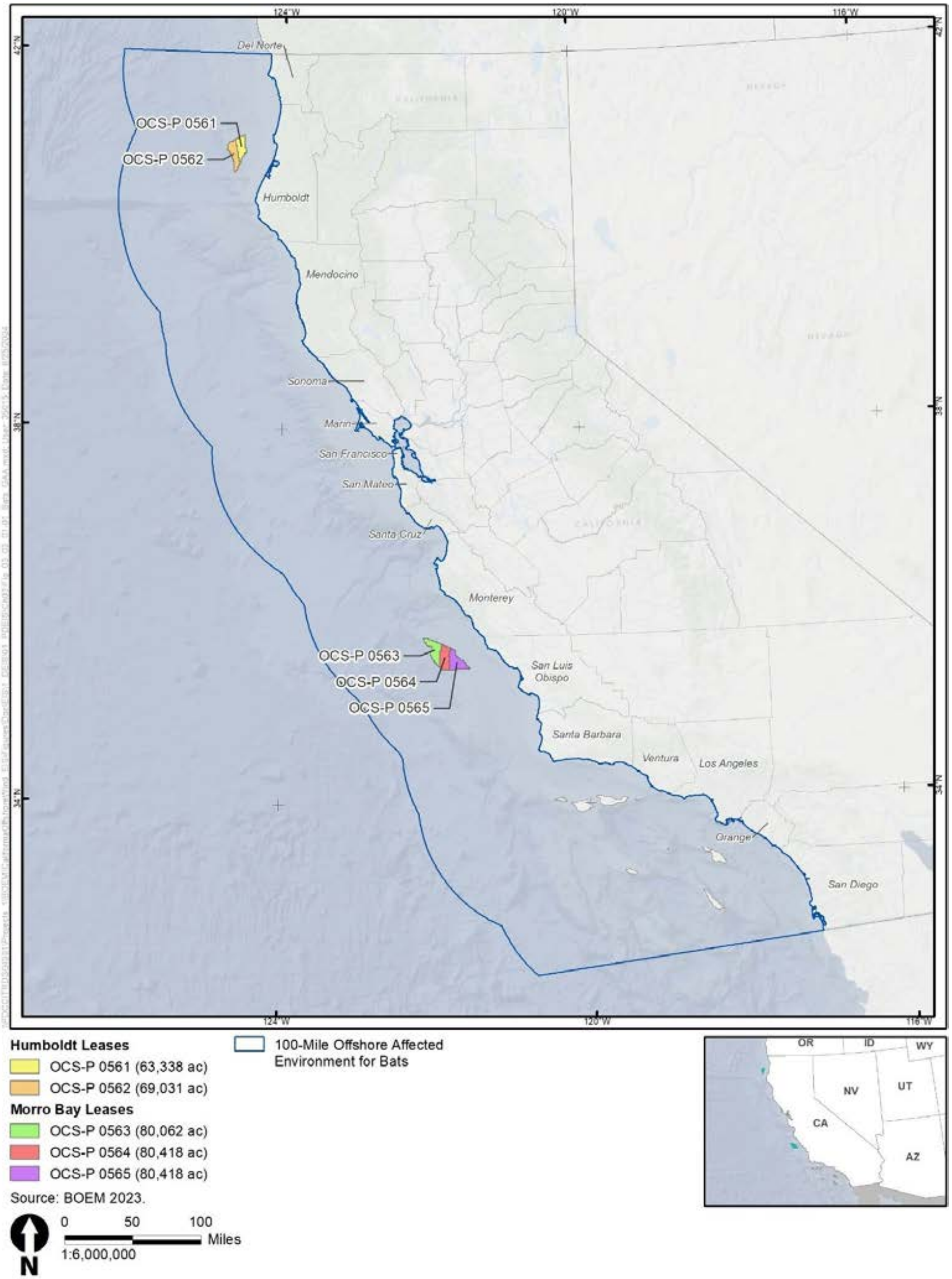

Figure 3.3.1-1. Bats Affected Environment

3.3.1.1 Description of the Affected Environment and Baseline Conditions

As shown in Table 3.3.1-1, there are 25 bat species present in California (Brown and Rainey 2018). Of these, 17 have documented California Natural Diversity Database (CNDDB) occurrences in coastal California and 14 have been recorded on California offshore islands, approximately the same distance offshore as the Humbolt and Morro Bay WEAs (Brown and Rainey 2018; CDFW 2023; Western Bat Working Group 2017).

There are no bat species protected under the ESA that have the potential to occur in the California offshore wind lease areas.[1]

Table 3.3.1-1. Bats present in California and their state and federal conservation status

Common Name	Scientific Name	California Status	Federal Status
Cave-Roosting Bats			
Mexican Long-tongued bat[1]	*Choeronycteris mexicana*	Species of Special Concern	None
Townsend's big-eared bat[1,2]	*Corynorhinus townsendii*	Species of Special Concern	None
Lesser long-nosed bat[1]	*Leptonycteris yerbabuenae*	Species of Special Concern	Delisted
California leaf-nosed bat[1]	*Macrotus californicus*	Species of Special Concern	None
Cave myotis	*Myotis velifer*	Species of Special Concern	None
Yuma myotis[1,2]	*Myotis yumanensis*	None	None
Tree-Roosting Bats			
Silver-haired bat[1,2]	*Lasionycteris noctivagans*	None	None
Hoary bat[1,2]	*Lasiurus cinereus*	None	None
Western red bat[1,2]	*Lasiurus frantzii*	Species of Special Concern	None
Western yellow bat[1,2]	*Lasiurus xanthinus*	Species of Special Concern	None
Cliff-Roosting Bats			
Spotted bat[1]	*Euderma maculatum*	Species of Special Concern	None
Western mastiff bat[1,2]	*Eumops perotis californicus*	Species of Special Concern	None
Pocketed free-tailed bat[1]	*Nyctinomops femorosaccus*	None	None
Big free-tailed bat[1]	*Nyctinomops macrotis*	Species of Special Concern	None
Multiple-Habitat Bats			
Pallid bat[1,2]	*Antrozous pallidus*	Species of Special Concern	None
Western small-footed myotis[1]	*Myotis ciliolabrum*	None	None
Long-eared myotis[1,2]	*Myotis evotis*	None	None
Arizona myotis	*Myotis occultus*	Species of Special Concern	None
Fringed myotis[1,2]	*Myotis thysanodes*	None	None
Canyon bat[2]	*Parastrellus hesperus*	None	None

[1] The little brown bat has been petitioned for listing under the ESA. USFWS is currently reviewing its status due to significant population declines, especially in eastern North America, largely attributed to wind turbine mortality and a fungal disease known as white-nose syndrome (https://ecos.fws.gov/ecp/species/9051#candidate; https://www.fws.gov/species/little-brown-bat-myotis-lucifugus). The lesser long-nosed bat was removed from the Federal List of Endangered and Threatened Wildlife in 2018 (83 FR 17093).

Common Name	Scientific Name	California Status	Federal Status
Little brown myotis	*Myotis lucifugus*	None	None
Big brown bat[2]	*Eptesicus fuscus*	None	None
Long-legged myotis	*Myotis volans*	None	None
California myotis[2]	*Myotis californicus*	None	None
Mexican free-tailed bat[2]	*Tadarida brasiliensis*	None	None

Sources: CDFW 2023, 2024; Western Bat Working Group 2017.
[1] CNDDB occurrences in coastal California counties (CDFW 2023).
[2] Species documented on the Channel Islands (Brown and Rainey 2018).

Bats are a primarily terrestrial species that spend almost their entire lives on or over land. As nocturnal insectivores, bats forage over a variety of forested and open habitats. However, bat presence also been documented in the U.S. offshore marine environment (Cryan and Brown 2007; Dowling et al. 2017; Hatch et al. 2013; Pelletier et al. 2013; Solick and Newman 2021; Kennerley et al. 2024). In the Atlantic, bats have been documented temporarily roosting on structures (i.e., lighthouses) on nearshore islands, and there is evidence of eastern red bats migrating offshore.

Data on bat species and their abundance in the Pacific offshore marine environment, particularly in the California OCS, is limited (U.S. Offshore Wind Synthesis of Environmental Effects Research 2022; Solick and Newman 2021; Cryan and Brown 2007; Brown and Rainey 2018). A hoary bat was spotted over the Humboldt WEA in October 2022. Hoary bats, along with western red bats and 12 other species, are known to inhabit the Farallon and Channel Islands (Brown and Rainey 2018). Both hoary and western red bats are migratory, suggesting a higher likelihood of their presence in the California OCS. Hoary bats, capable of long-distance over-ocean flights, migrate along the Pacific Coast to winter in California.

The population size and spatial distribution of long-distance bat migrants (including hoary bat and western red bat) are not well understood (U.S. Offshore Wind Synthesis of Environmental Effects Research 2022). Western red bats are also highly migratory and acoustic recordings provide evidence that they may be year-round residents in coastal California (Brown and Rainey 2018).

Data suggest higher bat activity onshore than offshore (Hein et al. 2021). A study in the North Sea found bat detections to be 24 times higher onshore (Brabant et al. 2021). In California, hoary bat migration was observed during low wind speeds, low moonlight, and high cloud cover (Cryan and Brown 2007). Atlantic flyway surveys showed 90 percent of bat passes occurred with wind speeds below 5.0 m/s and temperatures above 59°F (15.0°C) (Stantec 2018). BOEM is funding studies to understand bat movement in Southern California, with data to be included in future project-specific analyses. Until then, all 25 bat species in California are considered to have potential to occur in the Affected Environment.

North American bats face numerous threats, including disease like white-nose syndrome, wind turbine collisions, habitat loss, and climate change (Bat Conservation International 2023; Bat Conservation International and North American Bat Monitoring Program 2018). Cave-roosting bats are declining due to white-nose syndrome, with the causative fungus presumed present in California, though no infected bats have been confirmed (Whitenosesyndrome.org n.d.). Bats, particularly migratory tree-roosting species, risk collision with land-based wind turbines, especially during low wind speeds, high temperatures, and clear nights (Horn et al. 2008; True et al. 2021). Climate change could alter bat behaviors and habitats, while human activities like forestry, agriculture, mining, pest management, and urban development contribute to habitat loss and global bat population impacts (Bat Conservation International and North American Bat Monitoring Program 2018; Bat Conservation International 2023).

3.3.1.2 Impact Background for Bats

Issues and indicators to assess impacts on bats are described using the definitions in Table 3.3.1-2. Noise and presence, operation, and decommissioning of structures may all affect bats.

Table 3.3.1-2. Issues and indicators to assess impacts on bats

Issue	Impact Indicator
Collision/attraction	Qualitative estimate of collision risk with WTGs and OSSs
Displacement/barrier effects/disturbance	Changes to artificial light at night Changes to noise levels Projected traffic patterns/volume changes

3.3.1.3 Impacts of Alternative A – No Action – Bats

When analyzing the impacts of the No Action Alternative on bats, BOEM considers the impacts of ongoing activities on the baseline conditions for bats. The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative on existing baseline trends, including other planned activities, which are described in Appendix C, *Planned Activities Scenario*.

3.3.1.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for bats would continue to follow current regional trends and respond to other ongoing activities. Ongoing activities in the Affected Environment that contribute to impacts on bats include military use; marine transportation; fisheries use, management, and monitoring surveys; oil and gas activities; and global climate change. These activities may result in temporary and permanent impacts on bats including behavioral modification, injury, and mortality.

Ongoing activities in the Affected Environment may affect bats through the following IPFs.

Noise: Noise associated with marine vessels, aircraft traffic, and military use may result in behavior modifications, injury or mortality of bats. Information on over-ocean bat movement along the Pacific Coast is limited, and noise-related impacts on bats from planned activities would likely vary by species. Recent research has shown that some bat species may be less sensitive to temporary threshold shifts than other terrestrial mammals (Simmons et al. 2016). However, even temporary effects on hearing have been reported to negatively affect individuals (California Department of Transportation 2016). Noise-related effects are potentially greater during spring and fall migration when higher numbers of bats have been documented at that distance from shore (Solick and Newman 2021). BOEM expects that impacts have short-term, localized consequences for individuals that are detectable and measurable but would not lead to population-level effects. However, there is potential that noise impacts result in the loss of individuals.

Lighting: Marine vessels are currently the predominant source of offshore artificial lighting in the Affected Environment. Nighttime lighting is also utilized on oil and gas platforms off Southern California. Vessel lighting is intermittent, and the extent of impacts is limited to the immediate vicinity of the vessels or platforms. Artificial lighting in developed settings has been shown to have a variety of adverse effects on bat behaviors, including foraging, commuting, emergence, roosting, breeding, and hibernation (Stone et al. 2015). Lighting-related impacts on bats likely vary by species and are expected to be greater during spring and fall migration when higher numbers of bats have been documented at that distance from shore (Solick and Newman 2021). BOEM expects that lighting impacts have short-term, localized consequences for individuals that are detectable and measurable but do not lead to population-level effects. However, there is potential that lighting impacts result in the loss of individuals.

Presence of structures: Existing structures in the Affected Environment include offshore oil and gas platforms. The presence of structures offshore has the potential to result in impacts on bats such as migration disturbance and collisions. Observations from the Channel Islands indicate that hoary bats may migrate in flocks (Brown and Rainey 2018), which may make the species more vulnerable to collisions with offshore structures. BOEM expects that impacts do not lead to population-level effects. However, the presence of structures may result in the loss of individuals.

Traffic (aircraft): Documented bat collisions with aircraft in the United States include approximately 800 collisions (primarily Mexican free-tailed bats) with U.S. Air Force aircraft and approximately 417 collisions with commercial aircraft over a 10-year period (Voigt et al. 2018). Aircraft flying in the Affected Environment may result in injury or mortality of individual bats or may result in avoidance of airspace. Disturbance is likely temporary and localized, with impacts dissipating once the aircraft has left the area. BOEM expects that impacts of aircraft have short-term, localized consequences for individuals that are detectable and measurable but do not lead to population-level effects. However, there is potential for impacts to result in the loss of individuals.

3.3.1.3.2 Cumulative Impacts of the No Action Alternative

Ongoing and planned activities in the Affected Environment that have the potential to affect bats include decommissioning of oil and gas platforms, military activities, use of marine and aircraft vessels, and climate change (Appendix C). Ongoing and planned activities would have the same type of impacts as those described in detail in Section 3.3.1.3.1, *Impacts of the No Action Alternative*, but the impacts would be of greater intensity. These activities could affect bats through the following IPFs: noise, which could have physiological effects on and result in behavioral changes of bats; lighting, which could result in behavioral changes of bats; and the presence of structures and vessel traffic, both of which can result in collisions and behavioral changes in bats. Climate change has the potential to reduce reproductive output and increase individual mortality and disease occurrence (Bat Conservation International and North American Bat Monitoring Program 2018). Planned activities may result in temporary and permanent impacts on bats including behavioral modification, injury, and mortality.

3.3.1.3.3 Conclusions

Impacts of the No Action Alternative. Bats would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing temporary, long-term, and permanent impacts (disturbance, displacement, injury, and mortality) on bats primarily through offshore noise, lighting, presence of structures, traffic, and climate change. Bat species composition, abundance, and flight patterns on the OCS are largely unknown due to limited available studies in the Pacific. However, the extent of effects is anticipated to be greater during spring and fall migrations.

Cumulative impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue. Bats would continue to be affected by natural and human-caused impacts. Ongoing and planned activities would contribute to the impacts on bats due to the presence of offshore noise, lighting, presence of structures, traffic, and climate change.

3.3.1.4 Impacts of Alternative B – Development with No Mitigation Measures – Bats

The analysis of Alternative B considers the impacts on bats from the development of one representative project or five representative projects in each WEA without the adoption of mitigation measures.

3.3.1.4.1 Impacts of One Representative Project in Each WEA

Noise: All phases of wind energy development would generate noise with the potential to affect bats on the OCS. Construction noise may affect migrating bats, primarily if conducted during spring or fall migration. Construction could also generate enough noise to cause avoidance behavior by individual migrating bats, which could lead to displacement of individuals from potentially suitable habitats (Schaub et al. 2008). Construction-related activity would be temporary and localized; however, construction of an individual project could last up to 3 years and even temporary effects on hearing have been reported to negatively affect individuals (California Department of Transportation 2016).

Non-routine activities would generally require intense, temporary activity to address emergency conditions. Noise made by offshore repair vessels could temporarily deter bats from approaching the site of a given non-routine event. Impacts on bats, if any, would be temporary and last only as long as repair or remediation activities were necessary to address non-routine events. Studies of land-based wind turbines have shown that operational noise emitted by wind turbines is unlikely to be an attractant for bats (Szewczak and Arnett 2006; Arnett et al. 2005; Guest et al. 2022). However, noise-related attraction to operating turbines may differ by species (Long et al. 2011; Guest et al. 2022), and noise generated by larger offshore turbines may differ from that of land-based turbines.

BOEM anticipates that noise impacts would be detectable and measurable and would have the potential to result in the loss of individuals but are unlikely to lead to population-level effects. However, at the time of this programmatic analysis, there are no available data from the acoustic monitoring and Motus studies to analyze species composition, abundance, and seasonal trends in bat presence in the WEAs. Acoustic monitoring and Motus study results will be available to be incorporated into future project-specific analyses for COPs.

Lighting: Nighttime lighting would increase with the construction and operation of up to 200 WTGs and up to six OSSs and multiple vessels and persist through all phases of development. Artificial lighting could result in adverse effects on bat behaviors (Stone et al. 2015). Wind turbine lighting may result in reduced bat fatalities, based on prior land-based studies that have either found no changes in fatalities between lighted and unlighted turbines or a measurable reduction in fatalities at lighted turbines (Hein and Schirmacher 2016). However, lighting-related impacts on bats would likely vary by species; lighting required for offshore turbines may also differ from that used for land-based turbines. BOEM anticipates that for offshore structure lighting, in the absence of light-reduction measures (e.g., ADLS), construction- and operation-related lighting effects would be detectable and measurable and would have the potential to result in the loss of individuals but are unlikely to lead to population-level effects. However, at the time of this programmatic analysis, there are no available data from the acoustic monitoring and Motus studies to analyze species composition, abundance, and seasonal trends in bat presence in the WEAs. Acoustic monitoring and Motus study results will be available to be incorporated into future project-specific analyses for COPs.

Presence of structures: The presence of project-related structures offshore would have the potential to result in various types of impacts on bats such as migration disturbance and turbine strikes. One representative project would add between 30 and 200 WTGs and one to six OSSs on the OCS. The structures, and related bat impacts, associated with each representative project would remain at least until decommissioning and could thus pose long-term bat impacts.

Exposure to vessels or the rotor-swept zone (RSZ) of operating WTGs could result in bat injury or mortality. Bats are attracted to land-based turbines (Cryan et al. 2014; Guest et al. 2022), and potential hypotheses suggest bats are attracted to turbines for use as roost sites, foraging, mating, and scent marking territories (Guest et al. 2022). Artificial light and noise do not appear to be primary causes of bat attraction to wind turbines (Guest et al. 2022). Bats have been recorded approaching land-based turbines from downwind on moonlit nights (Cryan et al. 2014), especially at wind velocities lower than about 5 to 6 m/s; at higher wind speeds, bats avoid the RSZ (Wellig et al. 2018). Some fraction of recorded fatalities at land-based turbines are caused by pressure changes rather than by turbine blade strike (Baerwald et al. 2008; Grodsky et al. 2011).

Offshore O&M activities pose a seasonal risk to migratory bats, especially during spring and fall migration. However, data on the distribution, abundance, and species of bats in the Pacific offshore environment is limited, and it is unclear if bats are attracted to offshore wind turbines (U.S. Offshore Wind Synthesis of Environmental Effects Research 2022). The number of bats that might encounter wind turbines or related structures is unknown due to these uncertainties. The population size of long-distance bat migrants and the proportion undertaking over-ocean movements is also unclear (U.S. Offshore Wind Synthesis of Environmental Effects Research 2022). Wind turbines could affect cave-roosting bat populations susceptible to white-nose syndrome if significant numbers are present in the offshore project area.

Effects from the presence and operation of turbines would be more likely to occur during spring and fall migration when higher numbers of bats have been documented offshore (Solick and Newman 2021).

However, at the time of this programmatic analysis, there are no available data from the acoustic monitoring and Motus studies to analyze species composition, abundance, and seasonal trends in bat presence in the WEAs. Acoustic monitoring and Motus study results will be available to be incorporated into future project-specific analyses for COPs.

3.3.1.4.2 Impacts of Five Representative Projects

The same types of design parameters described for one representative project in each WEA would apply to development of all five projects in the Humboldt and Morro Bay WEAs, except that the number and length of each parameter would be scaled for five projects. Five projects would increase the potential for bat impacts due to the greater amount of offshore development. Impacts on bats in the offshore environment are anticipated due to the potential for a substantial number of bats to migrate through the Humboldt and Morro Bay WEAs, the potential for bats to be attracted to wind turbines, and the potential for injury and mortality from operating turbines.

3.3.1.4.3 Cumulative Impacts of Alternative B

Cumulative impacts on bats from the construction, O&M, and decommissioning of infrastructure for five representative projects combined with ongoing and planned activities in the Affected Environment would also contribute to the primary IPFs of noise, lighting, and presence of structures.

In the absence of data documenting bat presence, abundance, and potential population-level effects on bats in the Humboldt and Morro Bay WEAs, cumulative impacts on bats are anticipated in the offshore environment based on the known potential for bats to be attracted to wind turbines and the potential for injury and mortality from operating turbines. This would apply to all five individual California offshore wind projects being constructed simultaneously or staggered over time. In the context of reasonably foreseeable environmental trends, Alternative B is expected to contribute to the cumulative impacts on bats.

3.3.1.4.4 Conclusions

Impacts of Alternative B. The main significant risk to bats would be from operation of the offshore WTGs, which could lead to long-term impacts in the form of injury or mortality. Impacts are anticipated to be more likely during spring and fall migration when higher numbers of bats have been documented offshore (Solick and Newman 2021). However, there are currently insufficient data on bat presence, abundance, and behavior in the OCS to quantify these impacts.

Cumulative Impacts of Alternative B. Alternative B would contribute to the cumulative impacts primarily through long-term impacts from the presence and operation of offshore structures. However, there are currently insufficient data on bat presence, abundance, and behavior in the OCS to quantify these impacts.

3.3.1.5 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Bats

Alternative C, the Proposed Action, is the adoption of mitigation measures such that the potential impacts described for Alternative B may be avoided or reduced. The analysis for this alternative is presented as the change in impacts from those discussed under Alternative B. Other than the adoption of mitigation measures, all design parameters for Alternative C would be the same as described under Alternative B for project components and activities undertaken for construction and installation, O&M, and decommissioning. Mitigation measures proposed under Alternative C are analyzed for one representative project in each WEA and five representative projects in the Humboldt and Morro Bay WEAs. Appendix E, *Mitigation*, identifies the mitigation measures that make up the Proposed Action. Table 3.3.1-3 provides a summary of the mitigation measures proposed to avoid or reduce impacts on bats.

Table 3.3.1-3. Summary of mitigation measures for bats

Measure ID	Measure Summary
MM-12	This measure states that lessees may be required to comply with seasonal turbine cut-in speeds to reduce impacts on bats.
MM-13	This measure creates annual reporting requirements for dead or injured birds or bats, which would improve the overall understanding of bird and bat interactions with wind farms.
MM-14	This measure requires lessees prepare a Bird and Bat Monitoring Plan which will be used to determine the need for adjustments to monitoring approaches, consideration of new monitoring technologies, and/or additional periods of monitoring.
MM-15	This measure requires lessees to install bird and bat tracking technology on project infrastructure to address information gaps of offshore movements of selected species of birds and bats.
MM-17	This measure requires lessees to minimize impacts on avian species to the maximum extent practicable. Consistent with, and not conflicting with, any measures that may result from USCG requirements, the lessee must use any additional lighting only when necessary, and such lighting must be shielded downward and directed, when possible, to minimize use of high intensity lighting, and reduce upward illumination and illumination of adjacent waters.
MM-18	This measure requires lessees to develop a conservation strategy for migratory birds and bats. The conservation strategy will provide a framework for identifying and implementing actions to conserve birds and bats during project planning, construction, operation, maintenance, and decommissioning and for assessing impacts; avoiding, minimizing, and mitigating impacts; guiding current actions; and planning future impact assessments and actions to conserve birds and bats. If BOEM determines, through consultation with USFWS or other agencies, that compensatory mitigation is appropriate, the strategy would outline the actions needed to offset take of bats.

3.3.1.5.1 Impacts of One Representative Project in Each WEA

Mitigation measures under Alternative C may potentially reduce the extent or degree of bat impacts related to noise, lighting, and the presence of structures. However, at the time of this programmatic analysis, there are no available baseline data to definitively state a reduction of impacts. In the absence of such data, Alternative C is presumed to result in the same impact magnitudes as Alternative B.

Acoustic monitoring and Motus study results will be available to be incorporated into future project-specific analyses for COPs.

Lighting: The effects of artificial lighting (including WTG lighting) on bat collisions are unclear. Designing lighting to minimize avian impacts, using lighting only when necessary, shielding and directing lights downward, minimizing the use of high intensity lighting, and reducing upward illumination and illumination of adjacent waters (MM-17) are not expected to substantially affect potential bat fatalities. In the absence of species composition, abundance, and seasonal trend data in the WEAs at the time of this programmatic analysis, BOEM anticipates there would be no change in impact magnitudes from lighting compared to Alternative B.

Presence of structures: Surveys conducted under the Bird and Bat Monitoring Plan and data collected through bird and bat tracking technology (MM-14 and MM-15) would provide a baseline for comparison with post-construction survey results and would advance the understanding of bat interactions with offshore WTGs. MM-12 may require compliance with seasonal turbine cut-in speeds, which has been shown to reduce bat fatalities at land-based wind facilities. Reporting of any dead or injured bats (MM-13) would improve overall understanding of bat interactions with offshore wind structures and may reduce overall impacts on bats over time. MM-18 would require lessees to develop a conservation strategy for migratory birds and bats. The conservation strategy would provide a framework for identifying and implementing actions to conserve birds and bats during project planning, construction, operation, maintenance, and decommissioning and for assessing impacts; avoiding, minimizing, and mitigating impacts; guiding current actions; and planning future impact assessments and actions to conserve birds and bats. If BOEM determines, through consultation with USFWS or other agencies, that compensatory mitigation is appropriate, the strategy would outline the actions needed to offset take of bats. The specific components of a Compensatory Mitigation Plan would be developed during the COP stage (MM-18).

BOEM anticipates that mitigation measures may reduce impacts on bats in the offshore environment. However, due to the lack of baseline data at the time of this programmatic analysis the extent of this reduction cannot be known at this time.

3.3.1.5.2 Impacts of Five Representative Projects

With five representative projects, increased offshore development is expected to result in a higher likelihood and a greater severity of impacts. With mitigation measures, impacts from noise, lighting, and presence of structures are expected to be similar to those for a single representative project in each WEA. Acoustic monitoring and Motus study results will be available to be incorporated into future project-specific analyses for COPs.

3.3.1.5.3 Cumulative Impacts of Alternative C

Under Alternative C, cumulative impacts on bats from the construction, O&M, and decommissioning of infrastructure for five representative projects combined with ongoing and planned activities across the Affected Environment with mitigation measures would also contribute to noise, lighting, and presence of structures. Cumulative impacts on bats under Alternative C are based on the known potential for bats to be attracted to land-based wind turbines and the potential for injury and mortality from operating turbines, which could result in unavoidable impacts offshore. BOEM does not anticipate the impacts to result in population-level effects or threaten overall habitat function. However, at the time of this programmatic analysis, there are no available data from the acoustic monitoring and Motus studies to analyze species composition, abundance, and seasonal trends in bat presence in the WEAs. BOEM anticipates that in the context of reasonably foreseeable environmental trends, Alternative C would contribute to the impacts of noise, lighting, and the presence of structures on bats.

3.3.1.5.4 Conclusions

Impacts of Alternative C. All phases of offshore wind development under Alternative C, whether one project or five projects, are expected to have an impact on bats. The mitigation measures under Alternative C may reduce impacts on bats in the offshore environment and, therefore, could reduce potential impacts on bats compared to Alternative B. Bat presence, abundance, and use of the California offshore environment are largely undocumented at the time of this programmatic analysis and forthcoming acoustic monitoring and Motus studies will be available to inform project-specific analyses for COPs. Although mitigation measures may reduce impacts on bats in the offshore environment, the extent of this reduction cannot be known at this time.

Cumulative Impacts of Alternative C. Alternative C would contribute to cumulative impacts primarily through the long-term impacts from the presence and operation of offshore structures. Mitigation measures may reduce impacts on bats in the offshore environment, but the extent of this reduction cannot be known at the time of this programmatic analysis. Forthcoming acoustic monitoring and Motus studies will be available to inform project-specific analyses for COPs.

3.3 Biological Resources

3.3.2 Benthic Resources

This section discusses potential impacts of the Proposed Action, alternatives, and ongoing and planned activities in the Affected Environment on benthic resources, other than fishes and commercially important benthic invertebrates. The Affected Environment (Figure 3.3.2-1) includes an area within a 10-mile (16.1-kilometer) buffer around both the Humboldt and Morro Bay WEAs plus export cable corridors between the lease areas and the shoreline.[1] The Affected Environment is where seafloor disturbances and associated effects (e.g., suspended sediment) are most likely to occur and affect benthic resources. It is intended to account for localized benthic disturbance, sediment suspension (via water mass transport), and benthic invertebrate larval transport due to winds and ocean currents.

Section 3.3.4, *Coastal Habitat, Fauna, and Wetlands,* discusses terrestrial resources in coastal areas and tidal wetlands; Section 3.3.5, *Fishes, Invertebrates, and Essential Fish Habitat*, discusses fishes, pelagic invertebrates, and Essential Fish Habitat (EFH).

3.3.2.1 Description of the Affected Environment and Baseline Conditions

The wind affects the ocean surface, driving the California Current and the ecosystem it supports by creating localized upwelling.

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[1] Although project-induced sediment transport and benthic invertebrate larval transport beyond 10 miles (16.1 kilometers) is possible, both sediment and larval transport related to California project activities would likely be on a smaller spatial scale (i.e., less than 10 miles, or 16.1 kilometers). Project-specific sediment transport modeling would be required to verify this prediction, and the potential transport of benthic invertebrate larvae could be approximated based on sediment transport modeling results.

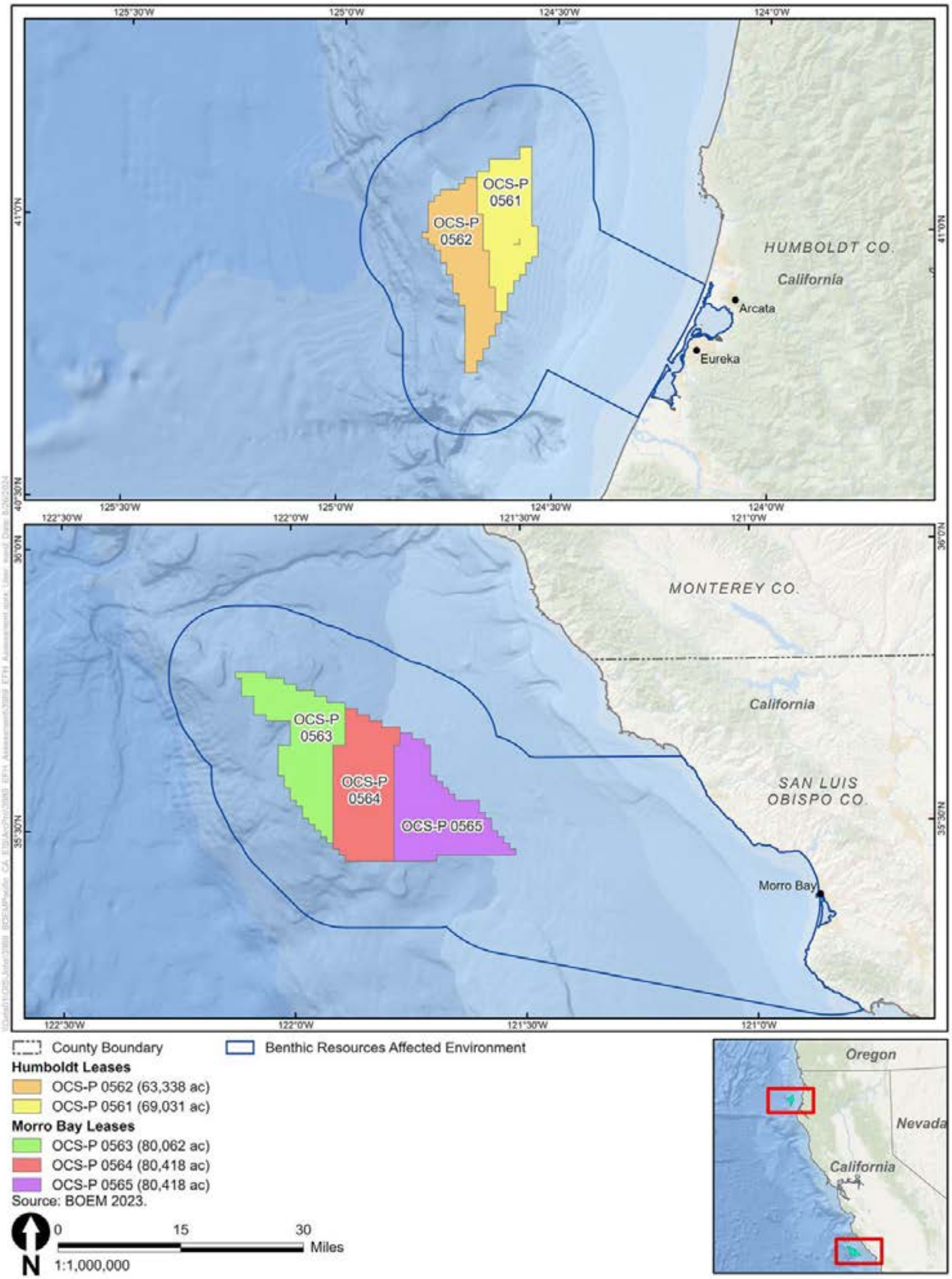


Figure 3.3.2-1. Benthic resources Affected Environment

Upwellings are common during the spring and early summer months, characterized by strong winds from the north and northwest that transport deep ocean water that are high-nutrient, low-oxygen, cold, and saline to the surface ocean in the nearshore environment, including estuaries (Barnhart et al. 1992; Brown and Nelson 2015). In the late summer and fall, mild winds are more common, resulting in reduced upwelling. During this time, the California Current moves warmer, low nutrient, moderately saline waters close to the shoreline. In the late fall and winter months, waters with high oxygen, low salinity, and moderate nutrients are brought into the nearshore waters during storms. These waters often carry high sediment loads, resulting in turbid waters, especially in the nearshore bays and estuaries where river inputs also contribute to suspended sediments (Brown and Nelson 2015). This period is accompanied by strong southerly winds coupled with the northerly-flowing Davidson Current. As a result, water mixes between the seafloor and the surface and result in similar temperature, salinity, and nutrient concentration throughout the water column (NOAA n.d.). Seasonal upwellings are highly productive and provide nutrient-rich water for krill, squid, sardines, and other bait fish low on the trophic food chain. Together with the export production from the sinking of organic matter produced in the photic zone, these processes serve as the foundation of the ocean food web (NOAA n.d.; Sigman and Hain 2012). Interannual climate patterns such as El Niño/La Niña events, which take place every 2 to 7 years, also affect the frequency and volume of upwelling in any given year. Longer timescale climate variability, such as the dual-phased Pacific Decadal Oscillation (PDO), also modulates upwelling strength and thus affects Pacific sea-surface temperature patterns on decadal timescales. The positive phase of PDO exhibits similar behavior to a La Niña event, while the negative phase is similar to an El Niño event, though each PDO phase can last 20 to 30 years.

The California coast is divided into beach compartments called littoral cells (Patsch and Griggs 2006). Littoral cells consist of all sand sources (e.g., tributary rivers, sand eroded from coastal bluffs) and sand sinks (i.e., where sand is lost to submarine canyons and longshore sediment transport) dry, wet, or submerged. Wind and waves move the sand onshore, offshore, and alongshore (Patsch and Griggs 2006). The Eureka littoral cell covers about 40 miles (64 kilometers) in Humboldt County from Trinidad Head to False Cape and is mostly fed by the sediment of three rivers (ICF 2021).

There are limited data available to characterize the sediment conditions of the seafloor in the Humboldt and Morro Bay WEAs (Cooperman et al. 2022). Previous studies that evaluated the geology, bathymetry, and seafloor characteristics of the Affected Environment that are relevant to wind energy development are focused on the assessment of potential geohazards (Tajalli Bakhsh et al. 2020, 2023).

The Pacific coastline has higher seismic risk relative to other sites for proposed U.S. offshore wind. Mapped fault lines occur along the California coast, including in both WEAs (Cooperman et al. 2022). Based on historical earthquake data in the WEAs, there is a significantly higher seismic risk for the Humboldt WEA relative to the Morro Bay WEA (Tajalli Bakhsh et al. 2020; Chapter 2, *Proposed Action and Alternatives*, Table 2-6).

3.3.2.1.1 Humboldt WEA

Offshore Benthic Resources

The Humboldt WEA is on a wide region of the continental shelf called the Eel Shelf. About 90 percent of the sediment along the Eel Shelf comes from the Eel River during winter storms. Major flood events can each result in the addition of 2 to 3.9 inches (5 to 10 centimeters) of deposited silty, clay-rich sediment (Bentley and Nittrouer 2003).

The benthic habitat between 1,312 and 4,921 feet (400 and 1,500 meters) is entirely composed of outer shelf and upper slope habitats. Soft sediment of mud/muddy sand covers most of the seafloor within this area, with sand waves in Trinidad Canyon (Goldfinger et al. 2014). Very few rock/rock mix areas are documented in outcrops, primarily in the central portion of the WEA in a northwest-to-southeast pattern, although smaller areas are throughout (Cooperman et al. 2022). Depths and seafloor slope increase closer to the western boundary, in some places exceeding four degrees, which can lead to slope instability and submarine landslides (Cooperman et al. 2022; Tajalli Bakhsh et al. 2020). The continental margin around the Mendocino fault, south of the WEA, contains more landslides than any other region of the West Coast (Tajalli Bakhsh et al. 2020).

Sediment composition and water depth dictate the benthic community assemblage (Henkel and Gilbane 2020). Filter-feeding invertebrates dominate the sandy sediments of the continental shelf, while deposit-feeding invertebrates dominate the finer silt and clay habitats of the deeper waters (including the continental slope and shelf break) (Henkel et al. 2020). These invertebrates serve a crucial role in the ocean food web for many other demersal species, including some commercially harvested species of flatfish, rays, hagfish, and sablefish.

Special habitats in the region include chemosynthetic communities, cold seeps, submarine canyons, corals, and sponges. Tissue analysis of the organisms from 1,476 to 1,969 feet (450 to 600 meters) water depth confirmed the presence of bacterial chemosynthesis, typical of cold seeps (Kennicutt et al. 1989). NOAA's Deep-Sea Coral Research and Technology Program, which compiles a national database of the known locations of deep-sea corals and sponges, shows the scattered presence of sea pens and sponges in the Affected Environment, including calcareous sponges and demosponges on the eastern edge or just outside of the Affected Environment (NOAA 2023a; Hourigan et al. 2015). These corals, sponges, and sea pens along with oysters (*Crassostrea virginica*), blue mussels (*Mytilus edulis*), and polychaete worms (*Sabellaria vulgaris*) act as ecosystem engineers that build structural complexity in otherwise flat benthic environments and affect community composition (Steimle and Zetlin 2000; Miatta and Snelgrove 2022; Haberlin et al. 2022).

Inshore Benthic Resources

Coastal and inshore habitats and their associated benthic resources along the Northern California shoreline include sandy and coarse-grained beaches, cliffs, shellfish beds, tidal flats, submerged aquatic vegetation (e.g., seagrasses and attached macroalgae), mollusk reef biota, coastal dune systems, barrier island forests, and both saltwater and freshwater marshes. Section 3.3.4 provides more details.

Humboldt Bay is composed of two large bays, the shallow South Bay and Arcata Bay to the north. A long, narrow sand spit and two rubble-mound jetties about 2,000 feet (610 meters) apart separate it from the ocean (USEPA and USACE 2020). Four watersheds drain into Humboldt Bay, making it the second only to San Francisco Bay in size (ICF 2021). Large volumes of fresh water and sediment are flushed into Humboldt Bay, requiring regular dredging to maintain safe navigation (USEPA and USACE 2020). It supports numerous ecosystem services and serves as nursery and foraging habitats for many species including over 400 plant species, 500 invertebrate species, and 100 fish species (ICF 2021). The inland waters contain the Humboldt Bay National Wildlife Refuge and the South Humboldt Bay State Marine Recreational Management Area (SMRMA), which focus on conserving eelgrass and wetland habitats (CDFW 2023a).

The Samoa State Marine Conservation Area protects sand seafloor habitat in nearshore waters 3 miles (4.8 kilometers) west of Arcata. It covers more than 13 square miles (35 square kilometers), including 4 miles (6.4 kilometers) of coastal dune shoreline to water depths of over 150 feet (46 meters). The area includes sand and mud-covered seafloor habitat (CDFW 2023b). Additionally, the South Humboldt Bay SMRMA, located in South Humboldt Bay, is 0.81 square mile (2.1 square kilometers) and made up of coastal marsh, eelgrass, and estuary.

California's kelp forests comprise over 20 different species of algae. CDFW conducted annual aerial surveys of giant kelp (*Macrocystis pyrifera*) and bull kelp (*Nereocystis luetkeana*) (collectively referred to as *kelp*). A 2016 survey of the north region that includes Humboldt Bay showed twice the measured 2015 canopy levels; however, kelp coverage is still below the normal range for the area. CDFW now monitors through satellite remote sensing imagery and this data has shown that kelp coverage has yet to fully recover in many areas along the North Coast of California as of 2022 (CDFW 2024a). Marine kelp has been found in small patches in the mouth of Humboldt Bay along the jetties, as well as just outside of the bay jetties. Kelp presence was found at both the canopy and subsurface levels.

Eelgrass (*Zostera marina*) is the greatest contributor to the primary production that occurs within Humboldt Bay (Gilkerson and Merkel 2017). An estimated 4,700 acres (1,902 hectares) are within Humboldt Bay, which accounts for more than 30 percent of the total eelgrass habitat available along the California coastline (ICF 2021; Schlosser and Eicher 2012). Eelgrass prevents erosion and helps to maintain stability by anchoring sediment with its spreading rhizomes, slowing the flow of water. Eelgrass beds provide foraging, breeding, or nursery areas for invertebrates, fish, and birds, normally growing in fine sand to muddy sediments near the mean lower low water (MLLW) elevation. Within the South Bay, eelgrass grows to a maximum depth of -6.9 feet (-2.1 meters) MLLW, while the maximum depth in Arcata Bay to the north is shallower at -4.3 feet (-1.3 meters) MLLW (Gilkerson and Merkel 2017; ICF 2021). California surfgrass (*Phyllospadix* sp.), known to grow on rocky substrates in intertidal zones, has not been documented in the Affected Environment.

Dungeness crab (*Metacarcinus magister*) is considered the most important benthic species in the area because of its abundance and biomass in inshore habitats, as well as its importance to local commercial and recreational fisheries (H.T. Harvey and Associates 2020). They are mostly found in soft-bottom (sand or mud) habitats from the intertidal zone out to 98 feet (30 meters) water depth. During their molt, they are often found in estuaries and shallow nearshore waters, and greater depths in the spring and fall. Dungeness crab is the largest fishery in the area and the fourth largest in the state (Love et al. 2017).

There are no documented artificial reefs in the benthic resources Affected Environment; however, mollusk reefs are common. Pacific oyster (*Crassostrea gigas*), an introduced species from Japan, is cultivated primarily in aquaculture farms in estuaries, including Arcata Bay. It is the second largest fishery, with about 70 percent of all oysters grown for consumption in-state, produced in Humboldt Bay (ICF 2021).

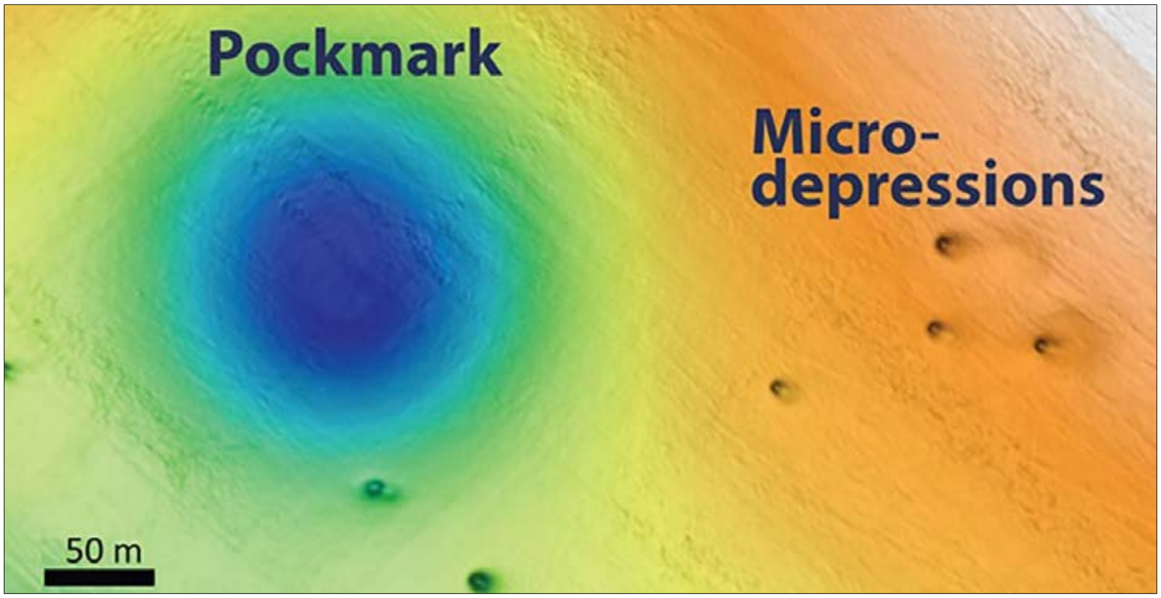
3.3.2.1.2 Morro Bay WEA

Offshore Benthic Resources

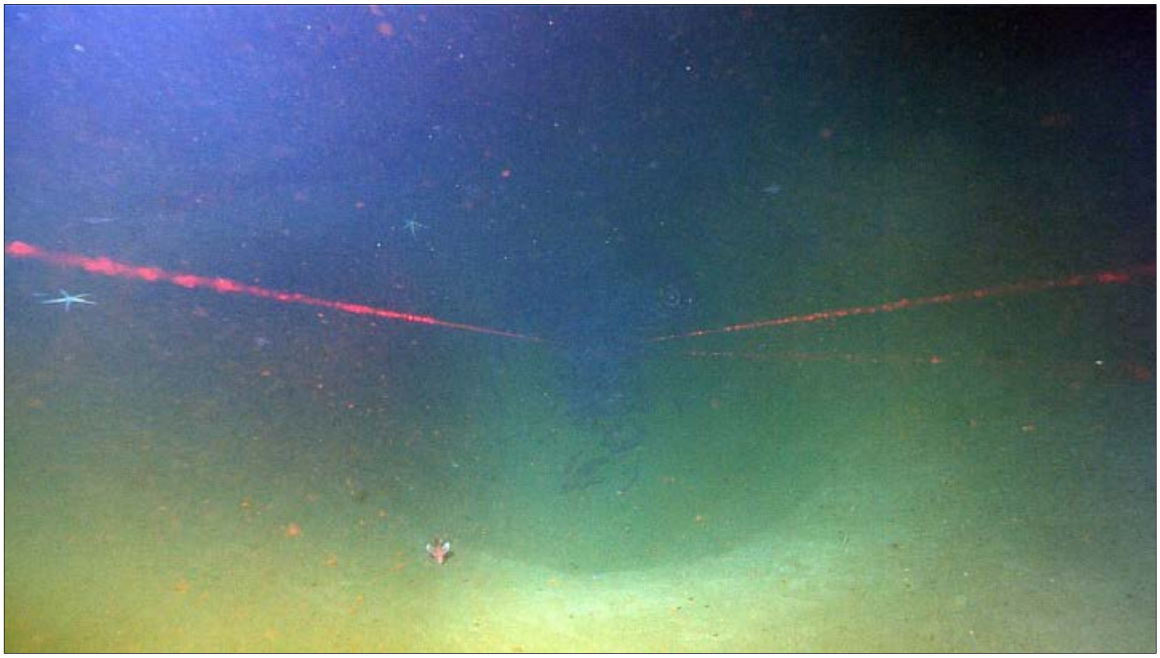
The Morro Bay WEA covers a variety of subtidal habitats with enhanced biodiversity from the merging of the colder northern waters and warmer Southern California waters. Unique habitats in the region include pockmark fields, submarine canyons, and bacterial mats (Cochrane et al. 2023; Kuhnz et al. 2021; Walton et al. 2021).

The Morro Bay WEA is entirely composed of upper slope habitats at water depths between 2,953 and 4,265 feet (900 and 1,300 meters). Soft sediments (e.g., sand, mud) cover most of the area, with hard substrate found on the WEA's western and southern reaches, and infrequently in nearshore waters (Cochrane et al. 2023; Cooperman et al. 2022). Water depth and substrate type influence the composition of benthic communities. For example, sediments on the continental shelf generally consist of sandy habitats nearshore and are dominated by filter-feeding organisms. Progressively deeper environments consisting of silt and clay sediments show an increase in deposit feeders. At the shelf break, where the continental slope begins, the sediment is completely silt and clay (e.g., mud).

Sur pockmark field was identified along with micro-depressions in the WEA (MBARI 2019, 2024a, 2024b). The pockmarks have an average diameter of 600 feet (175 meters), a depth of 16 feet (5 meters), and are nearly circular and evenly spaced (Figure 3.3.2-2) (MBARI 2024a). With over 5,200 pockmarks identified over 500 square miles (1,300 square kilometers), it is the largest pockmark field in North America (MBARI 2019, 2024a, 2024b). The micro-depressions are much smaller, with an average diameter of 36 feet (11 meters) and a depth of 3 feet (1 meter), and they often have an elongated shape and steeper sides (MBARI 2019, 2024a, 2024b) (Figure 3.3.2-2). Benthic species groups in and outside of pockmark features were not distinct (Kuhnz et al. 2021). The escape of fluid or discharge of thermogenic gases from the seabed sediment can develop bathymetric features like mounds, gas hydrates, mud volcanoes, or pockmarks (Ercilla et al. 2021). These features are potential indicators of processes associated with seabed fluid flow, which may cause seabed instabilities (Tajalli Bakhsh et al. 2023). Pockmarks without active methane venting may be maintained and shifted by turbidity currents (Lundsten et al. 2024), which appears to be the case for the Sur pockmark field as no evidence of methane gas has been found (MBARI 2024b).



a)



b)

Figure 3.3.2-2. a) Bathymetric figure comparing the size of micro-depression and pockmark as mapped by the Monterey Bay Aquarium Research Institute in 2019. b) Micro-depression on the seafloor off California (Photo courtesy of MBARI).

There are three statistically distinct biotic groups associated with the soft sediments of the Morro Bay WEA and the surrounding habitat to the shoreline: pom-pom anemones (*Liponema brevicorne*), tube-dwelling anemones (*Cerianthus* spp.), and sea stars (*Asterias* spp.) (Cochrane et al. 2022). Cochrane et al. (2022) found higher biodiversity in areas with greater slope and rugosity. Benthic invertebrate species that inhabit the WEA include echinoderms (e.g., sea cucumbers, sea stars, brittle stars, urchins, crinoids), cnidarians (e.g., sea pens, anemones), and a variety of crustaceans, mollusks, brachiopods, and sponges (Kuhnz et al. 2021). Many of these species provide the base of the ocean food web; some are also commercially harvested.

Structure-forming invertebrates such as corals and sponges were identified, the latter of which provide both habitat and food for other marine species. NOAA's Deep-Sea Coral Research and Technology Program, a national database of the known locations of deep-sea corals and sponges in U.S. waters, shows scattered sea pens and sponges in the Affected Environment, including calcareous sponges and demosponges in nearshore habitats (NOAA 2023a; Hourigan et al. 2015). One record of gorgonian coral is noted along the WEA's western edge. No chemosynthetic communities were observed in the WEA (Kuhnz et al. 2021).

Recent and planned expansions on seafloor protections will benefit the Affected Environment near Morro Bay. The Monterey Bay National Marine Sanctuary affords some protection on water quality and benthic disturbance between the WEA and the coastline. Beginning in 2020, the Amendment 28 Essential Fish Habitat Conservation Areas prohibited bottom trawling in portions of Monterey Bay National Marine Sanctuary waters and the Morro Bay WEA. NOAA's Office of National Marine Sanctuaries is expected to designate the Chumash Heritage National Marine Sanctuary in late 2024/early 2025. The sanctuary was nominated to protect an area of biological significance, as well as rich cultural importance for the Chumash people and other Tribal Nations and Indigenous communities of Central California (NOAA 2023b). See Section 3.4.2, *Cultural Resources*, for more details. Biologically, this area serves as an important ecological transition zone that fosters high productivity. It functions as the source of nutrient-rich upwelling that supports important ecosystems, including kelp forests, rocky reefs, sandy beaches, and unique and rare deep-sea corals and sponges in seamounts and canyons (NOAA 2023b).

Inshore Benthic Resources

Rippled scour depressions provide valuable habitat in a patchy spatial pattern to otherwise soft sediment communities on the inner continental shelf. Comprehensive mapping in state waters revealed that Rippled scour depressions covered nearly as much of the inner continental shelf as the rocky habitat (Hallenbeck et al. 2012). These abundant and widespread features range from hundreds to thousands of square meters and are 12 to 20 inches (30 to 50 centimeters) deep. The depressions contain coarser sediments, longer-period bedforms, and lower mean faunal density and richness of fish and invertebrates than are found on the surrounding seafloor. Rippled scour depressions contain significantly more young-of-the-year rockfishes and small flatfishes than adjacent fine sediments, suggesting a possible nursery function (Hallenbeck et al. 2012).

Morro Bay is a semi-enclosed lagoon estuary that encompasses 2,300 acres (930 hectares) and is connected to Estero Bay by a narrow channel midway between Point Estero to the north and Point Buchon to the south (Gerdes et al. 1974; Morro Bay National Estuary Program 2022a). Two streams feed into the lagoon and form a delta encompassing an area of salt marsh. Small sections of rocky shore exist on the seaward side of Morro Rock. Hardened shore structures were placed near Morro Rock, at the bay entrance, including the docks along Embarcadero Road. The benthic substrates in nearshore waters of

Estero Bay are classified as hard bottom near the shoreline but transition to soft sediment within 1 or 2 miles (1.6 or 3.2 kilometers) of the shore. Coastal and inshore habitats include the sandy beaches of Estero Bay and those in Morro Bay, the latter of which are composed primarily of coastal marsh, eelgrass beds, and tidal flats. North and south of Estero Bay, the shore is primarily a rocky coastline. Section 3.3.4 provides more details on inshore habitats.

The Pacific marine heatwave from 2013 to 2016 affected many species, including eelgrass (Magel et al. 2022). Following this anomalous warming of offshore waters, the Morro Bay National Estuary Program planted nearly 15,000 eelgrass over 5 years to boost recovery, which had declined more than 90 percent, to a minimum of only 13 acres (5.3 hectares). These restoration efforts likely contributed to 500 acres (202 hectares) of eelgrass mapped as of December 2021, even higher than before the heatwave (Morro Bay National Estuary Program 2022b).

Kelp was also affected by the marine heatwaves (Magel et al. 2022). Kelp is found north of Morro Bay as a canopy, with subsurface kelp mapped along the south-facing coastline of Estero Bay from Point Estero to Mouse Rock. Kelp density fluctuates along the Central California coastline, and some recovery of kelp cover has been observed along the central coast since 2014 (CDFW 2023c; Kelp Watch 2024). Satellite imagery has indicated that kelp populations have recovered since the 2013–2016 heatwave in parts of Central and Southern California, but Northern California kelp forests have not recovered (Kelp Watch 2024). Kelp forests exhibit high species diversity and provide high-value habitat for many marine species including invertebrates, fish, mammals, and birds. Some species graze directly on the algae as it grows while others consume the detached blades, or the detritus through filter feeding.

Grazers such as sea urchins can be devastating to kelp forests when they occur in large numbers. Keystone predators such as sea otters (*Enhydra lutris*) and sea stars may help minimize sea urchin population spikes, when present in a stable and balanced ecosystem. Massive die-offs of sea stars, like those caused by sea star wasting syndrome which occurred along the Pacific Coast in 2013 and 2014 (MARINe 2023; Di Lorenzo and Mantua 2016), likely played a role in destabilizing sea urchin populations, which led to heavy grazing on kelp. These sharp declines in kelp density can negatively influence associated species such as abalone (Rogers-Bennett et al. 2021). In 2017, kelp deforestation triggered mass abalone mortality (80 percent), forcing the closure of the recreational abalone fishery and the commercial red sea urchin fishery in Northern California (Rogers-Bennett and Catton 2019).

Two artificial reefs nearshore provide valuable habitat to marine invertebrates and fish that prefer to associate with hard substrate. The Atascadero Artificial Reef is composed of 0.4 acre (0.2 hectare, 3,500 tons) of quarry rock placed in 55-foot (~17-meter) water depth at the end of a subsea pipeline about 2 miles (3.2 kilometers) north of the Morro Bay entrance constructed in 1985 (Lewis et al. 2001a). The San Luis Obispo County Artificial Reef is much larger, at 13 acres (5.3 hectares), located in the southern section of the Affected Environment in water depths of 42 to 52 feet (13 to 16 meters) constructed of 27,000 tons of concrete tribar and rubble between 1984 and 1985 (Lewis et al. 2001b).

Like the offshore benthic habitats, inshore environments are sacred to native people. For example, Morro Rock, also referred to as the Gibraltar of the Pacific, is sanctified to the Santa Ynez Band of

Chumash Indians, protected as part of the Morro Bay State Park, and is a recognized California landmark (Reese 2022).

3.3.2.2 Impact Background for Benthic Resources

Accidental releases, anchoring, cable installation and maintenance, discharges/intakes, EMFs and cable heat, noise, port utilization, and presence of structures contribute to impacts on benthic resources. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.3.2-1.

Refer to Section 3.1.2, *Impact Terminology* regarding beneficial impacts.

Table 3.3.2-1. Issues and indicators to assess impacts on benthic resources

Issue	Impact Indicator
Underwater noise	Qualitative estimate of potential disturbance, injury, or mortality of infauna and epifauna based on extent, frequency, and duration of noise.
Crushing, deposition, and entrainment	Estimated extent of potential disturbance, injury, and mortality-level effects on infauna and epifauna from dredging, crushing, or burial by construction equipment and materials placement; entrainment by construction equipment and OSS cooling systems; and burial effects from suspended sediment deposition.
Seabed profile and water column alteration	Effects on water column and benthic habitats from habitat displacement by structures, anchors, export cable installation and maintenance, habitat modification by placement of scour protection and concrete mattresses, and alteration of soft-bottom or complex benthic habitat function.
Water quality impacts	Duration and intensity of suspended sediment impacts, accidental spills, and releases of trash and debris.
Power transmission	Exposure above ambient EMF levels based on extent, duration, and proximity of contact with or exposure to infrastructure; species sensitivity.[1]
Invasive species	Qualitative estimate of sources of invasive species, introduced habitat, and propagation or expansion of invasive species.

[1] EMF sensitivity varies widely; no effect threshold guidance has been established. The minimum EMF levels needed to produce behavioral responses observed in available research are one or more orders of magnitude larger than the anticipated EMF effects likely to result from the California offshore wind projects. Electrosensitive fish can detect low-frequency bioelectric fields at very weak levels but are unable to detect higher-frequency fields greater than 20 Hz (Bedore and Kajiura 2013).

3.3.2.3 Impacts of Alternative A – No Action – Benthic Resources

When analyzing impacts of the No Action Alternative on benthic resources, BOEM considered the impacts of ongoing activities on baseline conditions for benthic resources.

The cumulative impact analysis of the No Action Alternative considers the impacts of the No Action Alternative and other planned activities on existing baseline trends (Appendix C, *Planned Activities Scenario*).

3.3.2.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for benthic resources would continue to follow regional trends and respond to other ongoing activities in the Affected Environment. Ongoing activities that can affect benthic resources include bottom-tending commercial fishing gear, dredging for navigation, scientific research, discharges/intakes, and submarine cables. Ongoing noises produced from these activities can also have impacts on benthic species.

Climate change is anticipated to play a major role in the future of California's benthic resources by creating changes in temperature, precipitation, pH, oxygen levels, ocean circulation, nutrient availability, and storm frequency and severity. Corals, sponges, mollusk reefs, and submerged aquatic vegetation are susceptible to changes in water quality, physical disturbances, increased sedimentation, loss of habitat, and introduction of invasive species. Sessile and slow-moving species may have limited ability to relocate and avoid the rapid onset of adverse conditions; and may experience range retractions rather than shifts. Alternatively, relatively sessile species may adjust if an environmental change is gradual.

Furthermore, marine heatwaves are becoming more frequent. During 2013 and 2014, the area of the northeast Pacific sea-surface temperature anomaly was so large that it became known as "The Blob" (Bond et al. 2015). The 2019 marine heatwave in the north Pacific became the second greatest ever recorded. The heatwave of 2023 was the fourth largest by area and the fifth longest in duration since monitoring began in 1982 (NOAA 2024). Distribution and abundance of species have shifted to the north following heatwave events, which may affect ecosystem structure and function (Lonhart et al. 2019; Weber et al. 2021). Additionally, warming ocean temperatures and other climate change–related factors may induce favorable environmental conditions for invasive species (Zhang et al. 2020).

3.3.2.3.2 Cumulative Impacts of the No Action Alternative

Planned activities in the Affected Environment that contribute to impacts on benthic resources include new submarine cables and pipelines, port expansion projects, and designation of the Chumash Heritage National Marine Sanctuary (Appendix C).

Accidental releases: Increases in vessel traffic would increase the risk of accidental releases from ongoing and planned activities. Accidental releases usually consist of fuels, lubricating oils, and other petroleum-based compounds, which tend to float in seawater or are highly soluble and would occur at or near the ocean surface. They are unlikely to contact benthic resources in offshore waters. Releases in shallow waters may cause habitat contamination from releases (e.g., adsorption of spilled hydrocarbons to suspended sediments, and subsequent sinking). Cleanup activities could cause harm to sensitive habitats and species. The Humboldt WEA Affected Environment is entirely within a military operating area, which may increase the risk of accidental releases during at-sea training. The Chumash Heritage National Marine Sanctuary would restrict allowable discharges into the waters south of the Morro Bay WEA, likely enhancing overall water quality. Although vessels may release trash and debris, such impacts would be small in scale.

Anchoring: Anchoring from commercial, recreational, and military vessels would have temporary to permanent impacts where anchors and chains contact the seafloor. Sessile and slow-moving species would be most likely to be affected by anchoring. Impacts would be localized, with short-term elevated turbidity and mortality of soft-bottom benthic resources that are likely to recover relatively quickly (Dernie et al. 2003; Kraus and Carter 2018). In complex or gravel habitats or sensitive habitats (i.e., eelgrass beds, kelp forests, and mollusk reefs), recovery is expected to take longer. The Chumash Heritage National Marine Sanctuary will restrict permanent anchoring, providing some protection from bottom disturbances and turbidity.

Cable installation and maintenance: Submarine cable installation and maintenance would increase sedimentation, affecting benthic organisms. The sedimentation tolerance for benthic organisms varies among species, with sensitivity to burial determined primarily by infaunal feeding and motility type (Trannum et al. 2010; Jumars et al. 2015; Bigham et al. 2021). The sensitivity threshold for shellfish varies by species but is generally a deposition greater than 0.79 inch (20 millimeters) (Essink 1999; Colden and Lipcius 2015; Hendrick et al. 2016). Smit et al. (2008) evaluated the significance of depositional thickness on impacts on benthic communities and found that sediment deposition of 2.13 inches (54 millimeters) affected 50 percent of the benthos in the study, and a sediment burial thickness of 0.25 inch (6.3 millimeters) affected 5 percent of the studied benthos. Impact severity would depend on the time of year, especially if it overlaps temporally and spatially with sites with high benthic organism abundance and diversity. Sedimentation would result in local and short-term disturbances, which could have long-term negative effects on eggs and larvae of demersal and benthic species. Accordingly, cable installation and maintenance would contribute to cumulative impacts.

Cable-protection measures are required to guard unburied cables and prevent abrasion with other cables and would introduce hard substrate. Hard-bottom habitats serve as grounds for spawning, settlement, nurseries, and foraging and generally support higher species densities than surrounding habitat types, although not all species benefit from hard-bottom habitats (Flávio et al. 2023). At a local level, the addition of infrastructure can increase the relevance of hard-bottom fauna, influence food webs, and attract species preying upon these taxa. The biodeposition from these structures is expected to increase benthic biomass and biodiversity (Pohle and Thomas 2001; Fautin et al. 2010; Raoux et al. 2017; Kerckhof et al. 2019; Degraer et al. 2020; Coolen et al. 2022; Danovaro et al. 2024). The addition of new hard-bottom substrate in a predominantly soft-bottom environment may provide localized, incidental benefits for hard-bottom species but would negatively impact soft-bottom-associated species.

Natural causes of sedimentation include tsunamis and powerful storms, which can create scour while approaching the shoreline and benthic impacts similar to those created by cable installation.

Discharges/intakes: Permitted offshore discharges include uncontaminated bilge water, ballast, gray water, and treated liquid wastes. Upon designation in late 2024/early 2025, the Chumash Heritage National Marine Sanctuary would enhance protections in portions of the Affected Environment with regulations on discharges (NOAA 2023b). Pathogens may also be spread through discharged water, such as the yet-to-be-identified pathogen for sea star wasting syndrome, which is believed to be transmitted via direct contact, and indirectly through water. The syndrome heavily affected the sunflower sea star (*Pycnopodia helianthoides*), now proposed for federal listing as threatened under the ESA (NMFS 2023). Although generally found in waters shallower than 120 feet (36.6 meters) they can live as deep as 1,400 feet (427 meters) (NMFS 2023).

Water intake activities increase the risk of entrainment and impingement. *Entrainment* occurs when organisms pass through screens and enter the cooling water system. *Impingement* occurs when organisms too large to pass through the mesh are held against the screens by the water pumped through. The Diablo Canyon Power Plant (south of Morro Bay) draws in 1.74 million gallons (6.59 million liters) of seawater per minute to provide cooling for the nuclear power plant (Tenera Environmental Services 1997). Entrainment studies found that the larvae from deepwater species were not entrained in significant amounts; the highest was the northern anchovy (*Engraulis mordax*), at a maximum of 120,000 adults per year. However, nearshore species such as sculpins, kelpfish, blackeye goby (*Rhinogobiops nicholsii*), and monkeyface prickleback (*Cebidichthys violaceus*) showed relatively high larval loss (Central Coast RWQCB 2000; Tenera Environmental Services 2000). Once entrained, larval mortality was assumed to be 100 percent. After passing through the cooling water system, roughly 2.5 billion gallons (9.5 billion liters) of heated water (approximately 20°F [11°C] above ambient ocean temperature) is subsequently discharged directly into the ocean at Diablo Cove (Tenera Environmental Services 1997). Furthermore, dredging activities using a suction hopper dredge would increase the risk of entrainment of Dungeness crabs, shrimp, shellfish, and fishes. Water intake pumps on these dredges can entrain adult organisms, differing from the more widely known coastal power plant cooling water intake entrainment of eggs and larvae (Reine and Clarke 1998).

EMFs and cable heat: EMFs would result from ongoing and planned transmission or communication cables, natural processes, and impressed current cathodic protection (ICCP) systems. Power cables in offshore environments use either HVAC or HVDC. In DC cables, the main components involved in EMFs are the core (the conductor) and the sheath of the cables. For AC, the spacing of the conductors and the alternating magnetic fields induce alternating electric fields (Gill et al. 2023).

To date, no studies have been conducted examining the effects of EMF from ICCP on benthic resources and research is anticipated.

EMF is also naturally occurring and pervasive in the marine environment through the Earth's geomagnetic field and local EMF distortions in the surrounding environment (Williams et al. 2022). The Earth's magnetic field has field strengths varying between 30 and 70 microteslas (300 and 700 milligauss) (Hermans and Schilt 2022). Wave action also induces electrical fields (10 to 100 microvolts per meter) and magnetic fields (0.1 to 1 microtesla [1 to 10 milligauss]) at the water surface, depending on wave height, period, and other factors (Slater et al. 2010).

Recent reviews by CSA Ocean Sciences Inc. and Exponent (2019), Albert et al. (2020, 2022), Gill and Desender (2020), and Bilinski (2021) of the effects of EMF on marine organisms in field and laboratory studies concluded that measurable, though minimal, effects can occur for some species, but not at the relatively low EMF intensities representative of marine renewable energy projects. No biologically significant impacts on benthic resources have been reported from EMF from AC cables (Thomsen et al. 2016; CSA Ocean Sciences Inc. and Exponent 2019), and no differences in the invertebrate community were noted between energized (around 100 microtesla [1,000 milligauss]) and non-energized cables in the Pacific (Love et al. 2016). A review conducted by Gill and Desender (2020) found that benthic communities along cable routes are generally similar to nearby undisturbed habitats.

The maximum current that a cable can carry without exceeding its temperature rating (ampacity) is influenced by the heat transfer in the surrounding marine environment (Callender et al. 2020). Models show that the permeability of the sediment where the cable is placed is an important factor with ambient water temperature, burial depth, and spacing between cables affecting the ampacity of DC submarine cables (Mardiana 2011). The effects of EMFs and cable heat on most invertebrate taxa (embryonic and juvenile crustaceans and mollusks) remain understudied (Gill and Desender 2020), but studies to date indicate relatively low potential for impacts.

Gear utilization: Gear utilization by ongoing commercial and recreational fishing and scientific research would continue to affect benthic resources by modifying the nature, distribution, and intensity of fishing-related impacts, including those that disturb the seafloor (e.g., trawling, dredge fishing). Disturbance of benthic invertebrate communities and over-exploitation by commercial fishing activities can adversely affect community structure and diversity, abundance, and biomass and limit recovery (Thrush et al. 1998; Thrush and Dayton 2002; Kaiser et al. 2002; Hinz et al. 2009; Avanti Corporation and Industrial Economics 2019; Haberlin et al. 2022; Pitcher et al. 2022), although this impact is less notable in sandy areas that are strongly influenced by tidal currents and waves (Nilsson and Rosenberg 2003; Sciberras et al. 2016). Bottom-tending fish gear would result in repetitive impacts. Trawling in sensitive habitats could have detrimental impacts especially for slow-growing species.

Invasive species: Invasive species and marine diseases (Dahlgren et al. 2021) can be accidentally introduced or spread during ballast and bilge water discharges from marine vessels or from biofouling on hulls (Costello et al. 2022). Once established in the region, invasive species such as *Watersipora subatra*, a bryozoan fouling species, have been found to quickly colonize available hard surfaces on oil and gas infrastructure in Southern California (Viola et al. 2018; Page et al. 2019). Other well-known invasive species of the California coastlines include the European green crab (*Carcinus maenas*), Asian kelp (*Undaria pinnatifida*), and the clubbed tunicate (*Styela clava*) (CDFW 2024b). Aquatic alien invasive species costs were estimated in the United States at $23 billion in 2020 (Cuthbert et al. 2021). The trans-oceanic shipping industry has also increased the spread of invasive species worldwide.

Noise: Ocean noise is produced by biological, environmental, and anthropogenic sources. Weather conditions and geological process also contribute to the ocean soundscape (Duarte et al. 2021). Anthropogenic noise sources include vessel traffic, seismic surveys, active sonar used for navigation of large vessels and chart plotting, construction, impact and vibratory pile driving, G&G survey activities, and military activities. Increased noise will occur in inshore waters because of port expansion projects. Noises produced by these various sources include impacts from sound pressure and particle motion. Appendix H, *Background on Underwater Sound*, provides more details. Currently, there are no underwater noise thresholds for invertebrates, but the effect ranges are expected to be like those predicted for fishes without swim bladders described in Appendix H.

Ongoing activities along the Southern California coast include the use of seal bombs as deterrents in fisheries. The underwater charges are broadband in frequency, with sound exposure level source levels between 190 and 203 dB re 1 $\mu Pa^2 m^2 s$. Acoustic data collection (in Southern California and near Monterey Bay) recorded high charge volume (up to 2,800 per day) (Krumpel et al. 2021). UXOs on the seabed may be encountered during ongoing and planned activities. If encountered, the UXOs may be left alone, shifted, removed, or detonated. Detonation generates a shock wave with extreme changes in pressure, both positive and negative.

There is a knowledge gap regarding sound thresholds and recovery from impacts in almost all invertebrates (Carroll et al. 2017). Fish and invertebrates that lack swim bladders are more resistant to underwater blasts, which cause the rapid expansion and contraction of gas-filled spaces like swim bladders and result in the greatest physiological injury (Goertner et al. 1994). English et al. (2017) also reported that noise at high levels can cause short-term behavioral responses in marine invertebrates. All bivalves tested to date have been shown to behaviorally respond to sound, with responses in the frequency band width of roughly 10 to 1,000 Hz. Overall, studies conclude that invertebrates are resilient to pressure-related damage from underwater explosions. Many previous studies relied on effects from sound pressure but did not focus on the potential effect of particle motion (Hawkins and Popper 2014, 2017). Although these gaps exist, current studies concerning the effects of noise on invertebrates suggest low potential for impacts on benthic species.

Port utilization: Increases in port activity include planned expansion projects, which would disturb benthic habitats in inshore waters through construction and maintenance dredging.

Annual dredging of Humboldt Bay navigation channels removes about 1 million cubic yards (about 765,000 cubic meters) of material from the entrance channel alone, using large and small dredge hoppers and mechanical or pipeline dredges (USEPA and USACE 2020). Morro Bay conducts similar maintenance dredging (USACE 2013). Inshore projects increase water turbidity and can reduce the light eelgrass and kelp need for photosynthesis. Sediment deposition can bury young kelp, eelgrass, benthic invertebrates, and fish and invertebrate eggs. Impacts on benthic resources from port utilization would be localized and would occur in areas that are largely already disturbed.

3.3.2.3.3 Conclusions

Impacts of Alternative A. BOEM expects ongoing activities such as repetitive channel deepening, dredging, trawling for commercial fisheries, and the ongoing installation and maintenance of submarine cables to have short-term, long-term, and permanent impacts via disturbance, displacement, injury, mortality, and habitat conversion. Impacts on species are unavoidable but are not expected to result in population-level effects, especially if sensitive habitats are avoided and disturbances are temporally and spatially distributed.

Cumulative Impacts of Alternative A. Benthic resources would continue to be affected by natural and anthropogenic factors including existing environmental trends, ongoing activities, and planned activities such as port expansion projects and designation of the Chumash Heritage National Marine Sanctuary. Short -term to permanent habitat disturbance in the benthic community would occur from cable installation and port expansion projects, especially for inshore habitats and species.

3.3.2.4 Impacts of Alternative B – Development with No Mitigation Measures – Benthic Resources

The analysis of Alternative B considers the impacts on benthic resources from the development of one representative project in the Humboldt WEA and one in the Morro Bay WEA without the adoption of mitigation measures. The analysis of Alternative B also considers the impacts on benthic resources from the development of five representative projects (two in the Humboldt WEA, and three in the Morro Bay WEA) to evaluate the overall impacts of a full offshore wind build-out in the subject WEAs without the adoption of mitigation measures.

ESA Section 7 consultation with NMFS would be conducted for each project, and it is assumed that the Letter of Authorization would include mitigation requirements that would reduce impacts.

3.3.2.4.1 Impacts of One Representative Project in Each WEA

Accidental releases: The risk of accidental release would increase during construction or decommissioning but may also occur during O&M for one representative project. Diesel spills from vessels or maintenance activities on the OCS are relatively rare and small with the median size for spills of 1 barrel or less (42 gallons [159 liters]) to be 0.024 barrel (approximately 1 gallon [3.8 liters]) (Anderson et al. 2012). While accidental releases of trash and debris may occur, the anticipated volumes or amounts of trash or debris would not have measurable impacts on benthic resources. The low likelihood and limited extent and duration of the potential releases along with the cleanup measures in place suggest impacts on benthic resources would be localized and temporary.

Anchoring: Short-term impacts would occur from the increase in vessel anchoring during construction, O&M, and decommissioning. Any contact with benthic habitat for vessel stabilization or buoy anchoring would create pits and furrows on the seafloor, cause localized increased turbidity levels, and have the potential for mortality of benthic species that are in the construction pathway. Anchor drag would increase impacts, potentially resulting in scarring and additional damage (Maxwell et al. 2022). The estimated recovery time for benthic communities could range from months to years depending on factors such as water depth, scarring depth, sediment type, and community composition (Dernie et al. 2003; Sciberras et al. 2016; Broad et al. 2023). Anchoring on hard-bottom (i.e., gravelly) substrates would likely cause longer-term impacts. Studies of bottom-contacting fishing gear have shown that any level of impact in deep-sea benthic communities is harmful because the communities are not well adapted to frequent disturbance. Although no studies have been completed that assess the impacts of anchoring on deep-sea corals or sponges, it is assumed that the ecosystem damage recorded in tropical environments would be similar (Maxwell et al. 2022). BOEM expects the impacts from temporary vessel anchoring would be short term.

Long-term to permanent impacts would occur from the presence of mooring anchors associated with one representative project. The seabed contact area would range from 0.05 to 75 acres (0.02 to 30 hectares) per WTG or OSS depending on the selected mooring type and configuration (Chapter 2, Table 2-2). Catenary mooring systems would have the largest benthic footprint (Maxwell et al. 2022). These additional structures would result in new hard surfaces that could provide new hard-bottom species recruitment. The impacts from these long-term anchors would remain for the life of the project, if not longer. If anchor chains or cables sweep across the seafloor, sediment can be suspended and carried by the prevailing current, possibly affecting surrounding benthic communities through locally increased levels of turbidity. Overall, the maximum area affected by long-term to permanent anchors is expected to be roughly 20 to 25 percent of the benthic habitat in each WEA. The ecological impact of the anchors penetrating the seafloor is expected to be insignificant on soft bottoms without vulnerable megafaunal assemblages (Danovaro et al. 2024). Additionally, metocean buoys would be placed in each WEA to assess meteorological and physical oceanographic conditions, although these would be a temporary deployment and affect small areas (100 square feet [9.3 square meters]) of the seafloor in the WEAs.

Cable installation and maintenance: Array cables would be floating between WTGs, while the export cables would likely affect the benthic habitats in offshore, nearshore, and inshore waters.

The maximum case benthic disturbance from the export cable installation would be up to 16.1 square miles (41.6 square kilometers) from the maximum eight export cables (Chapter 2, Table 2-2). Installation impacts on benthic invertebrate species and habitats are expected to be temporary and localized to the cable corridor. If impacts occur, they may result in the loss of a few individuals relative to the population of the species. The Monterey Accelerated Research System cable, a smaller and less powerful cable than a typical offshore wind export cable, was installed from Monterey Bay to the continental shelf (Howe et al. 2006; MBARI 2024c). Post-installation surveys showed minor or undetectable changes in the benthic community within 64 to 328 feet (50 to 100 meters) from the cable. Long-term monitoring over 13 years showed that natural variability had a greater impact on the distribution and density of benthic macrofauna and megafauna than the cable installation (Kuhnz et al. 2021). The results of this study suggest that impacts on benthic communities from the installation of offshore wind export cables are likely to be localized and short term.

Discharges/intakes: Discharges and intakes could occur during all project phases from vessel activities, HVDC converters, and hydraulic dredging. Offshore discharges are regulated and include uncontaminated bilge water and treated liquid wastes. If hydraulic dredging or offshore converter stations are used in Alternative B, they could increase entrainment and impingement of larvae and juvenile benthic invertebrates and fish. Hydraulic dredge entrainment of adult fish generally results in lower mortality rates compared to the entrainment of eggs and larvae (Wenger et al. 2017), which typically succumb to sediment smothering, desiccation, or starvation, even if they survive the mechanical forces (Reine and Clark 1998). HVDC converter intakes on up to six OSSs would be required if HVDC cables are used for each representative project. HVDC converters with open loop cooling systems intake cool seawater and discharge warmer water, with minimal thermal effect (Woods Hole Group 2021; Middleton and Barnhart 2022). If the intake velocity is low (≤ 0.5 ft/s^{-1}; 40 CFR 125.84), most strong swimming juvenile fishes and smaller adults would be able to escape entrainment or impingement. However, drifting plankton would not be able to escape entrainment except for a few fast swimming larvae. Those organisms entrained may be stressed or killed, through mechanical damage or by changes in water temperature. CWA Section 316(b) requires NPDES permits to ensure the location, design, construction, and capacity of cooling water intake structures reflect the best technology available to minimize adverse environmental impacts. The operation design and technology used can help minimize or even eliminate impacts on juvenile and adult fish (Woods Hole Group 2021). For example, adjusting the intake pipe opening depth and pump system velocity can mitigate effects on invertebrate and benthic species (Middleton and Barnhart 2022). However, the current HVDC system design will likely cause a decrease in larvae, negatively affecting food supply (Middleton and Barnhart 2022) and recruitment and dispersal of larval life stages. Impacts from water intakes/discharges would be staggered over time and primarily localized. BOEM expects discharges/intakes impacts on benthic resources to be long term unless HVDC technology improves.

EMFs and cable heat: Both HVAC and HVDC technologies could be considered for offshore export cables. Additionally, ICCP systems could potentially be used on the WTG and OSS structures (Jessup 2015). The biological impacts from EMFs, cable heat, and ICCP systems is based on: (1) the amount of electrical current being generated or carried by the cable, (2) generator and cable design, including cable burial depth and protections, and (3) the distance of organisms from the generator or cable. The strength of the EMF rapidly decreases with increasing distance from the cable (Taormina et al. 2018), but is considered a long-term impact, as it is expected to be present in the environment for the life of the project.

EMF production from power transmission cables can be detected by some benthic species but does not appear to present a barrier to movement. Field studies conducted offshore California near energized cables showed no significant differences in species diversity or density in benthic invertebrate communities compared to unenergized cables or natural habitat (Love et al. 2016), which matched findings from a literature review (Gill and Desender 2020). Dungeness crab and red rock crab (*Cancer productus*) crossed the energized cable without issue (Love et al. 2017), and yellow rock crabs did not respond to EMFs (Love et al. 2015). Love et al. (2015) also showed that EMFs fell to background levels within 3.3 feet (1 meter) of the cable. Laboratory experiments exposing American lobster and Dungeness crab to EMFs and found that EMFs did not affect behavior (Woodruff et al. 2012). In Europe, monitoring studies of EMFs from wind farms have shown minimal, if any, effects on marine organism behavior or movement in part because EMFs produced by electrical cables tend to be restricted to an area of several meters from the cable (Sharples 2011).

Copping et al. (2016) found no evidence that the EMFs emitted from offshore wind activities would affect any species, despite potential for borrowing infauna to be exposed to stronger EMFs. Mobile species cease to be affected when they leave the affected area; however, there is no information on whether prior EMF exposure would influence the impacts of future exposure. Potential responses to EMFs by crustaceans and mollusks could include navigation interference that relies on natural magnetic fields, predator/prey interactions, avoidance or attraction behaviors, and physiological and developmental effects (Hutchison et al. 2018; Taormina et al. 2018; Normandeau et al. 2011).

Cable heat could alter benthic community structure, composition, and availability by displacing species laterally or vertically due to changing sediment temperatures. However, the physical extent of these effects would be limited relative to the unaffected foraging habitat available. AC cables emit more heat than DC cables at equal transmission rates. Sediment heat from two AC cables (33 kV and 132 kV) conducted at the Nysted wind farm in Denmark showed a maximum temperature difference of 4.5°F (2.5°C) (Taormina et al. 2018). While buried submarine cables can warm the surrounding sediment, impacts on bottom-dwelling organisms would be insignificant and localized around the cable. The water flow around dynamic cables, such as the array cables, dissipates thermal energy and confines the heat changes to the cable surface (Taormina et al. 2018).

While seafloor sediments do not shield magnetic fields, power cable burial substantially reduces the levels of EMFs. BOEM expects localized and long-term impacts on benthic resources from cable heat and EMFs; however, further research is needed in this field to better determine the effects of EMFs on benthic fauna.

Gear utilization: If used, bottom-contacting survey or monitoring gear for site assessment, monitoring, and post-construction surveys would affect the benthic resources by disturbing habitat and injuring, killing, collecting, or entangling benthic invertebrates and fish. The presence of floating structures, cables, mooring lines, and anchors from offshore wind activities would increase the risk of gear loss or damage by entanglement for certain sectors of the fishing industry. Impacts at any one location would likely be intermittent and long term while the structures are present.

A common method for retrieving lost gear involves dragging grapnel lines along the bottom until lost gear is caught. After the line catches the lost equipment, it will drag all the components along the seafloor until the gear is recovered, resulting in additional benthic impacts. The geographic distribution, temporal spacing, and recovery speed (Dernie et al. 2003) of these impacts would likely be unmeasurable. However, at water depths present in the WEAs and with floating interarray cables and mooring systems in place, dragging of grapnel lines may not occur. Instead, lessees may use a combination of divers and ROVs and these retrieval methods would not affect the seafloor or benthic resources.

Invasive species: Invasive species can be introduced from increased vessel traffic during construction and decommissioning. In the North Sea, invasive species have used offshore wind infrastructure as stepping stones to expand their range (De Mesel et al. 2015; Adams et. al. 2014). However, the WEAs are much further from the California coastline and in significantly deeper waters than the WTG locations in the North Sea. Marine disease can also spread from increased vessel traffic via pathogens carried in ballast water and marine fouling on the hull of the vessels. There is a Ballast Water Management (BWM) convention in place through the International Maritime Organization (IMO) designed to minimize the transport of nonnative species between ports. In addition to the BWM convention, the use of local ports as described in the RPDE significantly limits the risk of transporting invasive species. Although invasive species may be present on the floating infrastructure near the water's surface, it is unlikely these same species would be introduced and survive in the benthic environment in the offshore WEAs.

Once operational, timing of maintenance can be important in limiting the spread of any invasive species, especially those attached to the offshore infrastructure. Viola et al. (2018) found that scheduled maintenance of oil platforms in Central and Southern California that occurred after the reproductive period of *Watersipora* allowed enough time for native species to recolonize the bare surfaces disturbed during maintenance.

Noise: Many activities associated with all project phases in each WEA could cause underwater noise, including vessel traffic, G&G surveys, impact and vibratory pile driving, drilling, trenching, cable laying and dredging, and underwater detonations. O&M noise sources include vessel traffic, WTG rotors and blades, and WTG floating platforms and moorings (chains).

Noise (G&G surveys): Noise from G&G surveys of cable routes and other site characterization surveys disturb benthic resources in the immediate vicinity and cause temporary behavioral changes in invertebrate and benthic species. Equipment employed during site characterizations (shallow- and medium-penetration sub-bottom profilers, side-scan sonar, multibeam echosounder, and magnetometer) produce noise in the 1.1- to 200-kHz frequency range and generate sound waves that are similar to common deepwater echosounders. Impacts from vessel and equipment noise, including geotechnical sampling (e.g., coring) are expected to be unmeasurable.

Noise (impact and vibratory piling): Pile driving or drilling may be required for TLP foundations, anchoring, and to connect offshore export cables to onshore landings via HDD. Noise from drilling for anchor moorings is expected to be comparable to other drilling activities, which have been measured up to 145 dB re 1 µPa m from a jack-up platform (Erbe and McPherson 2017), and up to 162 dB re 1 µPa m from an anchored drilling vessel (Huang et al. 2023). In nearshore waters, temporary goal posts or cofferdams would require pile driving to accommodate the conduit used to pull the export cable through. Recent studies conducted on the responses from longfin squid (*Doryteuthis pealeii*) to pile driving showed short-term alarm responses such as high acceleration jet propulsion (Cones et al. 2022), startling, and inking (Jézéquel et al. 2023) only near the pile-driving activities where received particle acceleration root-mean-square levels were measured to be approximately 95.79 dB re 1 µm s^{-2}. No alarm responses were observed for squid 164 feet (50 meters) away, and all responses were only observed during the first pile-driving sequence (Cones et al. 2022; Jézéquel et al. 2023). This indicates these species may become habituated and suggests only short-term effects would be expected, which may be similar to expected responses from California market squid (*Doryteuthis loligo*). Also, deepwater, floating turbines can be constructed onshore and then transported offshore, further reducing both the amount and duration of anthropogenic noise emissions while at sea (Farr et al. 2021).

Noise (underwater detonations): If UXOs are encountered in a project area, non-explosive methods may be employed to remove them, but removal by explosive detonation may also be needed. As discussed in Section 3.3.2.3.2, *Cumulative Impacts of the No Action Alternative*, fish and invertebrate species without a swim bladder are less susceptible to injuries from underwater detonations. UXO detonation is anticipated to be infrequent, localized, and temporary. Impacts on benthic species may be short to long term, but most impacts on species are expected to be avoided; if impacts occur, they may result in the loss of a few individuals. Impacts on sensitive habitats would be avoided; impacts on other habitats are expected to be short term.

Noise (WTG operations): Operational noise from WTGs and heaving movements of ropes, chains, and WTG platforms can cause noise (Appendix H). The physical structures required for flotation and mooring are not expected to produce sounds of sufficient amplitude to risk non-auditory injury in fish and invertebrates because the noise events would be discrete and these species would likely not accumulate sound energy long enough to experience injury; however, behavioral disturbance could occur. Synthetic mooring line is expected to lower the source levels, but there is still significant uncertainty regarding chain and structure noise for offshore floating wind. The operational noise from floating wind turbines of the size proposed is yet to be determined, but for the purposes of this analysis, noise impacts of floating WTGs are assumed to be like those associated with bottom-founded WTGs.

Noise (decommissioning): Underwater explosives and mechanical cutting are two potential methods that could be used for decommissioning of WTG platforms. If explosives are used, impacts would be more severe than those associated with mechanical cutting. Impacts from the noise vary and are related to the distance from the sound source. Overall, BOEM anticipates the impacts on benthic resources from noise would range from short term to long term but would not result in impacts at a regional level or in population-level effects.

Port utilization: All phases of a project would require the use of one or more ports. Each COP submitted by a lessee will contain specifics about proposed port usage. Project vessel traffic would increase during the construction and installation phase but decrease during operations. If port expansions or modifications (e.g., dredging, pier replacement or installation, harbor, deepening, installation of new berths) were necessary, such work would be expected to be completed in accordance with pertinent federal and state regulations and permit conditions as well as in collaboration with multiple entities (e.g., port owners, governmental agencies, states, other offshore wind lessees). Therefore, analysis of such expansions or modifications are not carried through the PEIS analysis. Overall, BOEM anticipates impacts on benthic resources from port utilization would be short term.

Presence of structures: As outlined in the RPDE, Table 2-2, a project would install 30 to 200 WTGs and up to six OSSs, for a maximum total of 206 floating structures in each WEA. Different types of turbine and OSS substructures would be considered but all structure types would require moorings and anchors. The anchor type would depend on the substrate and mooring configuration. The seabed contact area is based on the anchor type selected and would range from 0.05 to 75 acres (0.02 to 30 hectares) per WTG/OSS depending on the mooring and anchor type and configuration.

The addition of the submerged portions of the WTGs, OSS, and anchors in the offshore environment, especially for spar structures, can increase the local relevance of hard-bottom fauna (Danovaro et al. 2024). The addition of new hard-bottom substrate in a predominantly soft-bottom environment would enhance local biodiversity (Pohle and Thomas 2001; Fautin et al. 2010; Degraer et al. 2020; Coolen et al. 2022; Danovaro et al. 2024). These habitats are largely unavailable in environments dominated by soft-bottom sediment. Creation of complex hard-bottom habitats may attract new species to the area and alter ecosystem dynamics (Degraer et al. 2020). The addition of offshore wind structures may also replace existing natural hard-bottom substrate, which could lead to a loss of biodiversity if those hard-bottom communities are destroyed or unable to relocate to the new structures. Surveys at floating offshore wind infrastructure in Scotland found they fostered benthic communities like those found in natural rocky intertidal habitats (Karlsson et al. 2022). Although floating turbines are likely to vary in size and depth, the literature suggests that the increase in novel space for biofouling is greater than for fixed turbines (Haberlin et al. 2022). This indicates that marine structures would generate some beneficial impacts on local ecosystems even though some impacts, such as the loss of soft-bottom habitat, may be adverse (Claisse et al. 2014).

Floating infrastructure, once operational, can act as FADs, providing refuge, enhancing larval settlement, and serving as nursery grounds (Claisse et al. 2014; Haberlin et al. 2022). These structures may alter natural predator/prey relationships, acting as an ecological trap for species initially seeking refuge from predators by reducing their fitness over time (Hale and Swearer 2016). Additionally, any perceived enhancement in larval settlement and use as nursery grounds cannot be attributed to new or redistributed production without long-term monitoring studies (Smith et al. 2016). Floating FADs differ from fixed-bottom artificial reefs in the types of marine species they attract, which depend on the species in surrounding habitats, available life stages, and environmental conditions present (Kramer et al. 2015). The extent to which the floating infrastructures would act as FADs or increase biodiversity is not well understood. Surveys of the spar turbines used for Hywind Scotland recorded 121 mobile and epifaunal species (Haberlin et al. 2022). As distance from the intertidal/coastal zone and water depth increases, benthic species composition would likely vary from those in natural or nearshore habitats (Page et al. 2019; Haberlin et al. 2022). Studies of oil and gas platforms can be useful for predicting potential biofouling species (Page et al. 2019; Integral 2021; Haberlin et al. 2022).

The effect on the hydrodynamics and primary productivity within the wind farm and beyond is not well understood. These ecosystem effects remain a topic of study, especially for floating wind farms. The potential impacts predicted by hydrodynamic modeling of fixed-bottom wind are likely to be similar for floating wind, although due to increased water depth, fewer impacts would occur in the benthic ecosystem (Haberlin et al. 2022; Integral 2021).

3.3.2.4.2 Impacts of Five Representative Projects

While lessees may elect a phased development approach, this PEIS assumes one project per lease area. The same types of design parameters described for one representative project in each WEA would apply to development in all five lease areas, except that the number and length of each parameter would be scaled for five representative projects. If multiple projects are constructed within the same timeframe, impacts on benthic resources would be greater than if project construction were staggered, particularly for anchoring, cable installation, discharge/intake, and presence of structures, as described below.

Anchoring: Anchoring impacts would be long term or potentially permanent (i.e., lasting beyond decommissioning). Due to sweeping of anchor chains, benthic communities within a radius of each WTG or OSS mooring anchor are likely to endure repeated disturbances. Vessel anchoring impacts would be short term, but permanent mooring anchors would have long-term impacts.

Cable installation: Cable installation would increase the benthic disturbance not only from the cable diameter, but from seabed preparation activities within the cable corridor prior to installation. This substantial increase in benthic disturbance would displace, injure, or kill benthic species in the construction pathway. Other expected impacts include increased localized turbidity, sediment deposition, and burial in and near the cable corridors. Sensitive life stages and sessile or slow-growing species would be most affected.

Discharge/intake: The increase of permitted offshore discharges and intake, including open loop cooling systems for HVDC converters on up to 30 OSSs and resulting entrainment or impingement caused by those systems would lead to impacts unless HVDC technology improves.

Presence of structures: The presence of structures would increase impact frequency/severity for sensitive species but not substantially for soft-bottom species and habitats. Recent modeling studies on potential upwelling changes along the California coast based on a hypothetical build-out (877 WTGs) of floating WTGs in the Morro Bay, Diablo Canyon, and Humboldt WEAs were conducted by Integral (2021) and additional results were published by Raghukumar et al. (2022, 2023). The Diablo Canyon WEA has been removed from further consideration by BOEM. Modeling results indicated that development of the offshore WEAs has the potential to reduce the wind shear stress at the sea surface and introduce wind stress curl, which could affect wind-driven upwelling, nutrient delivery, and ecosystem dynamics. Wind speed changes are found to reduce upwelling on the inshore side of wind farms and increase upwelling on the offshore side. Results showed that while the net upwelling in a wide coastal band changes relatively little, as it relates to volume transport and nutrient delivery, the spatial structure of upwelling within this coastal region shifted outside the bounds of natural variability. Wind farms could result in local diminishment and enhancement in upwelling on either side of the developed area. However, there would be little net change in upwelling regionally, when integrated over a larger area that fully encompasses the WEAs (Raghukumar et al. 2023). The modeled changes near the Humboldt WEA were substantially smaller than those of the Morro Bay WEA (Integral 2021). Modeling results showed a modest reduction of wind speeds in the lee (inshore) of the Humboldt WEA and a 5-percent reduction in wind speeds on the lee of the Morro Bay WEA (which included Diablo Canyon WEA during the study). This would lead to an approximate 10- to 15-percent decrease in upwelled volume transport and resulting nutrient supply to the coastal zone in the vicinity of the Morro Bay WEA (Integral 2021). However, the greatest change was observed within and south of the Diablo Canyon WEA, which cannot be separated from the Morro Bay data. Both studies stated that no conclusions on ecosystem impacts can be drawn from the modeled physical changes and that future studies on changes in phytoplankton productivity would be needed. The changes in upwelling would primarily be outside the 6.2-mile (10-kilometer) coastal zone, which is usually the region of strongest upwelling (Raghukumar et al. 2023).

3.3.2.4.3 Cumulative Impacts of Alternative B

Cumulative impacts from the construction, O&M, and decommissioning of five representative projects combined with other planned activities in the Affected Environment would result from repeated disturbances to benthic resources from bottom-contacting commercial fishing gear and anchor sweeping from the floating structures. Representative projects would contribute to disturbances from the long-term to permanent anchors, export cable installation, noise, and the presence of floating foundations. However, the area of benthic habitat disturbed could vary widely depending on the specific anchoring configuration and the siting of offshore export cables and landfall locations. Impacts would also occur from gear utilization and additional noise. Impacts are expected from long-term to permanent anchoring of mooring lines, cable installation, discharge and intake, and presence of structures for sessile invertebrates and structure-oriented or hard-bottom species.

3.3.2.4.4 Conclusions

Impacts of Alternative B. The type of habitats that would be disturbed is a determining factor in predicting the recovery of the benthic community. Substantial differences in impacts depend on the duration of effects, frequency of the disturbances, and water depths in the Affected Environment. Activities that would directly disturb the seabed, especially anchoring and cable installation/maintenance, are most likely to affect benthic communities. Vessel anchoring would be short term in nature, while WTG/OSS mooring would have long-term to permanent impacts. Sections of the cable route would require cable protection, which would present new hardbottom habitat. The displacement of soft-bottom species, habitat conversion to hardbottom from the protection structures, mooring anchors, and scour protection would result in long-term to permanent changes on benthic communities. Benthic communities would also be affected by discharge/intake, noise, accidental releases, EMFs and cable heat, gear utilization, and invasive species. Newly added hard surfaces could foster habitat and, thus, be considered a beneficial impact.

Cumulative Impacts of Alternative B. BOEM anticipates that cumulative impacts would be associated with port expansion projects and coastal dredging affecting nearshore habitats, while submarine cables and commercial trawling would repeatedly disturb and hinder recovery of offshore habitats and the benthic species they support. The addition of hard-bottom habitat could facilitate benthic colonization and recruitment.

3.3.2.5 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Benthic Resources

Alternative C, the Proposed Action, is the prospective adoption of mitigation measures intended to avoid or reduce Alternative B’s potential impacts. Accordingly, analysis considers the change in impacts relative to Alternative B. Other than mitigation measures, all design parameters for Alternative C would be the same as Alternative B for project components and activities undertaken for construction, O&M, and decommissioning.

Appendix E, *Mitigation,* identifies the mitigation measures that make up the Proposed Action. Table 3.3.2-2 summarizes the mitigation measures relative to benthic resources.

Table 3.3.2-2. Summary of mitigation measures for benthic resources

Measure ID	Measure Summary
MM-6	This measure requires that where post-construction surveys show significant changes in berm height, the lessee must develop and implement a Berm Remediation Plan to restore created berms to match adjacent natural bathymetric contours (isobaths), as technically and/or economically practical or feasible.
MM-19	This measure requires lessees to submit an Anchoring Plan that identifies and maps locations of interest including hard-bottom, sensitive habitats, potential shipwrecks, potential hazards, and existing and planned infrastructure. The plan will require all vessels deploying anchors to use, whenever feasible and safe, mid-line anchor buoys to reduce the amount of anchor chain or line that touches the seafloor.
MM-20	This measure requires lessees to submit a Sensitive Marine Species Characterization and Monitoring Plan for biological species and habitats that may be affected by a project's activities. Species and habitats that are particularly sensitive to impacts will be identified, avoided, and require monitoring, allowing for the identification of adverse effects and evaluation of mitigation efforts. Consolidated seafloor sediments are equivalent to sensitive habitats and species and shall be avoided from direct and indirect impacts unless data exist to demonstrate no harm to sensitive species and habitats.
MM-21	This measure proposes that the lessee prepare a Scour and Cable Protection Plan that includes descriptions and specifications for all scour and cable protection materials. All materials used for scour and cable protection measures should consist of natural or engineered stone that provides three-dimensional complexity in height and in interstitial spaces, as practicable and feasible. These methods would also ensure that the lessee avoid the use of engineered stone or concrete mattresses in complex habitat, use tapered or sloped edges for trawled areas, use materials that do not inhibit epibenthic growth, avoid use of plastics/recycled polyesters/net material, and submit the plan for review and approval.
MM-32	This measure encourages lessees to coordinate transmission infrastructure among projects by using, for example, shared intra- and interregional connections, meshed infrastructure, or parallel routing, to limit the combined footprint to minimize impacts.
MM-33	This measure requires monitoring of cables periodically after installation to determine cable location, burial depths, and site conditions to determine if burial conditions have changed and whether remedial action or additional mitigation measures are warranted.
MM-34	This measure recommends operators use standard underwater cables that have electrical shielding to control the intensity of EMFs.
MM-36	This measure requires the lessee to develop an Oceanographic Monitoring Plan. Monitoring reports are a required component of the plan and will be used to determine the need for adjustments to monitoring approach, consideration of new monitoring technologies, and/or changes to the frequency of monitoring. Components of the plan to consider include coordination relevant regulatory agencies and neighboring lessees; monitoring strategies for pre-construction, construction, post-construction, and decommissioning phases; comparisons with available model outputs; technologies; and appropriate physical and biochemical measurements.
MM-40	Lessees are encouraged to coordinate monitoring and survey efforts of long-term scientific surveys across lease areas to standardize approaches, understand regional potential impacts, and maximize efficiencies in monitoring and survey efforts.

3.3.2.5.1 Impacts of One Representative Project in Each WEA

Mitigation measures can be useful for reducing impacts, even if the impact determination remains the same as in Alternative B. The only IPFs addressed in the following analysis are those where mitigation measures outlined in Appendix E apply to the specific resource. If an individual IPF is not discussed, the impact determinations outlined under Alternative B still apply.

Anchoring: MM-19 would require lessees to submit an Anchoring Plan that would map the locations of interest to avoid intentional contact within hard-bottom substrate, rock outcroppings, seamounts, sensitive habitats, or deep-sea coral and sponge habitats. The plan will require mid-line anchor buoys, whenever feasible and safe, to reduce the amount of anchor chain or line that touches the seafloor. MM-20 would further mitigate direct and indirect impacts by requiring lessees to submit a Sensitive Marine Species Characterization and Monitoring Plan for biological species and habitats in the water column or on the seafloor that may be affected by a project's activities. Consolidated seafloor sediments (e.g., hard bottom, hard grounds, reefs) are equivalent to sensitive habitats and species (e.g., hard corals, sponges, commercially important fish species, endangered species). If the lessee or BOEM finds that sensitive seafloor habitats, EFH, or habitat areas of particular concern may be adversely affected by lessee's activities, BOEM must consult with NMFS (30 CFR 585.703). Even with mitigation measures, the spatial extent of any anchor impact and anchor chain sweeps could be large and of long duration, but the measures would minimize the potential anchoring impacts on sensitive benthic habitats.

Cable installation and maintenance: An Anchoring Plan (MM-19) would help with siting the cable installation within the offshore export cable corridor to minimize benthic impacts and avoid sensitive habitats (MM-19). The Sensitive Marine Species Characterization and Monitoring Plan for biological species and habitats required by MM-20 would minimize the impacts from cable installation, especially the offshore export cables. MM-13 would require a Scour and Cable Protection Plan to include descriptions of materials to be used for cable protection and that such materials reflect pre-existing conditions as much as possible. MM-6 would require a Berm Remediation Plan for any significant berm heights created during pre-construction or installation construction activities. Created berms would be restored to match adjacent natural bathymetric contours, which would minimize the long-term effects on benthic habitat from cable installation. MM-33 requires the lessee to conduct post-installation cable monitoring of array and export cables in set intervals after commissioning and additional events to ensure proper burial depth and cable integrity. These measures would lessen the frequency and severity of cable installation and maintenance impacts.

EMFs and cable heat: MM-34 recommends the lessees use standard underwater cables that have electrical shielding to control the intensity of EMFs. MM-33 requires the lessee to conduct post-installation cable monitoring of array and export cables in set intervals after commissioning and additional events to ensure proper burial depth and cable integrity. This would minimize the risk of exposed export cables, which may inadvertently expose benthic organisms to higher EMFs or cause avoidance behaviors compared to buried/protected cables. These mitigation measures would functionally reduce impacts.

Gear utilization: MM-19 requires lessees to submit an Anchoring Plan that describes how hard-bottom and sensitive habitat will be avoided during buoy deployment, operations, and retrieval. This measure would benefit various communities, especially sensitive deep-sea corals and sponges. The Sensitive Marine Species Characterization and Monitoring Plan for biological species and habitats required by MM-20 would minimize the impacts from site assessment and monitoring surveys. MM-36 requires an Oceanographic Monitoring Plan to determine the need for adjustments to monitoring approach, consideration of new monitoring technologies, and/or changes to the frequency of monitoring. Components of the plan to consider include coordination relevant regulatory agencies and neighboring lessees; monitoring strategies for pre-construction, construction, post-construction, and decommissioning phases; comparisons with available model outputs; technologies (e.g., gliders, moorings, Lidar buoys, profilers, floats, ship-based methods); and appropriate physical and biochemical measurements (e.g., ocean temperature, salinity, pH, current velocity, biogeochemistry, and nutrients). These mitigation measures would reduce impacts, especially on sensitive habitats.

Presence of structures: Berm remediation of any significant berm heights created during preconstruction or installation, required by MM-6, must be restored to match adjacent natural bathymetric contours, which would minimize the long-term effects. Monitoring efforts described in MM-33 would serve as an early detection of invasive species to expand their range and ensure that invasive species are not outcompeting native species. As part of the Oceanographic Monitoring Plan required by MM-36, physical oceanographic measurements (e.g., ocean temperature, salinity, pH, current velocity, biogeochemistry, and nutrients) would be collected and considered. While monitoring would not directly reduce the hydrodynamic effects of wind farms on benthic resources, the information gathered could be evaluated for efficacy and potentially lead to changes in or additions to existing mitigation measures. If implemented, these mitigation measures would lessen some impacts, with increased severity if structures were left on the seafloor permanently.

3.3.2.5.2 Impacts of Five Representative Projects

The same impact types and mechanisms described under one representative project in each WEA also apply to five representative projects. However, there would be more potential for impacts due to the greater amount of offshore and onshore development under five projects, although these impacts would be reduced to a greater extent with mitigation measures under Alternative C. Under MM-40, the lessees are encouraged to coordinate monitoring and survey efforts of long-term scientific surveys (e.g., NMFS scientific surveys) across lease areas to standardize approaches, understand potential impacts on resources at a regional scale, and maximize efficiencies in monitoring and survey efforts. In addition, if the projects coordinate the use of shared transmission infrastructure and parallel routing of transmission with existing and proposed linear infrastructure, as stated in MM-32, fewer benthic impacts would occur overall. MM-32 would reduce impacts associated with the footprint from cable installation and maintenance, EMFs and cable heat, and the presence of structures from cable protection. The Oceanographic Monitoring Plan required by MM-36 includes coordination with relevant regulatory agencies and neighboring lessees, monitoring strategies for all project phases, model comparisons, and appropriate measurements and technologies. While monitoring would not directly reduce hydrodynamic effects of wind farms, the information gathered could be evaluated for efficacy and potentially lead to changes in or additions to existing mitigation measures, which would mitigate impacts from the full build-out. Although a full build-out is five projects, accounting for the geographic separation of the WEAs, a maximum of two projects in Humboldt and three projects in Morro Bay would disturb benthic invertebrates and habitats at any given time. Projects would not only be spaced geographically, but also temporally. These actions would decrease benthic disturbances.

3.3.2.5.3 Cumulative Impacts of Alternative C

Repeated disturbances from bottom-contacting commercial fishing activities would disturb benthic communities and hinder recovery. Disturbances from the Proposed Action mainly include anchoring the moorings and cable installation of offshore export cables, which is expected to be permanent. However, the area of benthic habitat disturbed could vary widely depending on the mitigation measures, mooring anchor configurations, and the siting of offshore export cables and landfall locations. Most impacts on benthic species are expected to be avoided with mitigation measures; if impacts occur, they may result in the loss of a few individuals. Impacts on sensitive habitats would be mostly avoided with the mitigation measures; however, some impacts would remain long term. Beneficial impacts for sessile invertebrates and structure-oriented species would also occur from the presence of anchor structures and cable protection (especially if nature-inclusive designs are implemented).

3.3.2.5.4 Conclusions

Impacts of Alternative C. Mitigation measures would avoid/reduce the severity of some impacts on benthic communities, especially sensitive species. Anchoring-related impacts would most likely continue, but adherence to an Anchoring Plan (MM-19) would help avoid/lessen such impacts. Similarly, other mitigation would identify and/or monitor sensitive species prior to or during project activities. COP-level reviews will determine a more precise level of avoidance/impact reduction.

Cumulative Impacts of Alternative C. Similar to Alternative B, BOEM anticipates that cumulative impacts would be associated with port expansion projects and coastal dredging affecting nearshore habitats, while submarine cables and commercial trawling would repeatedly disturb and hinder recovery of offshore habitats and the benthic species they support. The addition of hard-bottom habitat could facilitate benthic colonization and recruitment. Mitigation measures noted above, particularly adherence to an Anchoring Plan and other measures to characterize and, thus, potentially avoid sensitive habitats and species, would lessen Alternative C's contribution to cumulative impacts.

3.3 Biological Resources

3.3.3 Birds

This section discusses the Affected Environment and potential impacts on birds from the offshore components of the Proposed Action, alternatives, and ongoing and planned activities in the region. The Affected Environment for birds, which includes the California coastline, extends 100 miles (161 kilometers) offshore (Figure 3.3.3-1). This was established to include resident and migratory marine, coastal, and landbird species that could be present within the Humboldt and Morro Bay WEAs throughout the year and could therefore be affected by the Proposed Action. The offshore limit was established to cover the movements of marine birds that breed or overwinter as far south as South America and the South Pacific, along the Pacific Flyway, and as far north as the Arctic that travel through the Affected Environment.

3.3.3.1 Description of the Affected Environment and Baseline Conditions

This section discusses offshore habitats and bird species that use offshore habitats, including resident and migratory marine bird species that use the California WEAs during all (or portions of) the year, and bird species that use onshore and nearshore habitats with the potential to pass through the WEAs during fall and spring migration. Given the differences in life history characteristics and habitat use between offshore and onshore bird species, the following discusses each group separately. This section also discusses Bald and Golden Eagles and addresses federally listed threatened and endangered landbirds with the potential to occur within the Humboldt and Morro Bay WEAs.

3.3.3.1.1 Offshore Habitat

The Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf (MMS 2007) includes a general description of the Affected Environment for offshore habitats along the entire Pacific Coast and is incorporated by reference and summarized here. The Affected Environment falls within the Pacific OCS, which plays an important role in the ecology of many bird species. It is located along the Pacific Flyway, an important migratory route for over 350 bird species moving between breeding and wintering areas along the Pacific Coast of North, Central, and South America. This includes more than 80 species of marine birds that spend a significant amount of time in the waters of the California Current (Adams et al. 2016). The Pacific OCS ranges from less than 50 miles wide (80 kilometers wide) with depths typically less than 660 feet (200 meters) (MMS 2007). The California Current flows south from southern British Columbia and transports cool, low-salinity water toward the equator, and extensive upwelling caused by prevailing winds brings colder, nutrient-rich subsurface waters to the surface (MMS 2007). These nutrient-rich waters support an assemblage of marine plankton and fish that provide abundant foraging resources for marine birds.

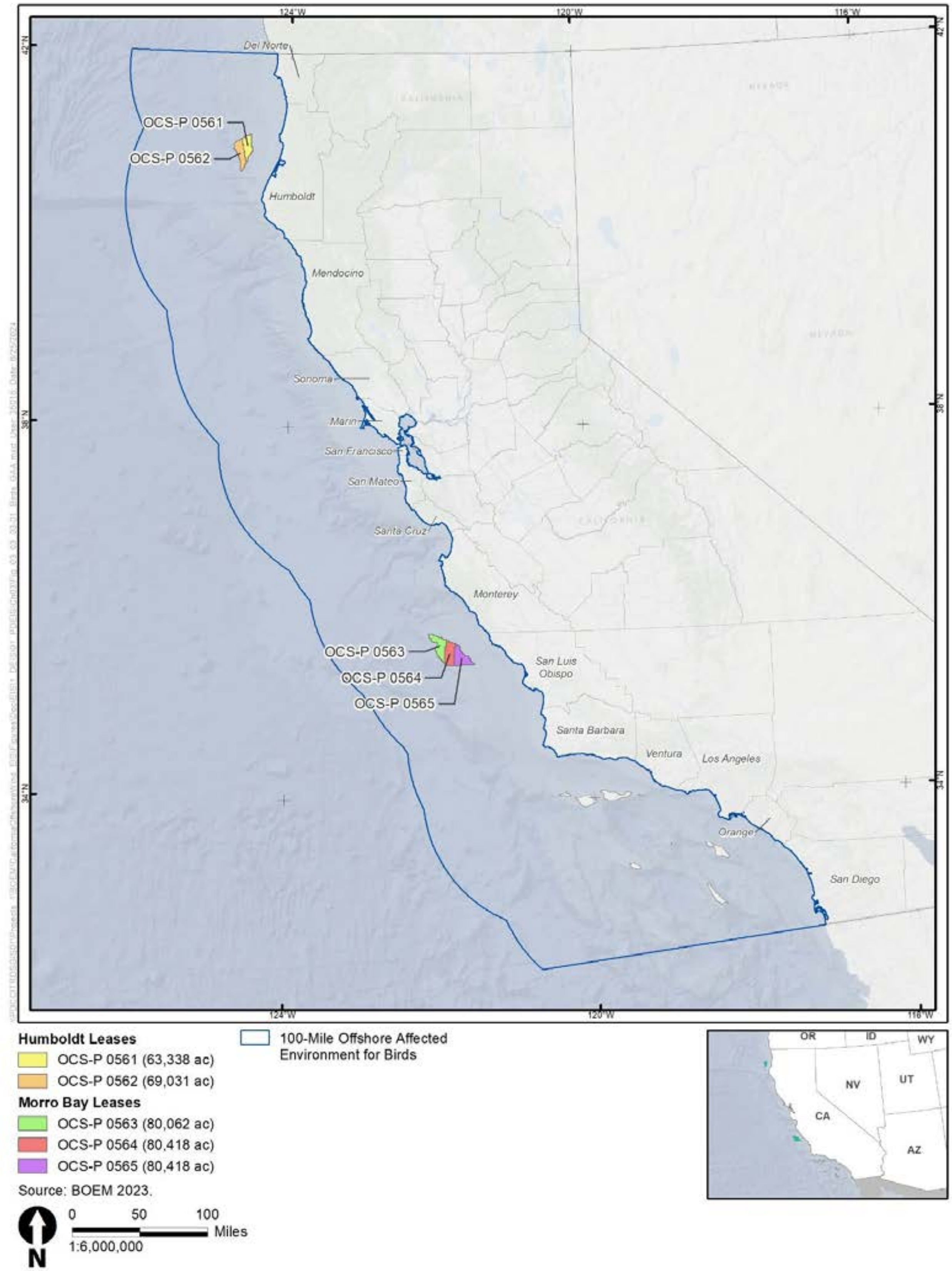


Figure 3.3.3-1. Bird Affected Environment

3.3.3.1.2 Offshore Birds

Marine birds spend most of their lives at sea, coming to land only for nesting. Some species are resident within the Affected Environment, breeding along cliffs, offshore islands, and coastal forests, while others breed elsewhere in the Northern and Southern Hemisphere along the eastern or western Pacific Ocean and overwinter in or migrate through the Pacific OCS, including the Humboldt and Morro Bay WEAs. Several million migratory and resident marine birds forage in the nutrient-rich waters of the Pacific OCS during breeding, migration, and nonbreeding seasons. Coastal waterbirds and terrestrial birds that use onshore and nearshore habitats may also pass through the Humboldt and Morro Bay WEAs during migration or could be blown offshore during storm events. Table 3.3.3-1 lists the bird species with potential to occur in the Affected Environment.

Table 3.3.3-1. Birds with potential to occur in the Affected Environment present in California and their state and federal conservation status

Common Name	Scientific Name	California Status	Federal Status
Ancient Murrelet	*Synthliboramphus antiquus*	None	Bird of Conservation Concern
Ashy Storm-petrel	*Hydrobates homochroa*	Species of Special Concern	Bird of Conservation Concern
Bald Eagle	*Haliaeetus leucocephalus*	Endangered	Delisted[1]
Black Oystercatcher	*Haematopus bachmani*	None	Bird of Conservation Concern
Black Scoter	*Melanitta nigra*	None	None
Black Skimmer	*Rynchops niger*	Species of Special Concern	Bird of Conservation Concern
Black Storm-petrel	*Hydrobates melania*	Species of Special Concern	Bird of Conservation Concern
Black-footed Albatross	*Phoebastria nigripes*	None	Bird of Conservation Concern
Black-legged Kittiwake	*Rissa tridactyla*	None	None
Black-vented Shearwater	*Puffinus opisthomelas*	None	Bird of Conservation Concern
Brandt's Cormorant	*Urile penicillatus*	None	Bird of Conservation Concern
Brown Pelican	*Pelecanus occidentalis*	Delisted	Delisted
Buller's Shearwater	*Ardenna bulleri*	None	Bird of Conservation Concern
California Gull	*Larus californicus*	None	Bird of Conservation Concern
California Least Tern	*Sternula antillarum browni*	Endangered	Endangered
Cassin's Auklet	*Ptychoramphus aleuticus*	Species of Special Concern	Bird of Conservation Concern
Clark's Grebe	*Aechmophorus clarkii*	None	Bird of Conservation Concern
Common Eider	*Somateria mollissima*	None	None
Common Loon	*Gavia immer*	Species of Special Concern	None
Common Murre	*Uria aalge*	None	None
Double-crested Cormorant	*Phalacrocorax auritus*	None	None
Elegant Tern	*Thalasseus elegans*	None	Bird of Conservation Concern

Common Name	Scientific Name	California Status	Federal Status
Golden Eagle	*Aquila chrysaetos*	Fully Protected	None[1]
Gull-billed Tern	*Gelochelidon nilotica*	Species of Special Concern	Bird of Conservation Concern
Hawaiian Petrel	*Pterodroma sandwichensis*	None	Endangered
Heermann's Gull	*Larus heermanni*	None	Bird of Conservation Concern
Laysan Albatross	*Phoebastria immutabilis*	None	Bird of Conservation Concern
Lesser Yellowlegs	*Tringa flavipes*	None	Bird of Conservation Concern
Long-tailed Duck	*Clangula hyemalis*	None	None
Manx Shearwater	*Puffinus puffinus*	None	None
Marbled Godwit	*Limosa fedoa*	None	Bird of Conservation Concern
Marbled Murrelet	*Brachyramphus marmoratus*	Endangered	Threatened
Mountain Plover	*Charadrius montanus*	Species of Special Concern	Bird of Conservation Concern
Pink-footed Shearwater	*Ardenna creatopus*	None	Bird of Conservation Concern
Pomarine Jaeger	*Stercorarius pomarinus*	None	None
Red Knot	*Calidris canutus roselaari*	None	Bird of Conservation Concern
Red Phalarope	*Phalaropus fulicarius*	None	None
Red-breasted Merganser	*Mergus serrator*	None	None
Red-necked Phalarope	*Phalaropus lobatus*	None	None
Red-throated Loon	*Gavia stellata*	None	None
Ring-billed Gull	*Larus delawarensis*	None	None
Royal Tern	*Thalasseus maximus*	None	None
Scripps's Murrelet	*Synthliboramphus scrippsi*	Threatened	Bird of Conservation Concern
Short-billed Dowitcher	*Limnodromus griseus*	None	Bird of Conservation Concern
Short-tailed Albatross	*Phoebastria albatrus*	Species of Special Concern	Endangered
Sooty Shearwater	*Ardenna grisea*	None	None
South Polar Skua	*Stercorarius maccormicki*	None	None
Surf Scoter	*Melanitta perspicillata*	None	None
Tufted Puffin	*Fratercula cirrhata*	Species of Special Concern	Bird of Conservation Concern
Western Grebe	*Aechmophorus occidentalis*	None	Bird of Conservation Concern
Western Gull	*Larus occidentalis*	None	Bird of Conservation Concern
Western Snowy Plover	*Charadrius nivosus nivosus*	Species of Special Concern	Threatened
White-winged Scoter	*Melanitta fusca*	None	None
Willet	*Tringa semipalmata*	None	Bird of Conservation Concern

Sources: California Natural Diversity Database 2024; U.S. Fish and Wildlife Service 2024.
[1] Bald Eagle and Golden Eagle are protected by the Bald and Golden Eagle Protection Act.

Marine bird relative density on the Pacific OCS (including the Humboldt and Morro Bay WEAs) was modeled for 33 species and 13 taxonomic groups using data collected between 1980 and 2017 (Leirness et al. 2021). Predicted densities varied seasonally and by area, reflecting species' seasonal movements and migration. Species that breed within the study area had higher nearshore densities during the summer and had more dispersed offshore distributions in the winter. Species that migrate through or overwinter in the study area had higher densities along the OCS in those months and were absent during summer. Species that breed in the Southern Hemisphere are found in the Pacific OCS during the summer and are absent in the winter. Species with the highest predicted densities offshore along the edge of the Pacific OCS in the spring, summer, and fall include auklets, gulls, Black-Footed Albatross, Ashy Storm-petrel, and Sooty Shearwater. Along the coast and nearshore waters, scoter, grebes, Marbled Murrelet, terns, cormorants, and Brown Pelican had the highest predicted densities. Section 3.3.3.4.1, *Impacts of One Representative Project in Each WEA,* includes more detail on seasonal variation in predicted densities for various marine bird groups. A GIS analysis was conducted using the publicly available dataset from this study (Leirness et al. 2022) to display predicted relative densities of representative species from each marine bird group listed in Table 3.3.3-2 (Attachment 1, Figure 3.3.3-2 through Figure 3.3.3-44). The representative species provide examples of potential occurrence for the marine bird groups by season for use in the impact analysis. ESA-listed species and species with the most complete seasonal data available were selected to represent each bird group. While these figures should be interpreted with caution due to varying levels of certainty and differing scales of predicted relative density among species and seasons, the dataset broadly demonstrates the potential for marine bird occurrences throughout the year.

Coastal bird species such as songbirds, raptors, and coastal waterbirds do not use offshore habitats for breeding or foraging; however, these species may be present over the Pacific OCS while in transit during migration or as a result of storm events. Coastal bird occurrence has been documented in low numbers at distances from shore similar to the Humboldt and Morro Bay WEAs (Richardson et al. 2003); therefore, while these species have the potential to occur, the probability of presence in the Humboldt and Morro Bay WEAs is low.

Table 3.3.3-2 describes bird group presence in the Affected Environment based on information from reports on species distribution and risk (Adams et al. 2016; Leirness et al. 2021, 2022). The table divides birds into six groups—shorebirds, wading birds, raptors, songbirds, coastal waterbirds, and marine birds. Marine birds are broken down further by family group.

Table 3.3.3-2. Bird presence in the Affected Environment by bird group

Bird Group	Potential Bird Presence in the Affected Environment
Shorebirds	Shorebirds (e.g., Black-bellied Plover, Semipalmated Plover) typically use coastal areas and generally avoid straying out over deep waters. Primarily, exposure of shorebirds to the offshore infrastructure would be limited to the spring and fall migration periods. Western Snowy Plovers are federally listed.
Wading Birds	Most long-legged wading birds, such as herons and egrets, breed and migrate in coastal and inland areas. Like the smaller shorebirds, wading birds are believed to avoid straying out over deep waters (Kushlan and Hafner 2000) but may fly offshore during spring and fall migration periods.

Bird Group	Potential Bird Presence in the Affected Environment
Coastal Waterbirds	Coastal waterbirds use terrestrial or coastal wetland habitats and rarely use the marine offshore environment. This group includes aquatic species not captured in other groupings, such as waterfowl, that are generally restricted to freshwater or use saltmarshes or beaches, although some grebe species do occur in offshore waters. Waterfowl comprise a broad group of geese and ducks, most of which spend much of the year in terrestrial or coastal wetland habitats but can travel long distances over the open ocean while migrating south from the arctic (Weiser et al. 2024). The diving ducks generally winter on open freshwater, as well as brackish or saltwater. Species that regularly winter on saltwater, including mergansers, scaup, and goldeneyes, usually restrict their distributions to shallow, very nearshore waters. Because most coastal waterbirds spend a majority of the year in freshwater aquatic systems and nearshore marine systems, there is little to no use of the offshore environment around lease areas during any season. A subset of diving ducks has a strong affinity for saltwater, either year-round or outside of the breeding season; these species are known as seaducks, described below.
Raptors	Several raptor species occur along the coastline near the California lease areas, including Bald Eagle, Red-tailed Hawk, Osprey, and Peregrine Falcon (eBird 2023c, 2023d). Bald Eagle, Osprey, and Peregrine Falcon often forage in bays, beaches, and nearshore waters, and may also use offshore waters for foraging. While migrating raptors follow the coastline and will cross large bodies of water such as bays, they have low potential to occur offshore within the California lease areas.
Songbirds	Songbirds (e.g., warblers, sparrows) almost exclusively use terrestrial, freshwater, and coastal habitats and do not use the offshore marine system except during migration. Many North American breeding songbirds migrate to the tropical regions, many in flocks. On their migrations, neotropical migrants generally travel at night and at high altitudes where favorable winds can aid them along their trip. Songbirds regularly cross large bodies of water (Bruderer and Lietchi 1999; Gauthreaux and Belser 1999). Songbirds have been documented during migration, in low numbers, at Southeast Farallon Island (Richardson et al. 2003), and many species reside on the Channel Islands (Collins et al. 2021), which occur a similar distance offshore as the California lease areas.
Marine Birds (by family group)	
Loons	Common Loons, Red-throated Loons, and Pacific Loons are known to use the Pacific OCS throughout the year, with highest densities in nearshore waters. Predicted distributions of loon species are highest in the Affected Environment in the winter and spring (Leirness et al. 2021).
Seaducks	The seaducks (e.g., Black Scoter, Surf Scoter, Long-tailed Duck) use the Pacific OCS in winter and during migration. Predicted seaduck densities are highest in the northern portions of the Pacific OCS, extending to Northern California, and lower in Central and Southern California (Leirness et al. 2021). Most of these seaducks dive to forage on mussels and other benthic invertebrates, and generally winter in shallower inshore waters or out over large offshore shoals, where they can access benthic prey. Based on predicted collision and displacement vulnerability, seaduck exposure is expected to be low to medium (Adams et al. 2016) and would be primarily limited to migration or travel between wintering sites.
Petrel Group	In the Pacific, this group consists mostly of petrels (e.g., Hawaiian Petrel, Mottled Petrel), shearwaters (e.g., Sooty Shearwater, Black-vented Shearwater, Buller’s Shearwater), storm-petrels (e.g., Leach’s Storm-petrel, Ashy Storm-petrel), and albatrosses (e.g., Black-footed Albatross) that forage in nutrient-rich waters along the Pacific OCS, including in the Affected Environment. Shearwaters and petrels are extremely aerial species, flying high and swooping down to either dive for prey items (shearwaters and diving petrels) or pluck food items near the surface (Hawaiian Petrel). Petrels feed during the day and at night near the ocean surface (Simons and Bailey 2020; Ainley et al. 2021).

Bird Group	Potential Bird Presence in the Affected Environment
Cormorants and Pelicans	Cormorants (Pelagic, Brandt's, and Double-crested Cormorant) and Brown Pelicans have potential to be found offshore; however, these species are concentrated in nearshore waters, especially during the summer (Leirness et al. 2021). During migration, Brown Pelican is found offshore to 6.2 miles (10 kilometers) from the coast (Adams et al. 2016).
Gulls, Skuas, and Jaegers	Jaegers (particularly Pomarine Jaeger) and South Polar Skua are present in the Pacific OCS during migration, with high numbers of Pomarine Jaegers in California in late summer and fall (Adams et al. 2016). Several species of gulls are present in the Pacific OCS throughout the year. Most gulls are typically found in nearshore waters; however, some species such as California Gull, Sabine's Gull, and Black-legged Kittiwake have the potential to occur in relatively high densities offshore in some seasons (Leirness et al. 2021).
Terns	Black Tern, Least Tern, Common Tern, Forster's Tern, Elegant Tern, and Royal Tern have been observed in and around the California lease areas. Terns generally restrict themselves to coastal waters during breeding, although species such as Arctic Tern and Common Tern migrate through offshore waters of California, including the Affected Environment (Hatch et al. 2020; Arnold et al. 2020). California Least Terns are federally listed.
Alcids	Several alcid species that breed on offshore islands, coastal cliffs, and forests along the Pacific Coast (e.g., Common Murre, Pigeon Guillemot, Scripps' Murrelet, Marbled Murrelet) can be found nearshore near colonies during breeding and dispersed in nearshore to offshore waters during winter. After breeding, alcids that breed in the north will move southward; species such as Pigeon Guillemot that breed in the south will move north after breeding.

Five bird species listed as threatened or endangered under the ESA have the potential to occur in the Humboldt and Morro Bay WEAs: the endangered California Least Tern (*Sterna antillarum browni*), endangered Hawaiian Petrel (*Pterodroma sandwichensis*), threatened Marbled Murrelet (*Brachyramphus marmoratus*), endangered Short-tailed Albatross (*Phoebastria albatrus*), and threatened Western Snowy Plover (*Charadrius nivosus nivosus*) (USFWS 2023). There is no designated critical habitat for ESA-listed bird species within the areas that may be affected by project activities in the WEAs.

Hawaiian Petrel breeds in the Hawaiian Islands and occurs over offshore waters along the Pacific OCS during foraging flights made during breeding (Adams et al. 2016; Simons and Bailey 2020). Short-tailed Albatross breeds in two extant colonies on islands in Japan and Taiwan, and individuals present in the Pacific OCS are largely dispersing males and juveniles, concentrated in areas of upwelling in marine and pelagic waters (Adams et al. 2016; Carboneras et al. 2020). Occurrences of Hawaiian Petrel and Short-tailed Albatross are known near Humboldt and Morro Bay (eBird 2023a, 2023b), but these species are rare off the California coast (Adams et al. 2016; Leirness et al 2021). Therefore, there is a low probability of occurrence in the Humboldt and Morro Bay WEAs.

California Least Tern nests along the California coast from San Francisco Bay to Baja California, Mexico, and migrates south and east to winter in marine coastal areas of Central and South America (Thompson et al. 2020). The species forages typically within 2 miles (3.2 kilometers) (occasionally up to 5 miles [8.1 kilometers]) of nesting sites in coastal and nearshore habitats generally less than 25 feet (7.6 meters) deep (USFWS 2020) but is occasionally found offshore (Thompson et al. 2020). While offshore occurrences exist for California Least Tern (Adams et al. 2016), little information about the species' use of offshore habitats exists, and probability of presence within the Humboldt and Morro Bay WEAs is unknown.

Western Snowy Plover is resident along the Pacific Coast from Washington to Baja California Sur, Mexico, breeding on beaches, salt evaporation ponds, and agricultural wastewater ponds; and foraging on beaches, tidal flats, and playas above and below mean high tide level and in shallow water (less than 0.8 inch [2 centimeters] deep) (Page et al. 2023). Because the species is restricted to coastal habitats with limited movement to coastal islands such as the Channel Islands, the likelihood of presence within the Humboldt and Morro Bay WEAs is low.

Marbled Murrelet nests in trees in coastal forests from Alaska to the Central Coast of California, forages primarily in nearshore waters within 3.1 miles (5 kilometers) of shore, and is often found 0.06 to 1.2 miles (0.1 to 2 kilometers) from shore (Adams et al. 2016) but also in areas of upwelling (Nelson 2020). Winter range overlaps much of breeding range but extends south to Southern California and northwestern Mexico (Nelson 2020).

Bald Eagle (*Haliaeetus leucocephalus*) and Golden Eagle (*Aquila chrysaetos*) are federally protected by the Bald and Golden Eagle Protection Act (16 USC 668 et seq.). Bald Eagles are broadly distributed across North America and generally nest and perch in areas associated with water (lakes, rivers, bays) in both freshwater and marine habitats, often remaining largely within roughly 1,640 feet (500 meters) of the shoreline (Buehler 2022). Bald Eagles are year-round residents in California and occur in a variety of terrestrial environments, including along the coast near the lease areas and on the Channel Islands (eBird 2023c). Golden Eagles are found throughout the United States, but mostly in the western half of the United States (Cornell University 2023). Golden Eagles occur along the Pacific Coast, including Humboldt Bay and Morro Bay (eBird 2023d), but do not fly over the open ocean away from the coast or offshore islands. The general morphology of eagles dissuades long-distance movements in offshore settings, as the species generally rely upon thermal formations, which develop poorly over the open ocean, during long-distance movements. As such, Bald Eagles and Golden Eagles are unlikely to fly through the Humboldt and Morro Bay WEAs.

More than one-third of bird species that occur in North America (37 percent, 432 species) are at risk of extinction unless significant conservation actions are taken (NABCI 2016). This is likely representative of the conditions of birds within the Affected Environment. Species that live or migrate through the Pacific Flyway have historically been, and will continue to be, subject to ongoing anthropogenic stressors, including entanglement in fishing gear, overfishing of prey species, pollution, introduced species, and climate change (Paleczny et al. 2015), which may impact bird species.

According to the North American Bird Conservation Initiative, more than half of the offshore bird species (57 percent, 31 species) have been placed on its watch list as a result of small ranges, small and declining populations, and threats to required habitats. This watch list identifies species of high conservation concern based upon high vulnerability to a variety of factors including population size, breeding distribution, non-breeding distribution, threats to breeding, threats to non-breeding, and population trend (NABCI 2016). Globally, monitored offshore bird populations have declined by nearly

70 percent from 1950 to 2010, which may be representative of the overall population trend of seabirds (Paleczny et al. 2015) including those that forage, breed, and migrate over the Pacific OCS. Overall, offshore bird populations are decreasing; however, considerable differences in population trajectories of offshore bird families have been documented.

3.3.3.2 Impact Background for Birds

Accidental releases of petroleum products, cable installation and maintenance, noise, lighting, presence of structures, and traffic may all affect birds (Table 3.3.3-3).

Refer to Section 3.1.2, *Impact Terminology*, regarding beneficial impacts.

Table 3.3.3-3. Issues and indicators to assess impacts on birds

Issue	Impact Indicator
Collision/injury/electrocution	Qualitative estimate of species vulnerability to collision/electrocution with WTGs and OSSs.
Displacement/barrier effects	Extent, frequency, and duration of impacts resulting from presence of structures and changes to in-air and underwater noise levels from construction, operation, and decommissioning. Projected traffic patterns/volume changes.
Habitat loss/modification	Habitat disturbance or modification.

3.3.3.3 Impacts of Alternative A – No Action – Birds

When analyzing the impacts of the No Action Alternative on birds, BOEM considers the impacts of ongoing activities on the baseline conditions for birds. The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative on existing baseline trends, including other planned activities, which are described in Appendix C*, Planned Activities Scenario*.

3.3.3.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, the baseline conditions for birds described above would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities.

Ongoing activities within the Affected Environment that contribute to impacts on birds include undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; dredging projects; marine minerals use and ocean dredged material disposal; military use; marine transportation; scientific research; fisheries use, management, and monitoring surveys; oil and gas activities; and global climate change. These activities could affect birds through the following IPFs: accidental releases, which can have physiological effects on birds; cable installation and maintenance, which can disturb benthic habitats and affect water quality for prey species; noise, which can have physiological effects on, and result in behavioral changes of, birds; lighting, which can result in behavioral changes of birds and their prey species; and the presence of structures and vessel traffic, both of which can result in collisions and behavioral changes of birds. The primary contributors to marine bird population declines, other than climate change, are fisheries bycatch, overfishing of prey fish species, and marine debris pollution (NABCI 2022).

BOEM expects ongoing activities to affect birds through the following IPFs.

Accidental releases: The accidental release of fuel/fluids, other contaminants, trash, and debris could occur because of ongoing activities. The risk of an accidental release would be increased primarily during construction activities, but also during operations and decommissioning of facilities. Ingestion of hazardous contaminants, such as fuel and fluids from vessels, has the potential to result in lethal and sublethal impacts on birds, including decreased hematological function, dehydration, drowning, hypothermia, starvation, and weight loss (Briggs et al. 1997; Haney et al. 2017; Paruk et al. 2016). Additionally, small exposures to vessel fuel/fluids that result in oiling of feathers can lead to sublethal effects such as changes in flight efficiencies that result in increased energy expenditure during daily and seasonal activities. These daily and seasonal activities include, but are not limited to, chick provisioning, commuting, courtship, foraging, long-distance migration, predator evasion, and territory defense (Maggini et al. 2017).

Vessel compliance with USCG regulations would minimize trash or other debris; therefore, BOEM expects accidental trash releases from offshore vessels to be rare and localized. In the unlikely event of a release, lethal and sublethal impacts on local bird species could occur, resulting in blockages caused by both hard and soft plastic debris (Roman et al. 2019) and attraction of predators to the WEAs. Given that accidental releases are anticipated to be rare and localized and occur primarily during construction activities, BOEM expects that accidental releases of trash and debris pose a low potential for impacts.

Lighting: Studies have indicated that several species of marine birds (e.g., alcids, shearwaters, storm-petrels, sea ducks) can be attracted to lighting on oil and gas platforms at night (Adams et al. 2016). Vessels are the predominant offshore source of artificial lighting in the Affected Environment. Overall, BOEM anticipates varying degrees of lighting impacts related to existing offshore structures and vessels on birds depending on species' distribution, abundance, and susceptibility to light attraction.

Cable installation and maintenance: Generally, installation of submarine cables would result in increased suspended sediments that may affect diving birds, cause displacement of foraging individuals or decreased foraging success, and have impacts on some prey species (e.g., benthic assemblages) (Cook and Burton 2010). Impacts associated with cable installation would be temporary and localized. Birds are expected to successfully forage in adjacent areas not affected by increased suspended sediments. Any dredging necessary prior to cable installation could also contribute to additional impacts. Disturbed seafloor from construction of ongoing projects may affect prey of some bird species. However, the duration and extent of impacts are expected to be short term and localized; benthic assemblages would be expected to recover from disturbance. Impacts are expected to be minor because suspended sediments and potential displacement of foraging birds would be short term and benthic habitats would recover. However, more impacts could occur for marine birds with highly specialized diets requiring unique foraging resources if cable installation activities disrupt unique foraging resources not available elsewhere.

Noise: Anthropogenic noise associated with aircraft, anchoring, G&G surveys, offshore construction, and vessel traffic has the potential to result in behavioral (avoidance) and physiological impacts on birds. BOEM anticipates that these impacts would be localized and temporary; therefore, effects of noise from these ongoing activities are expected to be minor. In the event unique foraging resources for some species is present in the disturbance area that are not available elsewhere, potential impacts of noise and displacement of birds could be more substantial. Due to the temporary nature of ongoing activities, population-level effects are not anticipated.

Noise associated with vessel traffic could disturb some individual diving birds, but they would likely acclimate to the noise or retreat, potentially resulting in a temporary loss of habitat (BOEM 2012). However, brief, temporary responses, if any, would be expected to decrease once the vessel has passed or the individual has moved away. No population-level effects would be anticipated. Overall, noise impacts are anticipated to be minimal because noise would primarily occur during construction (i.e., be short term) and be localized; however, if avoidance and displacement of birds occurs during seasonal migration periods or if the WEAs provide unique foraging resources not available elsewhere, there would be a higher potential for impacts.

Presence of structures: Existing structures in the Affected Environment include offshore oil and gas platforms. The presence of structures offshore may result in the loss of individuals and has the potential to result in no-to-low potential for impacts on birds such as migration disturbance and collisions. However, BOEM expects that impacts do not lead to population-level effects.

Traffic (aircraft): General aviation traffic is responsible for approximately three bird strikes per 100,000 flights (Dolbeer et al. 2023). Aircraft flying at low altitudes cause birds to flush, resulting in increased energy expenditure. Disturbance, if any, would be temporary and localized, with impacts dissipating once the aircraft has left the area. As such, aircraft traffic is expected to have low potential for impacts on birds.

Traffic (vessels): As described in Section 3.4.7, *Navigation and Vessel Traffic*, ongoing vessel traffic in the Humboldt WEA consists of primarily fishing, pleasure craft, and cargo vessels; in the Morro Bay WEA, cargo vessels were the dominant vessel type. Marine vessels traveling near surface-sitting birds can cause birds to flush, resulting in increased energy expenditure, and disrupt foraging behaviors. Disturbance, if any, would be temporary and localized, with impacts dissipating once the vessel has left the area. As such, vessel traffic impacts are not expected to appreciably contribute to overall impacts on birds.

3.3.3.3.2 Impacts of the No Action Alternative on ESA-Listed Species

There are five ESA-listed bird species that may occur within the Affected Environment; however, the potential occurrence of these listed bird species in the WEAs is expected to be low. The IPFs described in Section 3.3.3.3.1, *Impacts of the No Action Alternative,* for all birds would also apply to ESA-listed bird species. Any future federal activities that could affect any listed bird species would need to comply with ESA Section 7 to ensure that the proposed activities do not jeopardize the continued existence of the species.

3.3.3.3.3 Cumulative Impacts of the No Action Alternative

Planned activities within the Affected Environment that have the potential to affect birds include decommissioning of oil and gas platforms, military activities, use of marine and aircraft vessels, and climate change (Appendix C). Global climate change is also an ongoing threat to marine birds in the Affected Environment. Climate change is known to increase temperatures, increase ocean acidity, change ocean circulation patterns, raise sea levels, alter precipitation patterns, increase the frequency and intensity of storms, and increase freshwater runoff, erosion, and sediment deposition. Climate change could affect birds through changes in prey abundance and distribution, changes in nesting and foraging habitat abundance and distribution, altered predator communities, and changes to migration patterns and timing (Carey 2009).

Planned activities within the Affected Environment would have the same type of impacts as those described in detail in Section 3.3.3.1.1, but the impacts would be of greater intensity. These activities could affect marine birds through the following IPFs: noise and lighting, which could result in behavioral changes, and the presence of structures and vessel traffic, both of which can result in collisions and behavioral changes. Climate change has the potential to reduce reproductive output and increase individual mortality and disease occurrence. Planned activities may result in temporary and permanent impacts on marine birds, including behavioral modification, injury, and mortality.

3.3.3.3.4 Conclusions

Impacts of the No Action Alternative. Birds would continue to be affected by existing environmental trends and ongoing activities. BOEM anticipates ongoing activities to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, habitat degradation, habitat alteration) on birds primarily through construction activities and climate change. Ongoing activities would not significantly contribute to population-level impacts on birds.

Cumulative impacts of the No Action Alternative. Under the cumulative No Action Alternative, existing environmental trends and ongoing activities would continue. Birds would continue to be affected by natural and anthropogenic IPFs. Ongoing and planned activities would contribute to bird impacts due to noise, lighting, the presence of structures, vessel traffic, and climate change.

3.3.3.4 Impacts of Alternative B – Development with No Mitigation Measures – Birds

The analysis of Alternative B considers the impacts on birds from the development of one representative project in each WEA without the adoption of mitigation measures. The analysis of Alternative B also considers the impacts from the development of five representative projects to evaluate the overall impacts of a full offshore wind build-out in the subject WEAs without the adoption of mitigation measures. However, at the time of this programmatic analysis, there is little available data to analyze species distribution, abundance, and seasonal trends in marine bird presence, prey availability, or other factors in the individual WEAs, which are necessary to reach conclusive effects determinations. In the absence of these data, the effects discussions included in this analysis are presented at a high level to account for the uncertainty in potential effects compared to the No Action Alternative. Forthcoming studies supported by BOEM will be available to be incorporated into future project-specific analyses for COPs to refine impact findings.

3.3.3.4.1 Impacts of One Representative Project in Each WEA

Accidental releases: Accidental releases of fuel, fluids, hazardous materials, and trash and debris may increase because of the development of one representative project in each WEA. The risk of an accidental release would be increased primarily during construction and decommissioning when vessel usage is highest, and particularly during the potential refueling of primary construction vessels at sea. Each project would be required to comply with state and federal requirements to prevent, minimize, and control releases. The impact of accidental releases of hazardous materials and trash/debris from O&M would be the same, though slightly reduced, as that described above for construction and decommissioning. During O&M, at-sea refueling for maintenance vessels would not likely occur, thereby reducing overall risk for an accidental spill. Therefore, the potential impact from accidental releases would likely be limited for birds because most impacts would be avoided or would result in the loss of one or a few individuals and would not be greater than those described for the No Action Alternative.

Lighting: Nighttime lighting would increase with the construction and operation of up to 200 WTGs and up to 6 OSSs, and multiple vessels. Artificial lighting could represent a source of bird attraction and may pose an increased collision or predation risk to migrating birds (Hüppop et al. 2006), particularly to night-flying migrants during low-visibility weather conditions, depending on timing, location, and intensity of lighting and species' distribution. Vessel-related lighting impacts during construction and operation would be localized. In the absence of light-reduction measures (e.g., ADLS), potential offshore structure lighting impacts during operations depend on timing, location, and intensity of lighting and species' distribution, abundance, behavior, and site-specific environmental factors. Potential impacts could affect species that are vulnerable to light attraction because effects could be measurable, but population-level effects are not anticipated; therefore, the effects of lighting on marine birds would vary compared to those described for the No Action Alternative.

Cable installation and maintenance: Installation of array cables and export cables would increase suspended sediments that may affect diving birds through displacement of foraging individuals or decreased foraging success. In areas where the export cable is buried, seafloor disturbance and increased turbidity could result in temporary impacts on some benthic prey species for birds. However, suspended sediments are expected to remain localized to the area of disturbance and settle quickly to the seafloor. Therefore, impacts from suspended sediments would be short term and localized. Because the impact would be localized and short in duration, marine birds are expected to successfully forage in adjacent areas not affected by increased suspended sediment, and benthic prey species would be expected to recover from disturbance. However, if a site has unique foraging resources that are not available nearby, birds may have to travel longer distances to forage, which could be a measurable effect, but population-level effects are not anticipated. Therefore, impacts from cable installation and maintenance would be limited but may be greater depending on species' seasonal distribution and abundance and site-specific conditions.

Noise: Offshore construction noise associated with one representative project is anticipated to result in temporary and highly localized impacts limited to behavioral avoidance of construction activity. Construction of WTGs would create noise and may temporarily affect diving birds. Noise transmitted through water has the potential to result in temporary and localized displacement of diving birds during construction and dissipating when construction activities cease; however, construction of an individual project could last up to 3 years. The impacts from such noise can cause short-term stress and behavioral changes ranging from mild annoyance to escape behavior (MMS 2007). Additionally, localized noise impacts on prey species may affect bird foraging success. G&G site characterization surveys for offshore wind facilities, which would occur sporadically, would produce high-intensity impulsive noise around sites of investigation, leading to similar impacts. Construction-related noise could temporarily disturb and displace individuals and flocks of birds and alter foraging behavior, but birds should be able to avoid the noise-affected areas. Impacts could occur for marine birds if unique foraging resources present within the WEAs that are important for life-stages such as breeding are not available due to construction noise, but population-level effects are not anticipated to occur due to the temporary nature of construction.

Presence of structures: The addition of WTGs and OSSs could lead to impacts on birds. The structures, and related bird impacts would remain at least until decommissioning is complete. Impacts can occur from entanglement, gear loss/damage, migration disturbances, collision with operating WTGs, and displacement. These impacts may arise from the construction and use of WTGs, buoys, meteorological towers, foundations, scour/cable protections, and transmission cable infrastructure. BOEM predicts that structures would be added and that they would remain until decommissioning of each facility is complete, approximately 30 years following construction. Beneficial effects can occur through fish aggregation and associated increase in foraging opportunities around structures and through providing perching opportunities for species such as Peregrine Falcon, cormorants, and gulls.

Collision with operating WTGs could affect birds flying through lease areas or approaching WTGs to perch on the structure. Motion smear, a phenomenon where spinning turbine blades become deceptively transparent to the eye, can also factor into collision risk (Hodos 2003). In the contiguous United States, bird collisions with operating WTGs are a relatively rare event, with an estimated 140,000 to 500,000 (mean = 320,000) birds killed annually by 49,000 onshore turbines in 39 states (USFWS 2018). Similar broad-scale collision estimates are not currently available for offshore WTGs because estimating fatalities is more difficult to measure offshore than for land-based WTGs. Overall, bird collision rates reported from individual offshore wind facilities in Europe are relatively low due to high displacement and avoidance behavior. However, small numbers of fatalities from multiple wind energy facilities could affect the sustainability of certain seabird populations (Rezaei et al. 2023). Collision risk may differ in the Pacific OCS due to differences in the coastal and offshore environment and the bird species present, as well as patterns of bird movements along the Pacific Flyway.

A recent study of long-term data collected in the North Sea found that despite the substantial observed displacement of loons in response to the development of 20 wind farms, there was no decline in the region's local loon population (Vilela et al. 2021). However, Garthe et al. (2023) found that the distribution and abundance of loons in the North Sea shifted substantially following the construction of wind farms. Extensive foraging habitat for resident birds in the Affected Environment is expected to remain available outside of the planned wind energy facilities. However, if the planned WTGs occur in an area with unique foraging resources, there would be greater potential for impacts to occur.

The presence of new structures could result in increased prey for some local marine bird species by creating habitat for structure-oriented and hard-bottom species, typically referred to as the “reef effect” (Vanermen et al. 2013, 2014) and by providing perching opportunities. Increased foraging opportunities could attract marine birds, potentially exposing those individuals to increased collision risk associated with operating WTGs. This reef effect has been observed around fixed-bottom WTGs, which can result in local increases in biomass and diversity (Causon and Gill 2018). Recent studies have revealed increased biomass for benthic fish and invertebrates, and potentially for pelagic fish, marine mammals, and birds (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019), indicating that the construction of offshore wind energy facilities can generate beneficial permanent impacts on local ecosystems, resulting in increased foraging opportunities for individuals of local marine bird species. However, it is unclear if similar potentially beneficial effects would occur for floating WTGs.

There are few, if any, resources that show the level of bird use of the OCS and the ultimate consequences of mortality associated with operating WTGs. Leirness and others (2021) modeled distributions of 33 seabird species and 13 taxonomic groups that have the ability to occur on the Pacific OCS at a distance from shore where WTGs could be operating. However, generally the abundance of bird species that overlap with the proposed development of wind energy facilities on the Pacific OCS is relatively small (Leirness et al. 2021). Migratory landbirds have been documented on the Farallon Islands and Channel Islands (Richardson et al. 2003; Collins et al. 2021) and have the potential to pass through the California lease areas, but, overall, a small number is expected within the lease areas given their distance from shore and offshore islands. Forthcoming studies supported by BOEM will be available to be incorporated into subsequent project-specific analysis of COPs.

The Humboldt and Morro Bay WEAs are approximately 20 miles (32 kilometers) offshore. Within the Pacific Flyway along the North American Pacific Coast, much of the bird activity is concentrated along the coastline (Leirness et al. 2021). However, operation of WTGs in the WEAs could result in impacts on some individuals of bird species that are present offshore and possibly some individuals of coastal and inland bird species during spring and fall migration. These impacts could arise through direct mortality from collisions with WTGs or through behavioral avoidance and habitat loss (Drewitt and Langston 2006; Fox et al. 2006; Goodale and Millman 2016).

Many birds would avoid the WTG site altogether, especially the species that ranked “high” in vulnerability to displacement by offshore wind energy development (Adams et al. 2016). In addition, many birds would likely adjust their flight paths to avoid WTGs by flying above, below, or between them (e.g., Desholm and Kahlert 2005; Plonczkier and Simms 2012; Skov et al. 2018), and others may take extra precautions to avoid operational WTGs (Johnston et al. 2014). Vattenfall (a European energy company) recently studied bird movements within an offshore wind farm situated 1.9 to 3 miles (3 to 4.9 kilometers) off the coast of Scotland (Vattenfall 2023). The study aimed to improve the understanding of seabird flight behavior inside an offshore wind farm with a focus on the bird-breeding period and post-breeding period when densities are highest. However, the California lease areas are farther offshore than the WTGs in this study, and behavioral differences between species in the study and in the Affected Environment may result in different responses to the presence of WTGs. Seabirds were tracked inside the array with video cameras and radar tracks, which allowed for measuring avoidance movements (meso- and micro-avoidance)[1] with high confidence and at the species level. Detailed statistical analyses of the seabird flight data were enabled both by the large sample sizes and by the high temporal resolution in the combined radar track and video camera data. Meso-avoidance behavior showed that species avoided the RSZ by flying in between the turbines with very few avoiding the RSZ by changing their flight altitude to fly either below or above the rotors. The most frequently recorded adjustment under micro-avoidance behavior was birds flying along the plane of the rotor; other adjustments included crossing the rotor either obliquely or perpendicularly, with some birds crossing the RSZ without making any adjustments to the spinning rotors. The study concluded that, together with the recorded high levels of micro-avoidance in all species (greater than 0.96), seabirds would be exposed to very low risks of collision in offshore wind farms during daylight hours. This was substantiated by the fact that no collisions or even narrow escapes were recorded in over 10,000 bird videos during the 2 years of monitoring covering the April to October period. The study's calculated micro-avoidance rate (greater than 0.96) is similar to that of Skov et al. (2018). Further evidence supporting turbine avoidance can be found in Schwemmer et al. (2023), in which 70 percent of approaching Eurasian curlews (*Numenius arquata arquata*) demonstrated horizontal avoidance responses when approaching offshore wind farms in the Baltic and North Seas.

Overall, the abundance of bird species that overlap with the Humboldt and Morro Bay WEAs is relatively small. Some pelagic marine bird species could occur in higher densities during some seasons (Attachment 1, Figure 3.3.3-2 through Figure 3.3.3-44). The potential for individual species to occur in the WEAs depends on factors such as environmental conditions affecting prey populations and species' migratory pathways and foraging behavior (Leirness et al. 2021). Coastal birds are considered to have minimal exposure (occurrence) within the Humboldt and Morro Bay WEAs because the WEAs are far enough offshore to be beyond the range of most breeding terrestrial or coastal bird species.

Population collision vulnerability (PCV) and population displacement vulnerability (PDV) have been modeled for 81 marine bird species that have potential to occur within the California Current System (CCS) (Adams et al. 2016; Kelsey et al. 2018), which overlaps with the Pacific OCS. The study quantified three vulnerability indices (population, collision, and displacement) and developed PCV and PDV scores by multiplying collision and displacement vulnerability scores by a population vulnerability score for each species (Adams et al. 2016; Kelsey et al. 2018). Population vulnerability metrics include global population size, proportion of the population in the CCS, annual occurrence, adult survival, breeding score, and threat status; collision vulnerability metrics include flight activity, macro-avoidance of WTGs, and percent of time in the RSZ; and displacement vulnerability metrics include macro-avoidance of WTGs and habitat flexibility. In many cases, high collision vulnerability has been driven by four factors:

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[1] Micro-avoidance is flight behavior within and in the immediate vicinity of individual wind turbine RSZs (i.e., last-second action to avoid collision); meso-avoidance is flight behavior within and in the immediate vicinity of the wind farm (i.e., anticipatory/impulsive evasion of rows of turbines in a wind farm).

high occurrence on the OCS, low avoidance rates with high uncertainty, high population vulnerability, and proportion of time spent in the RSZ. Many of the species with potential to occur in the Affected Environment likely have low collision vulnerability, including passerines and coastal waterbirds that spend very little time on the Pacific OCS during migration. Within the CCS, pelicans, terns (Forster's [*Sterna forsteri*], Caspian [*Hydroprogne caspia*], Elegant [*Thalasseus elegans*], and Least Tern [*Sternula antillarum*]), gulls (Western [*Larus occidentalis*] and Bonaparte's Gull [*Chroicocephalus philadelphia*]), South Polar Skua (*Stercorarius maccormicki*), and Brandt's Cormorant (*Phalacrocorax penicillatus*) had the greatest PCV scores, and Brown Pelican (*Pelecanus occidentalis*) had the greatest overall PCV score. Some alcids (Scripps's Murrelet [*Synthliboramphus scrippsi*] and Marbled Murrelet [*Brachyramphus marmoratus*]), terns (Elegant and Least Tern), and loons (Yellow-Billed [*Gavia adamsii*] and Common Loon [*G. immer*]) had the greatest PDV scores. Ashy Storm-petrel (*Oceanodroma homochroa*) had the greatest overall PDV score. Results are summarized below for species with high displacement vulnerability and medium to high collision vulnerability (Adams et al. 2016). To assess the potential for marine birds to occur in the WEAs, predicted densities of representative species or taxonomic groups (Leirness et al. 2021) are presented in Attachment 1 at the end of this section. One representative species or taxonomic group from each of the bird groups in Table 3.3.3-1 was selected to provide examples of seasonal predicted density (Attachment 1, Figure 3.3.3-2 through Figure 3.3.3-44). While these results must be interpreted with caution,[2] the predicted densities provide broad examples of potential spatial distribution of birds seasonally in the Affected Environment and potential occurrence within the WEAs, which can help inform impact analysis.

Waterfowl: Brant, Surf Scoter, and Black Scoter had medium PCV due to moderate percentage of time spent flying at night and in the RSZ, and high macro-avoidance. Waterfowl species had high PDV due to high macro-avoidance. The highest predicted densities of scoters occurred in summer, followed by winter and spring, and were lowest in fall (Leirness et al. 2021). Predicted densities of scoters were mostly coastal with highest predicted densities near shore for all seasons; no medium to high densities of scoters were recorded within the WEAs (Attachment 1, Figure 3.3.3-41 through Figure 3.3.3-44)

Loons: Loons had high PDV due to high macro-avoidance, low habitat flexibility, and elevated population vulnerability. Loons are most commonly found within a few kilometers of shore and have relatively lower densities at distances offshore where the WEAs would be located. Predicted densities of loons show relatively higher densities in the winter and spring concentrated nearshore with moderate predicted density offshore in both WEAs (Attachment 1, Figure 3.3.3-5 and Figure 3.3.3-7). In summer and fall, loons were concentrated nearshore with relatively lower predicted densities in the WEAs and had lower predicted densities than in winter and spring overall (Attachment 1, Figure 3.3.3-4 and Figure 3.3.3-6).

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[2] As stated in Leirness and others (2021), the figures in Attachment 1 at the end of this section represent modeled spatial predictions of long-term average density and indicate where a species or group may be more or less abundant seasonally, rather than actual numbers of individuals. These figures must be interpreted with caution due to differing levels of uncertainty in the models and different scales of predicted density (minimum and maximum values) among species and seasons.

Grebes: Western Grebe had high PCV due to the large percentage of time flying at night and in the RSZ and high population vulnerability. However, grebes are most commonly found less than 0.3 mile (0.5 kilometer) from the coast far inshore from the WEAs. Grebes had higher predicted densities in winter (maximum 257.99 individuals/km^2) than in fall and winter, especially nearshore (Attachment 1, Figure 3.3.3-8 through Figure 3.3.3-10).

Albatrosses: Black-footed Albatross and Short-tailed Albatross had high PCV due to the large amount of time spent flying, nocturnal flight activity, moderate time spent in the RSZ, and elevated population vulnerability. Short-tailed Albatross also had high PDV due to high macro-avoidance and high population vulnerability. Both species are present over the Pacific OCS but have relatively low densities in the Affected Environment compared with other bird groups (Leirness et al. 2021). The highest predicted densities of Black-footed Albatross occurred in fall, followed by spring and summer (Attachment 1, Figure 3.3.3-11 through Figure 3.3.3-13). In winter, Black-footed Albatross had higher predicted density far offshore outside of the Affected Environment with relatively low densities in the vicinity of the WEAs (Attachment 1, Figure 3.3.3-14). In all seasons, predicted densities were higher in the Humboldt WEA than in the Morro Bay WEA.

Shearwaters: Pink-footed Shearwater, Sooty Shearwater, and Black-vented Shearwater had medium PCV. Pink-Footed Shearwater had high PDV due to high population vulnerability, high macro-avoidance, and low habitat flexibility. Black-vented Shearwater had high PDV due to high macro-avoidance and high population vulnerability. Sooty Shearwater is commonly found in the Pacific OCS, including the WEAs. Pink-footed Shearwater had highest predicted density in summer and winter (Attachment 1, Figure 3.3.3-17 and Figure 3.3.3-18), followed by fall and spring (Attachment 1, Figure 3.3.3-15 and Figure 3.3.3-16). For all seasons, the highest predicted densities were found in nearshore to offshore waters overlapping with the WEAs (Attachment 1, Figure 3.3.3-15 through Figure 3.3.3-18).

Storm-petrels: Leach’s Storm-petrel, Black Storm-petrel, and Least Storm-petrel had medium PCV. Ashy Storm-petrel had high PCV due to high population vulnerability and the large percentage of time flying at night but had a low percentage of time flying in the RSZ. Ashy Storm-petrel had high PDV due to high population vulnerability and high macro-avoidance. Leach’s Storm-petrel, Black Storm-petrel, and Least Storm-petrel occur in the Pacific OCS in low numbers in the Affected Environment. Ashy Storm-petrel breeds in California and occupies waters on the continental slope greater than 2,625 feet (800 meters) in depth. Predicted densities of Ashy Storm-petrel varied seasonally (Attachment 1, Figure 3.3.3-19 through Figure 3.3.3-21). The highest predicted densities were in summer, with relatively even distribution throughout the Affected Environment, followed by fall, with relatively higher potential to occur in the Morro Bay WEA than in the Humboldt WEA. In spring, predicted densities were lowest and concentrated in a relatively small area in the Affected Environment outside of the WEAs.

Cormorants: Brandt’s Cormorant, Double-crested Cormorant, and Pelagic Cormorant had high PCV due to the high percentage of time flying in the RSZ and large percentage of time spent flying. Cormorants have highest densities in coastal and nearshore areas; however, they are attracted to offshore oil rigs that provide roosting habitat so could be attracted to WTGs and OSSs, increasing their potential to occur offshore. Predicted density of Brandt’s Cormorant was available for spring and summer, and generalized cormorant predicted density was used for fall and winter. In all seasons, the maximum predicted density was concentrated in coastal and nearshore waters throughout the Affected Environment, decreasing to moderate predicted density offshore and overlapping the WEAs (Attachment 1, Figure 3.3.3-22 through Figure 3.3.3-25).

Pelicans: American White Pelican and Brown Pelican had high PCV due to low macro-avoidance, high percentage of time flying in the RSZ, and high population vulnerability. Brown Pelican had high PDV due to low habitat flexibility and high population vulnerability. Pelicans typically use nearshore areas and are less common offshore. The highest predicted densities of Brown Pelican occurred in summer, followed by fall and spring, and lowest in winter. In all seasons, the highest predicted densities were concentrated in coastal and nearshore waters throughout the Affected Environment with moderate to low relative densities offshore overlapping with the WEAs (Attachment 1, Figure 3.3.3-26 through Figure 3.3.3-29).

Jaegers: Pomarine Jaeger had high PCV due to year-round presence in the CCS, large percentage of time flying in the RSZ, and low macro-avoidance. Parasitic Jaeger and Long-tailed Jaeger had medium PCV. Jaegers are found in low numbers over the Pacific OCS (Attachment 1, Figure 3.3.3-30 through Figure 3.3.3-33). In fall, winter, and spring, the highest predicted densities were evenly distributed throughout the Affected Environment, including the WEAs. In summer, the highest predicted density was in the northern end of the Affected Environment farther offshore from the WEAs, with lower relative densities overlapping with the WEAs (Attachment 1, Figure 3.3.3-30 through Figure 3.3.3-33).

Alcids: Marbled Murrelet and Scripps's Murrelet had medium PCV. Common Murre, Pigeon Guillemot, Marbled Murrelet, Scripps's Murrelet, Craveri's Murrelet, Cassin's Auklet, and Tufted Puffin had high PDV due to year-round presence in the CCS and high macro-avoidance. Marbled Murrelets are typically found in nearshore waters, rarely greater than 3.1 miles (5 kilometers) from shore. The highest predicted densities in summer and spring were concentrated in nearshore waters, particularly near the Humboldt WEA (Attachment 1, Figure 3.3.3-2 and Figure 3.3.3-3). Predicted density within the WEAs was low, approaching the minimum predicted density value in the Morro Bay WEA.

Gulls: Bonaparte's Gull, Heermann's Gull, California Gull, Ring-billed Gull, Western Gull, Thayer's Gull, and Glaucous-winged Gull had high PCV due to year-round presence in the CCS and moderate percentage of time spent flying in the RSZ. Black-legged Kittiwake, Sabine's Gull, and Herring Gull had medium PCV. California Gull predicted densities were highest nearshore, with high to moderate predicted densities offshore overlapping with the WEAs (Attachment 1, Figure 3.3.3-34 through Figure 3.3.3-37). Seasonally, predicted density of California Gull was highest in winter and lowest in summer when individuals are found closer to nesting colonies onshore and on coastal islands.

Terns: Least Tern had high PCV due to the large percentage of time flying in the RSZ, nocturnal flight activity, and high population vulnerability. Least Tern had high PDV due to high macro-avoidance and high population vulnerability. Caspian Tern, Common Tern, Arctic Tern, Forster's Tern, Royal Tern, Elegant Tern, and Black Skimmer had high PCV due to the large percentage of time flying in the RSZ, nocturnal flight activity, and high population vulnerability. Terns had relatively low predicted densities within the Affected Environment compared with other species. Relative densities in spring and fall were highest offshore overlapping with the WEAs (Attachment 1, Figure 3.3.3-38 through Figure 3.3.3-40).

Overall, collision and displacement and habitat loss impacts on birds due to presence of structures in the Affected Environment would vary, depending on species' distribution and abundance, behavior, and site-specific environmental factors. For landbird species with very low potential to occur offshore, presence of structures impacts may not be measurable or would result in loss of only a few individuals. For marine birds with potential to occur within the WEAs, impacts could range from loss of a few individuals, to unavoidable, severe, long-term population or habitat effects. Impacts on some marine bird species (i.e., Black-footed Albatross and Marbled Murrelet) would likely be higher in the Humboldt WEA due to higher predicted densities in the northern portion of the Affected Environment. In the Morro Bay WEA, impacts on species such as Ashy Storm-petrel would likely be higher due to relatively higher predicted density of the species in the southern portion of the Affected Environment.

Traffic (aircraft): Offshore wind activities may employ helicopters and fixed-wing aircraft for transporting construction or maintenance crew or monitoring during construction activities. Aircraft noise could temporarily disturb and displace individuals and flocks of birds, and birds could collide with project-related aircraft. With implementation of regulatory requirements and the irregular occurrence of project aircraft traffic, bird impacts would not increase beyond those described for the No Action Alternative.

Traffic (vessels): Offshore wind activities would involve use of various marine vessels (e.g., installation, cable-laying, support, transport/feeder, deck carriers, and crew vessels) during construction. Increased vessel traffic could temporarily disturb and displace individuals and flocks of birds and alter foraging behavior; birds could also collide with project-related vessels, but most species should be able to avoid construction-related vessels. The impacts from vessels may also affect bird foraging success by displacing prey species. Vessel traffic impacts would dissipate when construction activities cease; however, construction of an individual project could last up to 3 years. Impacts could occur for marine birds if unique foraging resources present within the WEAs that are important for life-stages such as breeding are not available due to increased presence of marine vessels, but population-level effects are not anticipated to occur due to the temporary nature of construction. Therefore, the effects of vessel traffic on marine birds are expected to vary depending on timing and location of vessel traffic, species' distribution, abundance, and behavior, and other site-specific environmental factors.

3.3.3.4.2 Impacts of Five Representative Projects

There would be greater potential for impacts on birds due to the greater amount of offshore development under five representative projects compared to one representative project in each WEA. Although the intensity of the impacts discussed in Section 3.3.3.4.1 would be higher with five representative projects, the impact would be similar as those anticipated for one representative project, depending on site-specific conditions that would be analyzed further at the COP stage (Table 3.3.3-3). Therefore, impacts on birds in the offshore environment under five representative projects are anticipated to occur, depending on individual species' abundance, behavior, and site-specific environmental conditions.

3.3.3.4.3 Impacts of Alternative B, Development with No Mitigation Measures, on ESA-Listed Species

The potential occurrence of ESA-listed bird species within the WEAs is expected to be low. The IPFs described in Section 3.3.3.4.1 for all birds would also apply to ESA-listed bird species. BOEM would need to comply with ESA Section 7 to analyze the effects of Alternative B on listed bird species and to determine if implementation of Alternative B would jeopardize the continued existence of these species.

3.3.3.4.4 Cumulative Impacts of Alternative B, Development with No Mitigation Measures

Cumulative impacts on birds from Alternative B combined with ongoing and planned activities would contribute to the primary IPFs of accidental releases, cable installation and maintenance, noise, lighting, presence of structures, traffic (aircraft), and climate change.

The cumulative impacts on birds would vary in severity due to the construction and presence of WTGs within the Affected Environment that could result in unavoidable impacts offshore. The impact severity would vary with bird distribution and abundance within the Affected Environment, individual species' behavior, and site-specific environmental factors. The impacts of five representative projects would have a higher intensity, but overall impacts would be within the same range as for the cumulative impacts of one representative project, depending on site-specific conditions. In context of reasonably foreseeable environmental trends, Alternative B would contribute to the cumulative impacts related to accidental releases, lighting, cable installation and maintenance, presence of structures, and traffic (aircraft) on birds.

3.3.3.4.5 Conclusions

Impacts of Alternative B. Construction, O&M, and decommissioning of Alternative B, whether one representative project in each WEA or five representative projects, would have impacts on birds depending on the offshore lighting scheme, the duration and timing of construction activities, and affected species. Operation of the offshore WTGs (including lighting) would pose the largest risk and could lead to long-term impacts in the form of mortality and displacement. Alternative B could also result in increased foraging opportunities for some marine birds, although the potential benefit associated with floating WTGs is not conclusive. Forthcoming studies supported by BOEM would be available to be incorporated into subsequent project-specific analysis of COPs to refine the effects determination.

Cumulative impacts of Alternative B. Cumulative impacts on birds would vary in severity under one or five representative projects. In the context of other reasonably foreseeable environmental trends, incremental impacts on birds contributed by Alternative B would occur. Alternative B would contribute to cumulative impacts primarily through permanent impacts from the presence of offshore structures.

3.3.3.5 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Birds

Alternative C, the Proposed Action, is the adoption of mitigation measures intended to avoid or reduce Alternative B's potential impacts. The analysis for this alternative is presented as the change in impacts from those discussed under Alternative B. Appendix E, *Mitigation*, identifies the mitigation measures that would be included in the Proposed Action. Table 3.3.3-4 provides a summary of the mitigation measures relevant to birds.

Table 3.3.3-4. Summary of mitigation measures for birds

Measure ID	Measure Summary
MM-11	This measure requires all vessels traveling to the project location to comply with vessel strike avoidance measures, including avoiding areas of visible bird aggregations, adhering to a 100-meter avoidance zone around surface-sitting birds, reducing vessel speed to 4 knots if operational safety prevents avoidance, and incident reporting.
MM-13	This measure creates annual reporting requirements for dead or injured birds or bats, which would improve the overall understanding of bird and bat interactions with wind farms.
MM-14	This measure requires lessees prepare a Bird and Bat Monitoring Plan, which will be used to determine the need for adjustments to monitoring approaches, consideration of new monitoring technologies, and/or additional periods of monitoring and describes reporting requirements for injured and dead ESA-listed species.
MM-15	This measure requires lessees to install bird and bat tracking technology on project infrastructure to address information gaps of offshore movements of selected species of birds and bats.
MM-16	This measure requires installation of bird deterrent devices (e.g., anti-perching or other deterrent devices) where appropriate on project facilities and preparation of a Bird Deterrent Plan, which will identify how deterrent devices will be incorporated along with a monitoring plan for the life of the project, to reduce potential bird collisions with WTGs.
MM-17	This measure requires lessees to minimize impacts on avian species to the maximum extent practicable. Consistent with, and not conflicting with, any measures that may result from USCG requirements, the lessee must use any additional lighting only when necessary, and such lighting must be shielded downward and directed, when possible, to minimize use of high intensity lighting, and reduce upward illumination and illumination of adjacent waters.
MM-18	This measure requires preparation of a conservation strategy for migratory birds and bats. The conservation strategy will provide a framework for identifying and implementing actions to conserve birds and bats during project planning, construction, operation, maintenance, and decommissioning and for assessing impacts; avoiding, minimizing, and mitigating impacts; guiding current actions; and planning future impact assessments and actions to conserve birds and bats. If BOEM determines, through consultation with USFWS, that compensatory mitigation is appropriate, the conservation strategy would outline actions to offset take of ESA-listed birds and birds protected under the MBTA.
MM-4	This measure requires all vessels to travel at 10 knots or less during project-related activities and within the lease areas.
MM-7	This measure recommends following the most current International Maritime Organization's guidelines for reduction of underwater radiated noise.

3.3.3.5.1 Impacts of One Representative Project in Each WEA

Mitigation measures under Alternative C could potentially reduce impacts on birds related to lighting, noise, and presence of structures. Alternative C does not include mitigation measures specific to reducing impacts of accidental releases, cable installation, and aircraft traffic on birds; therefore, the impact levels for those IPFs would remain the same as for Alternative B, and they are not discussed further in this section.

Lighting: Implementation of light impact reduction measures for birds (MM-17) could reduce potential collisions with WTGs by using additional lighting only when necessary and shielding and directing lights downward could minimize the potential for these lights to be an attractant to migratory birds and reduce the potential for collision with WTGs. This could reduce the potential impacts from nighttime lighting on birds.

Noise: Construction noise from offshore activities may temporarily disturb and displace some bird species. The use of underwater noise-reduction measures (MM-7) and construction-related measures in the Bird and Bat Conservation Strategy (MM-18) would likely reduce this impact. However, birds may still be displaced by noise during construction, depending on species and site-specific factors, similar to Alternative B.

Presence of structures: Installation of bird deterrent devices on project infrastructure (MM-16) would reduce the risk of collisions with WTGs and OSSs. MM-18 would require a Bird and Bat Conservation Strategy to identify and implement actions to conserve birds during project planning, construction, operation, maintenance, and decommissioning, which would reduce the risk of injury, mortality, and disruption of normal behaviors of marine birds. Implementation of monitoring outlined in the Bird and Bat Monitoring Plan (MM-14) and installation of tracking technology on project infrastructure (MM-15) would provide a baseline for comparison with post-construction survey results and improve the overall understanding of bird interactions with offshore wind farms through monitoring and reporting requirements. The immediate reporting of dead or injured ESA-listed birds and annual reporting of any dead or injured birds would improve understanding of bird interactions with offshore wind structures and may reduce overall impacts on birds over time (MM-13, MM-14). While implementation of these measures would reduce impacts on marine birds relative to Alternative B, impacts could still occur, depending on species and site-specific factors, similar to Alterative B.

Traffic (vessels): Implementation of vessel strike avoidance measures (MM-11) and speed limits (MM-4) for project-related vessels during all phases of the project would reduce the potential for collisions and disruption of normal behaviors of birds. However, if operational safety prevents vessels from avoiding surface-sitting birds or adhering to speed limits, impacts may still occur, similar to Alternative B.

If BOEM determines, through consultation with USFWS or other agencies, that compensatory mitigation is appropriate, the Bird and Bat Conservation Strategy would outline actions needed to offset take of ESA-listed or bird species protected under the MBTA, and specific components of a Compensatory Mitigation Plan would be developed during the COP stage (MM-18).

Adoption of mitigation measures would reduce the impacts from presence of WTGs relative to Alternative B; however, unavoidable impacts may still occur. Therefore, presence of structures could result in impacts, depending on species and site-specific factors, similar to Alternative B.

3.3.3.5.2 Impacts of Five Representative Projects

The same IPF impact types and mechanisms described under one representative project in each WEA apply to five representative projects. There is a greater likelihood for impacts due to the increased amount of offshore development under five representative projects. However, with implementation of the mitigation measures described above and in Appendix E, and the localized nature of most impacts, impacts of five representative projects are expected to be similar to those of one representative project in each WEA. Therefore, impacts from accidental releases, cable installation and maintenance, lighting, noise, presence of structures, and vessel traffic are expected to vary in severity as discussed in Section 3.3.3.5.1, *Impacts of One Representative Project in Each WEA*.

3.3.3.5.3 Impacts of Alternative C on ESA-Listed Species

Adoption of mitigation measures would result in similar reductions in impacts for ESA-listed birds as described for all birds, with the exception of MM-14, which requires immediate reporting of injured and dead ESA-listed species. As stated previously, the presence of ESA-listed bird species in the offshore environment would generally be limited, with more potential effects occurring from onshore activities (Section 3.3.4, *Coastal Habitat, Fauna, and Wetlands*).

3.3.3.5.4 Cumulative Impacts of Alternative C

Under Alternative C, cumulative impacts on birds would occur and vary in severity as described for Alternative A. While adoption of mitigation measures is expected to reduce impacts, there could be unavoidable impacts offshore, and severity of impacts would depend on individual species' distribution and abundance, flight behavior, and site-specific environmental factors. Alternative C would be unlikely to contribute a noticeable increase to the cumulative impacts related to accidental releases, lighting, cable installation and maintenance, noise, presence of structures, traffic (aircraft), and climate change on birds.

3.3.3.5.5 Conclusions

Impacts of Alternative C. Construction, O&M, and decommissioning of one representative project or five representative projects under Alternative C would result in impacts on birds depending on the duration of activities performed, species' distribution and abundance, flight behavior, and site-specific environmental conditions. Forthcoming studies supported by BOEM would be available to be incorporated into subsequent project-specific analysis of COPs. Mitigation measures would provide some certainty in reducing bird impacts in the offshore environment and, therefore, could reduce potential impacts on birds compared to those under Alternative B. However, unavoidable impacts could occur. Noise effects from construction are expected to be limited to temporary and localized behavioral avoidance that would cease once construction is complete. Alternative C could also result in increased foraging opportunities for some marine birds, although the benefit from floating WTGs is not conclusive.

Cumulative impacts of Alternative C. In context of reasonably foreseeable environmental trends, the incremental impacts on birds contributed by Alternative C would be minor to major depending on species distribution and abundance. Alternative C would contribute to cumulative impacts primarily through construction-related noise and collision with turbines. Implementation of mitigation measures would provide some certainty in reducing impacts on birds in the offshore environment; however, unavoidable impacts could occur.

Attachment 1: Modeled Predicted Density of Representative Marine Birds in the Affected Environment

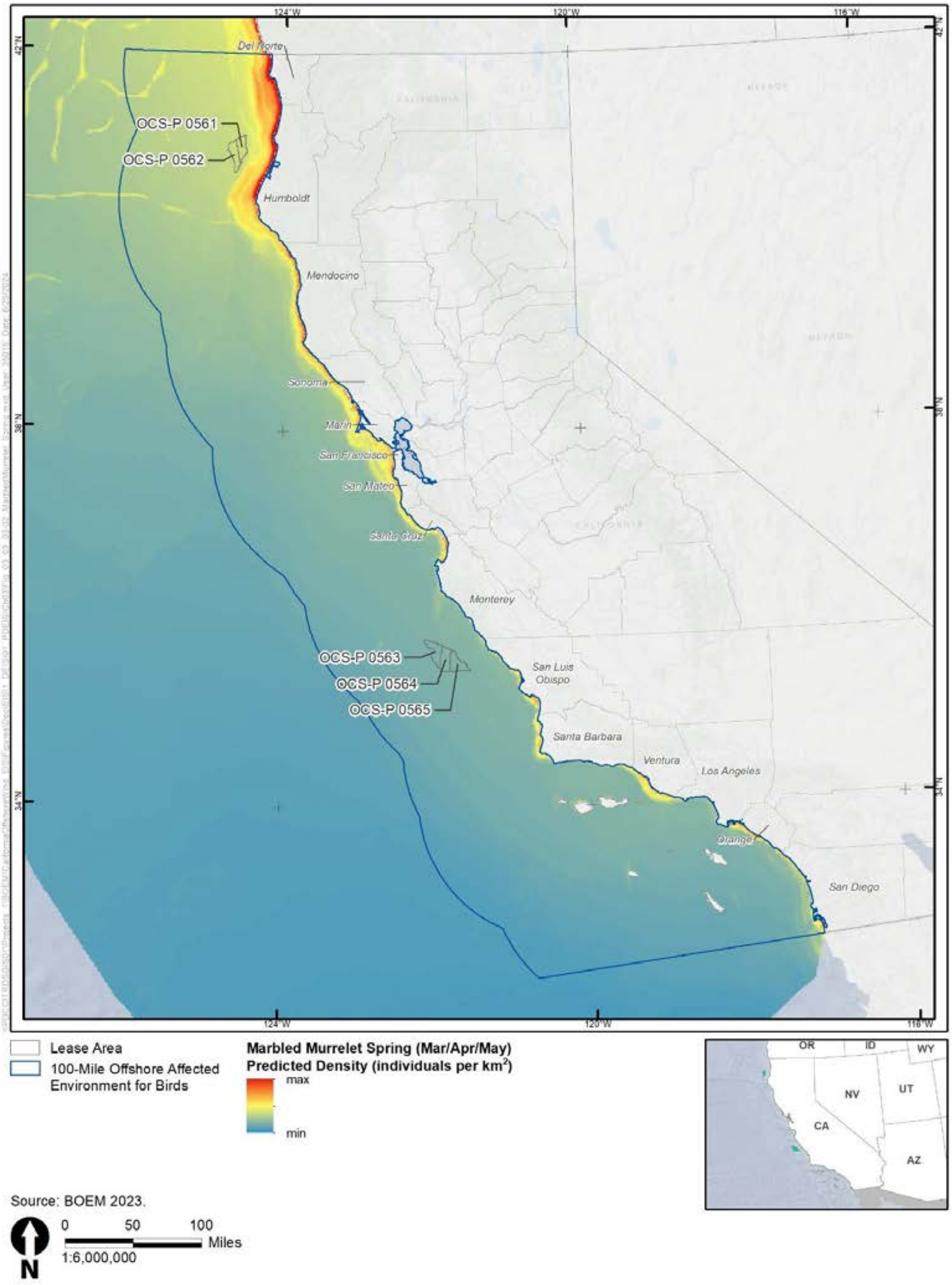

Figure 3.3.3-2. Modeled predicted density of Marbled Murrelet in the Affected Environment, spring

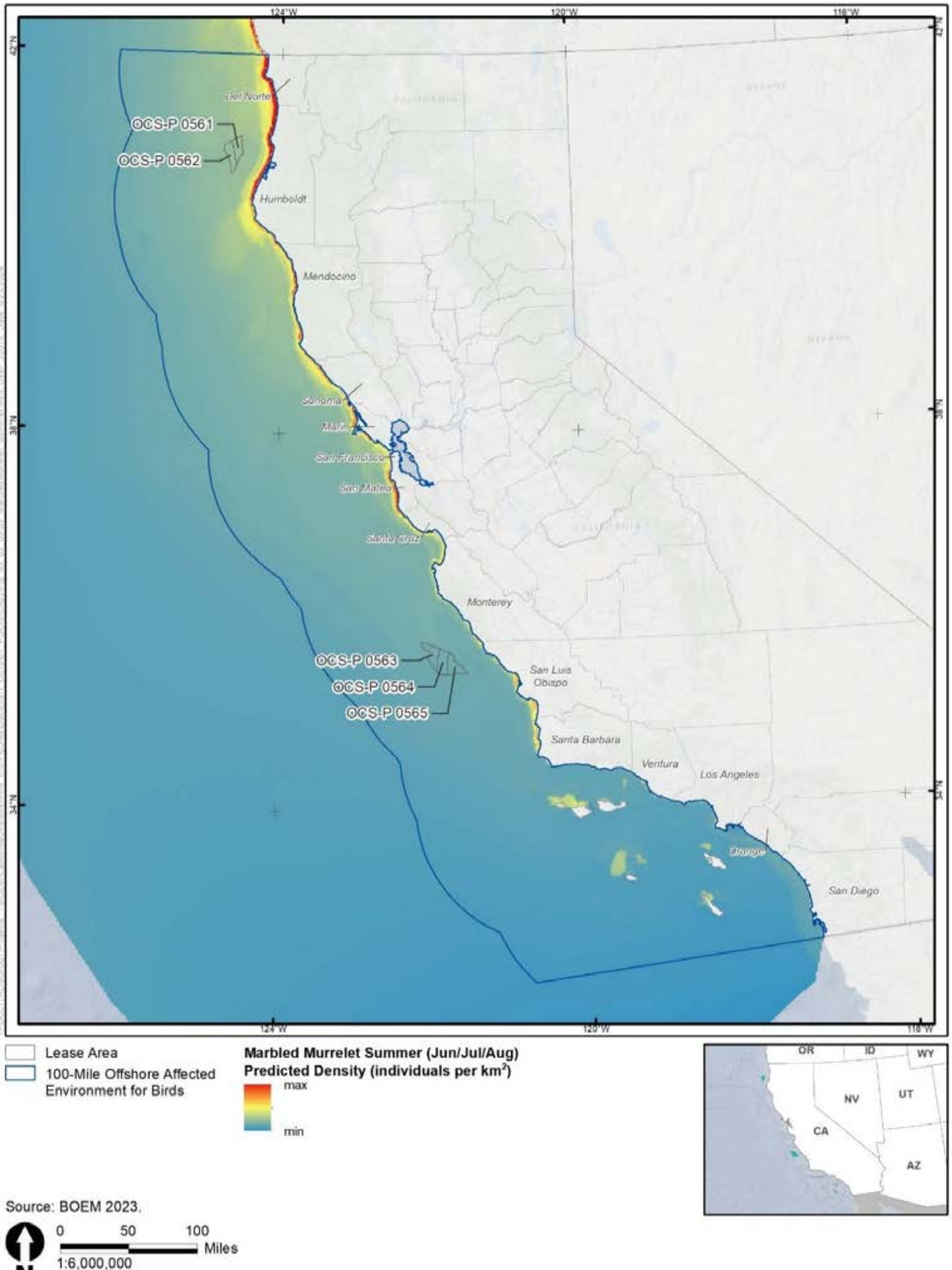

Figure 3.3.3-3. Modeled predicted density of Marbled Murrelet in the Affected Environment, summer

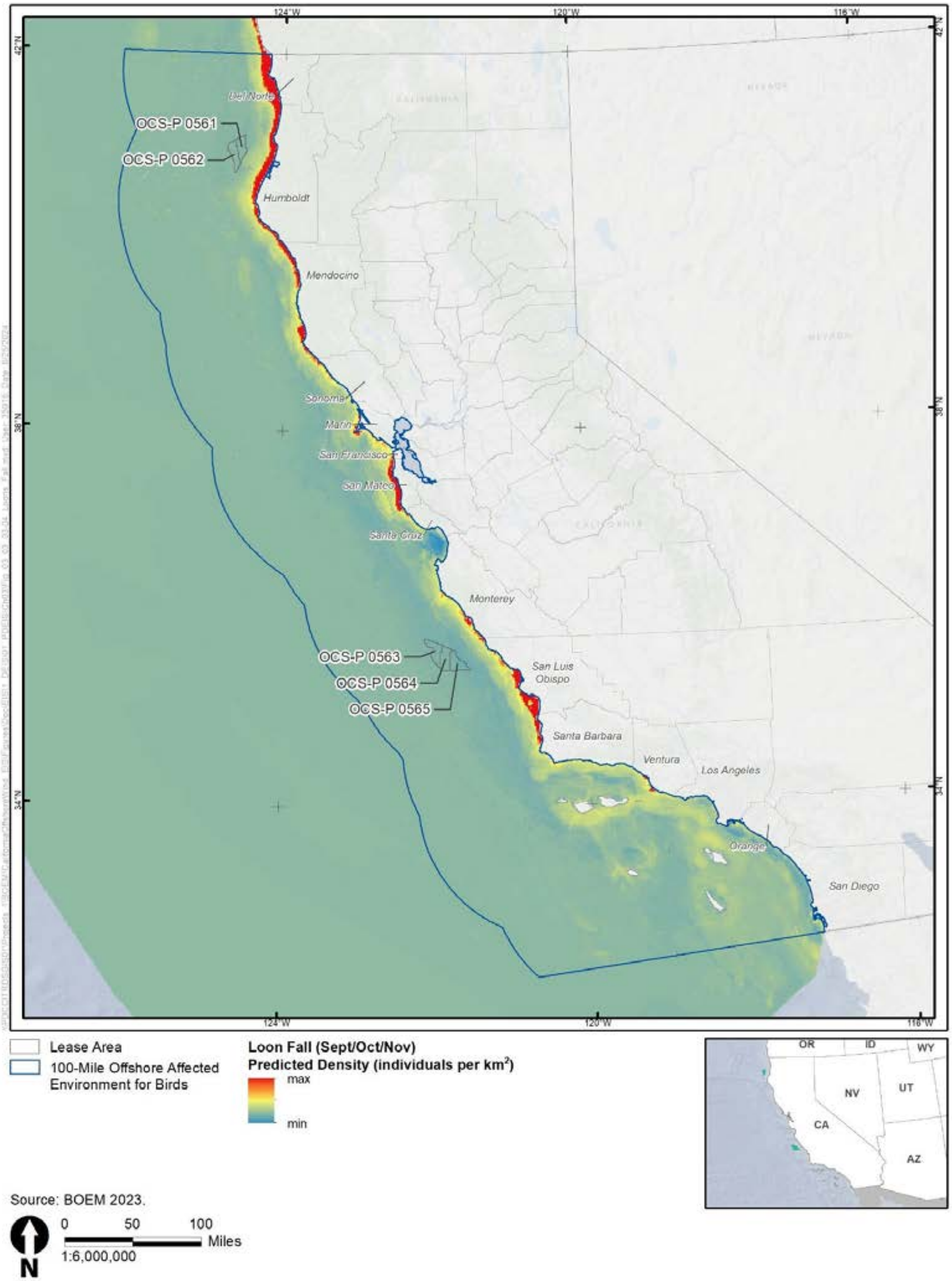

Figure 3.3.3-4. Modeled predicted density of loons in the Affected Environment, fall

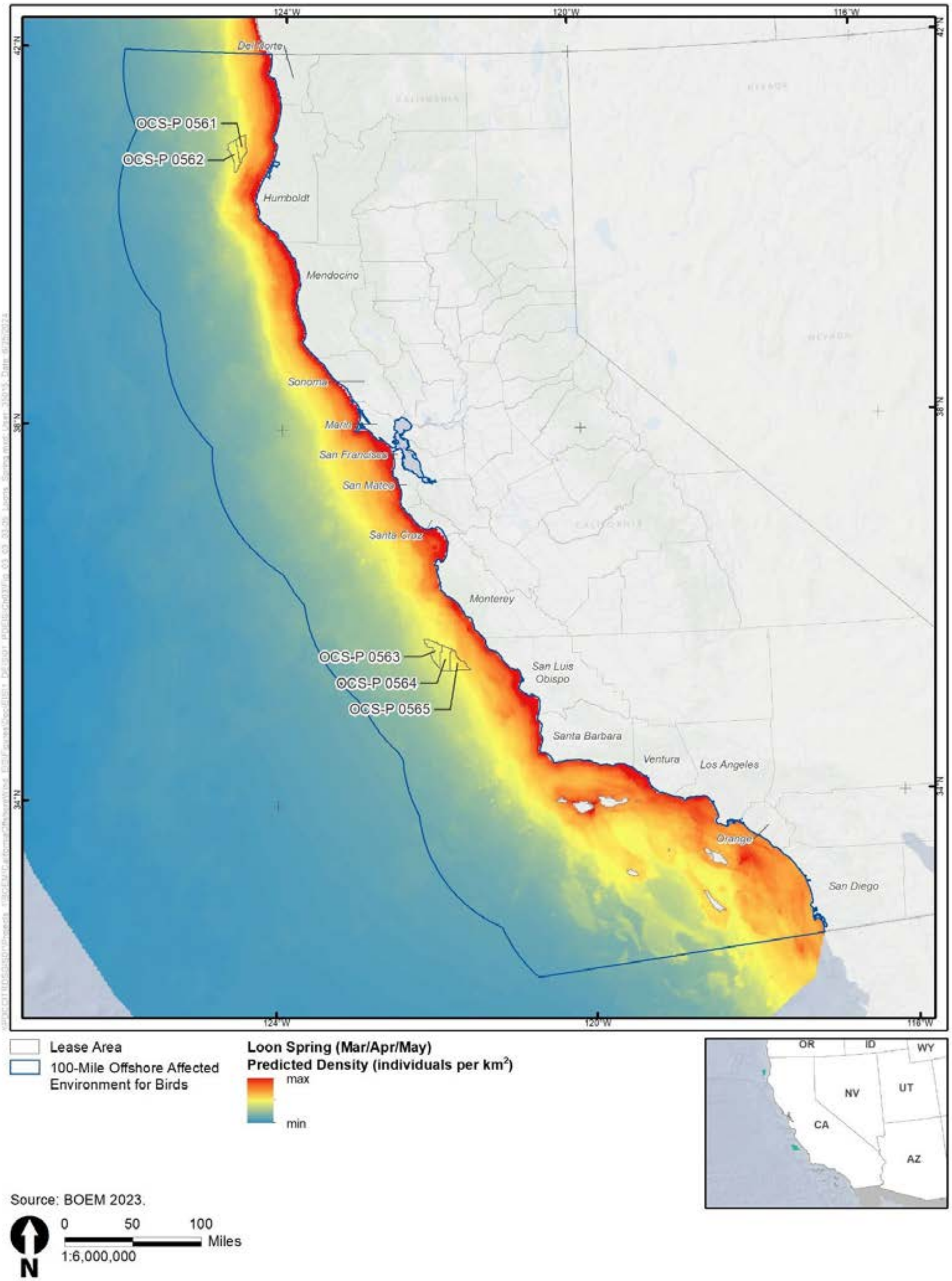

Figure 3.3.3-5. Modeled predicted density of loons in the Affected Environment, spring

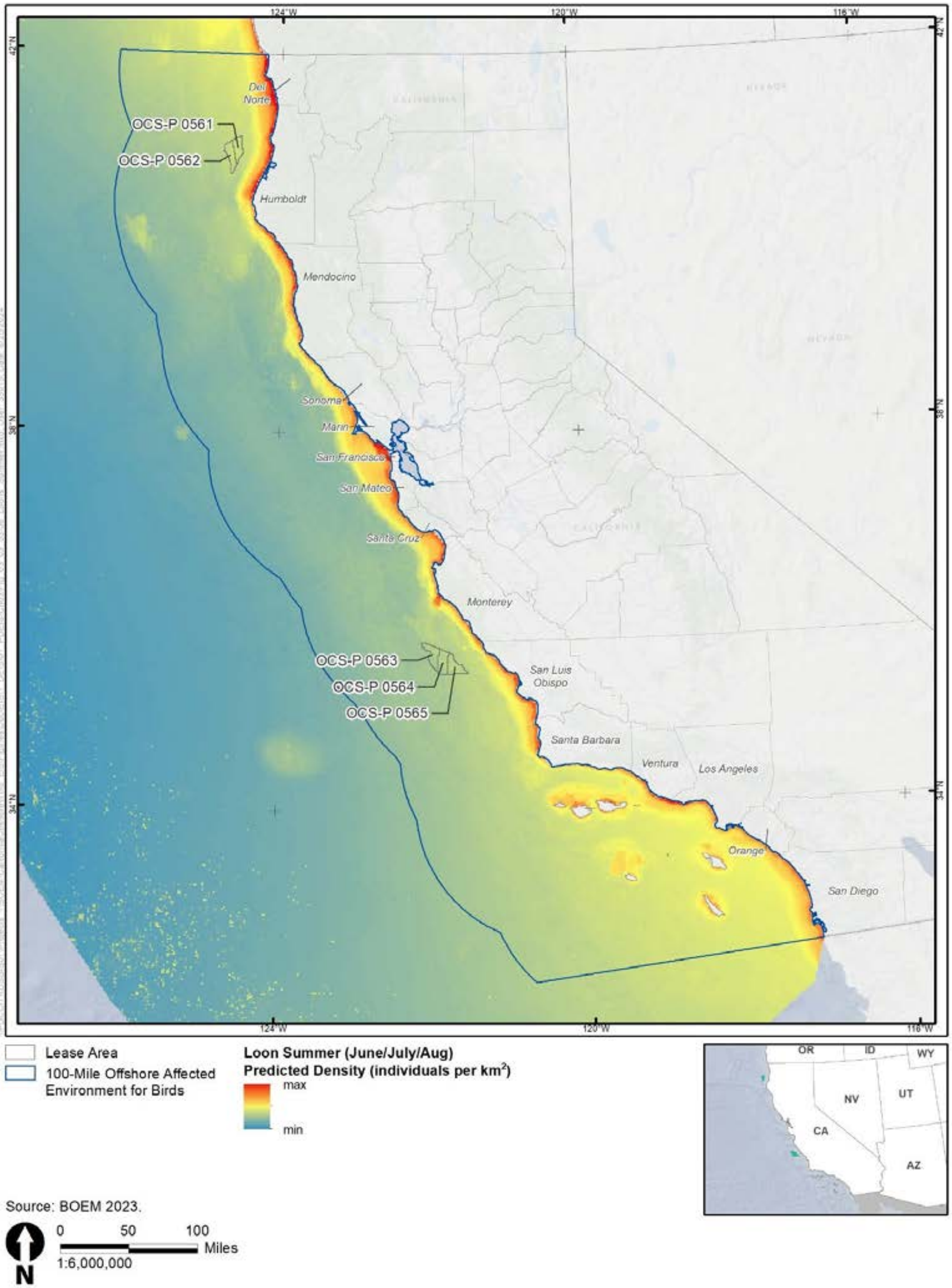

Figure 3.3.3-6. Modeled predicted density of loons in the Affected Environment, summer

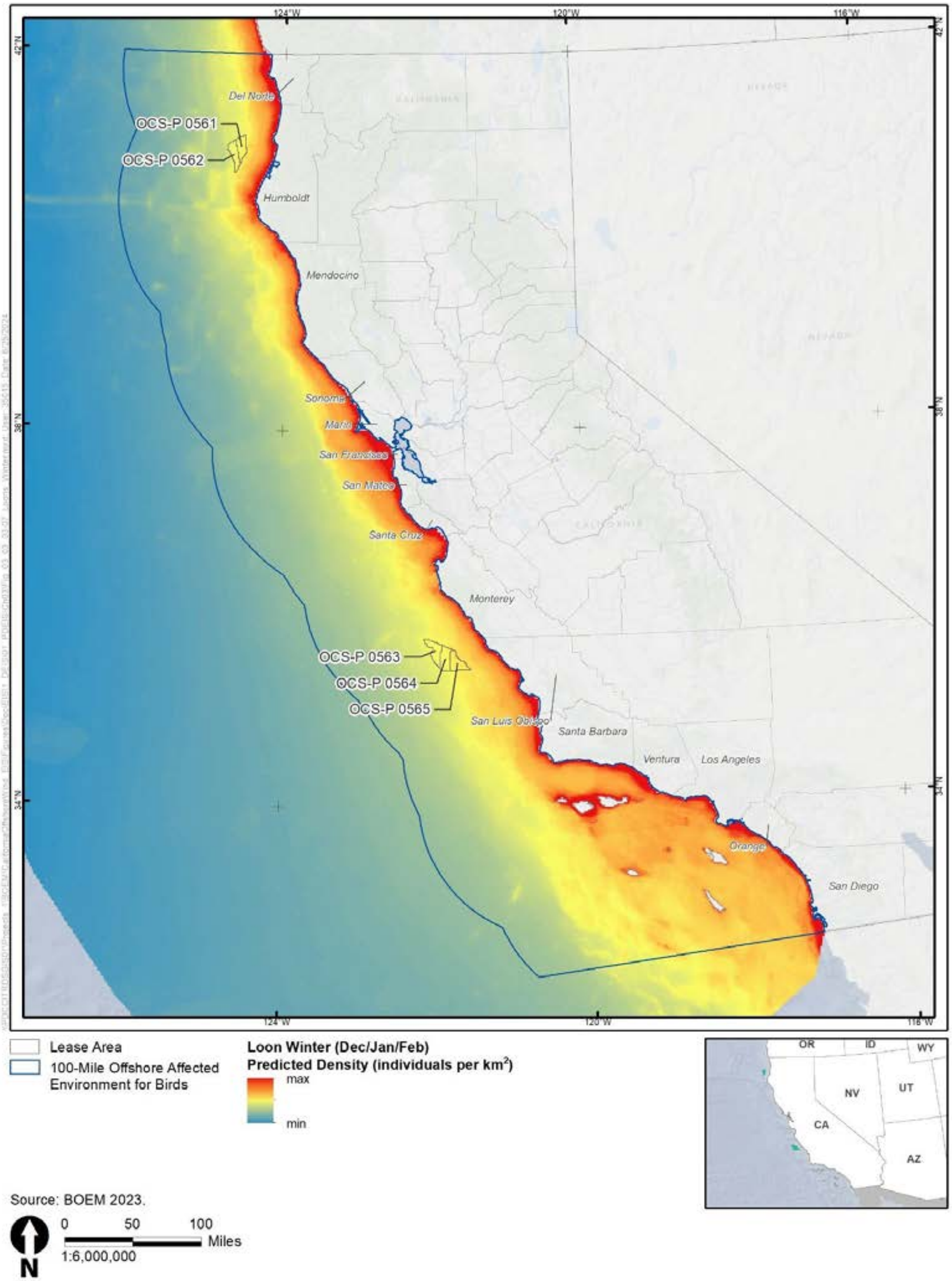

Figure 3.3.3-7. Modeled predicted density of loons in the Affected Environment, winter

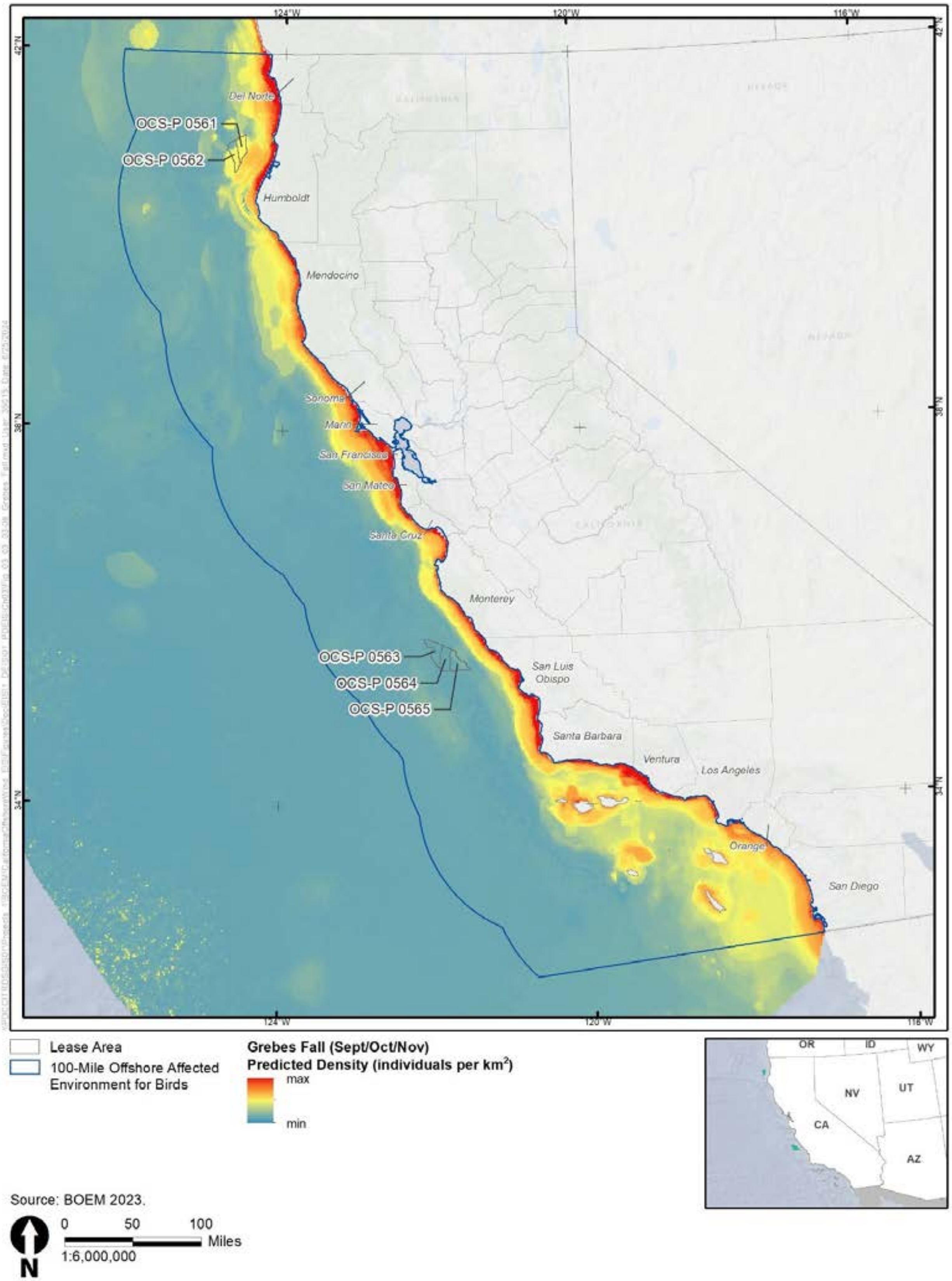

Figure 3.3.3-8. Modeled predicted density of grebes in the Affected Environment, fall

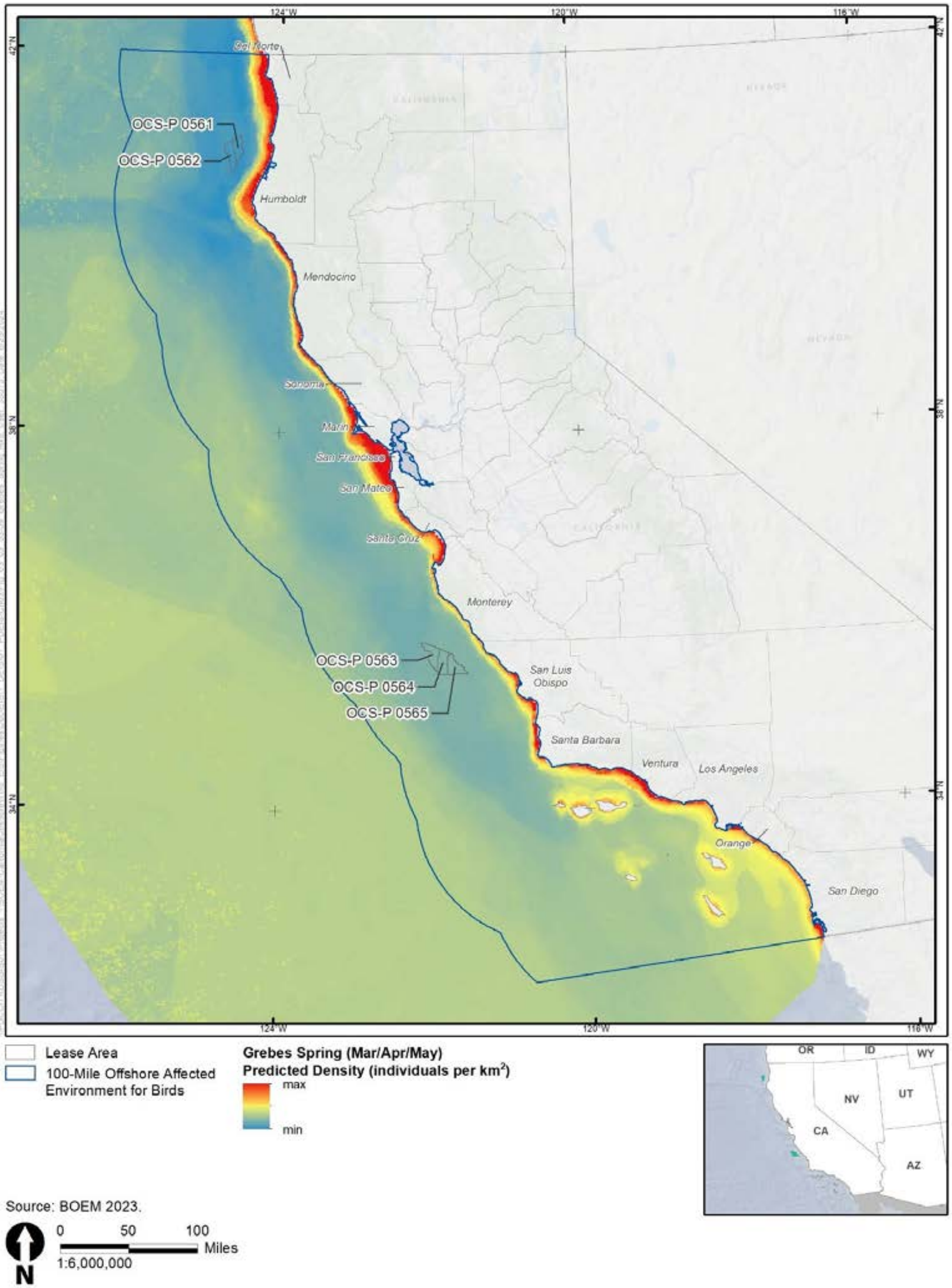

Figure 3.3.3-9. Modeled predicted density of grebes in the Affected Environment, spring

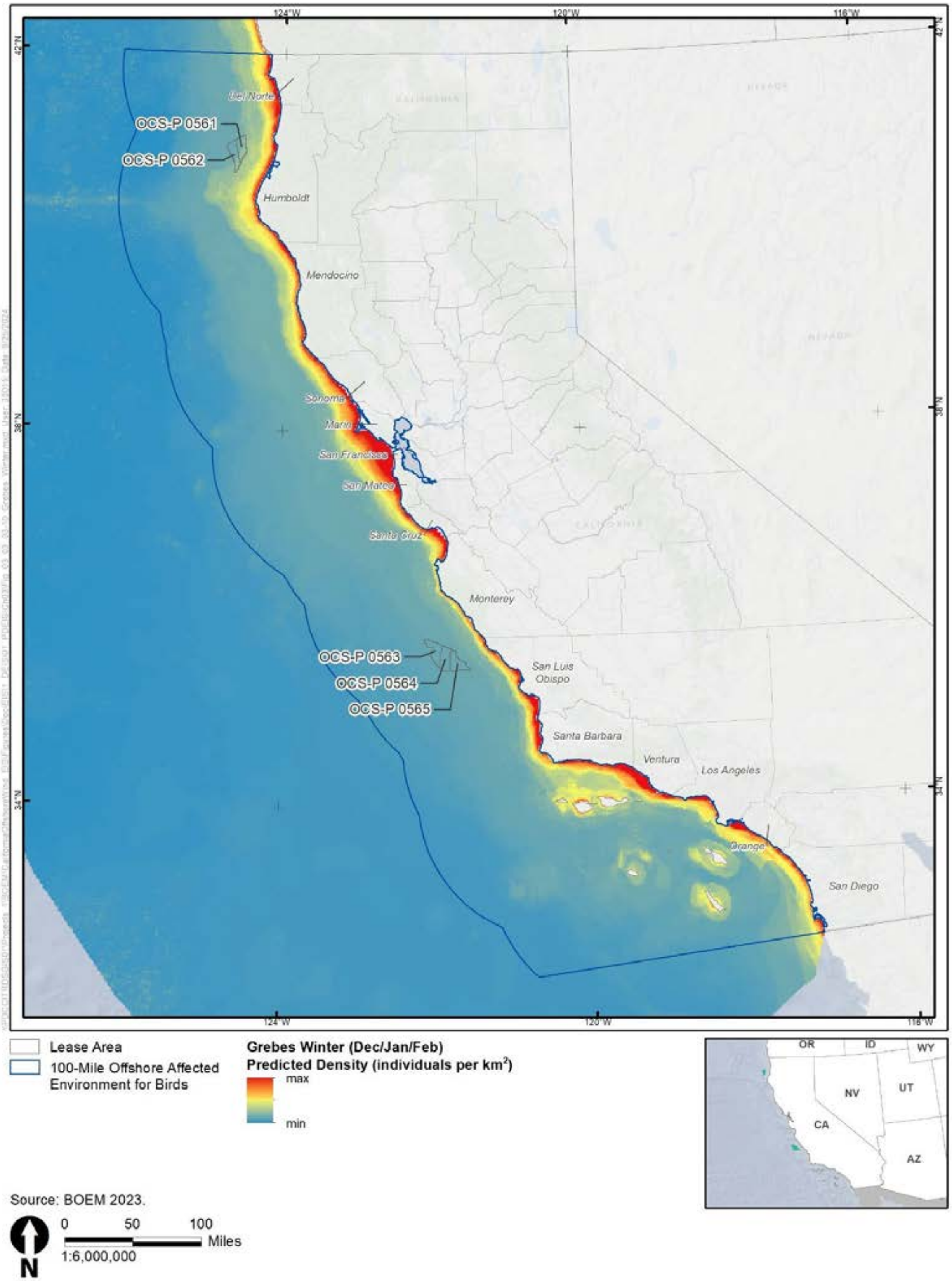

Figure 3.3.3-10. Modeled predicted density of grebes in the Affected Environment, winter

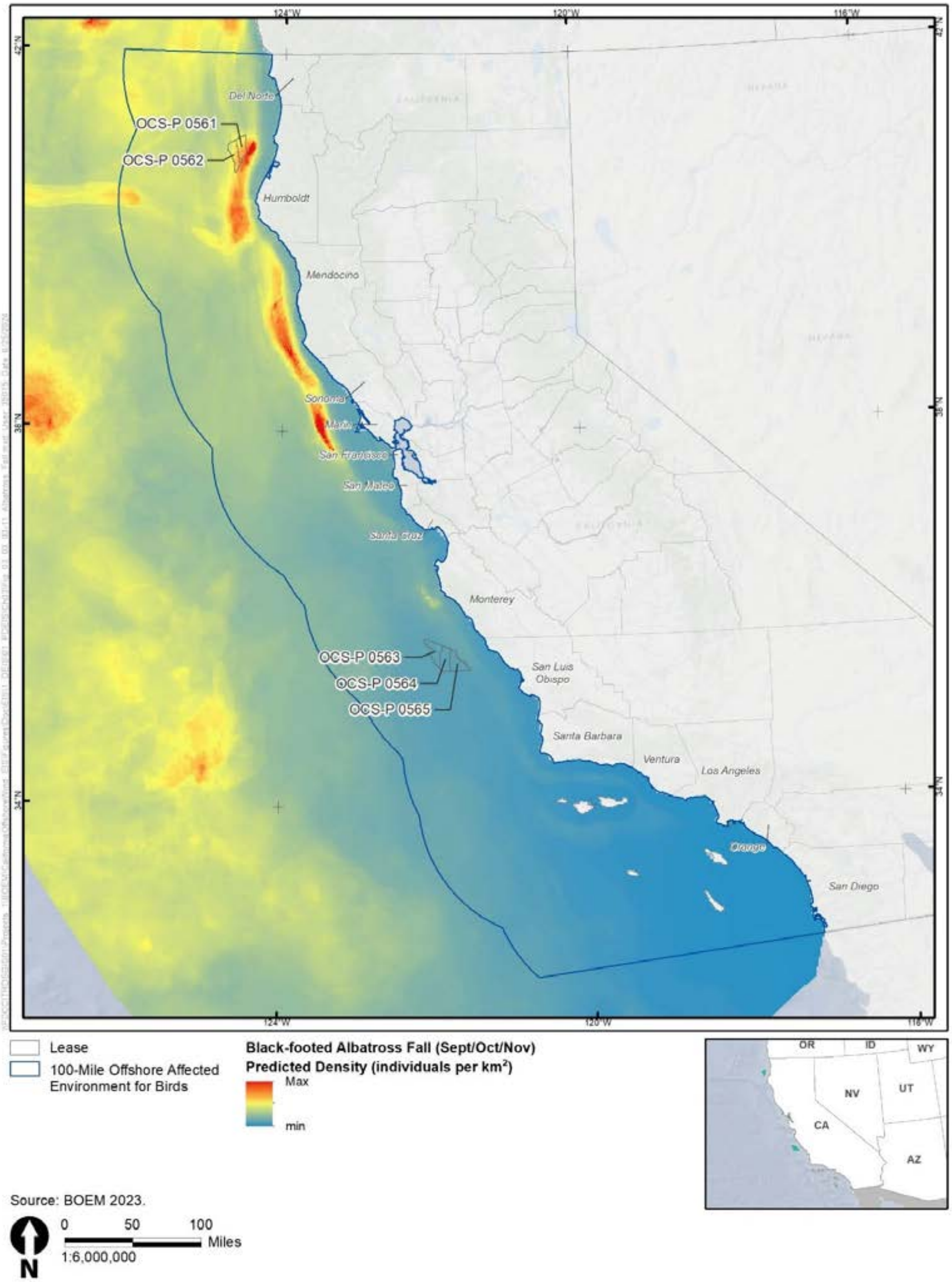

Figure 3.3.3-11. Modeled predicted density of Black-footed Albatross in the Affected Environment, fall

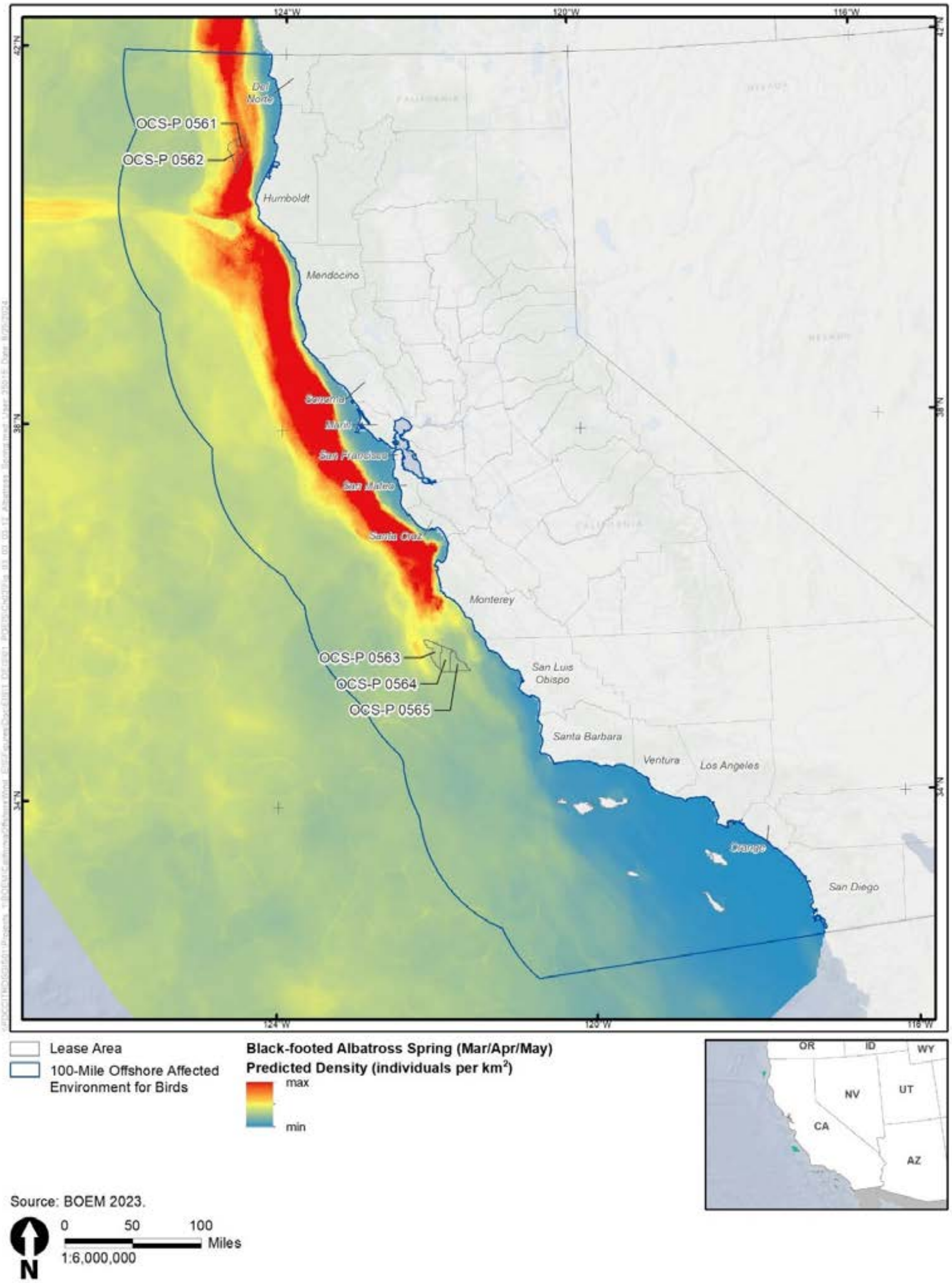

Figure 3.3.3-12. Modeled predicted density of Black-footed Albatross in the Affected Environment, spring

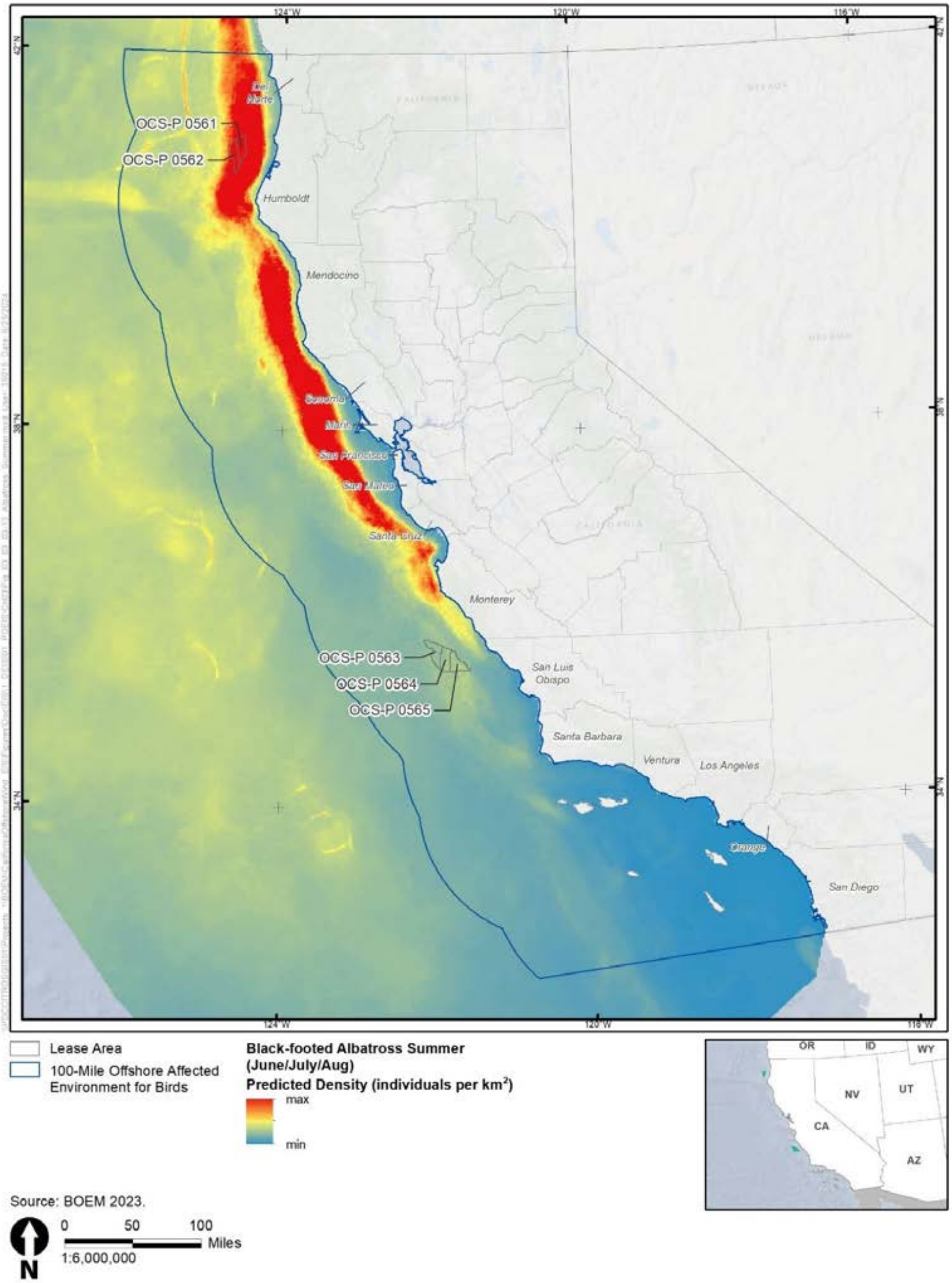

Figure 3.3.3-13. Modeled predicted density of Black-footed Albatross in the Affected Environment, summer

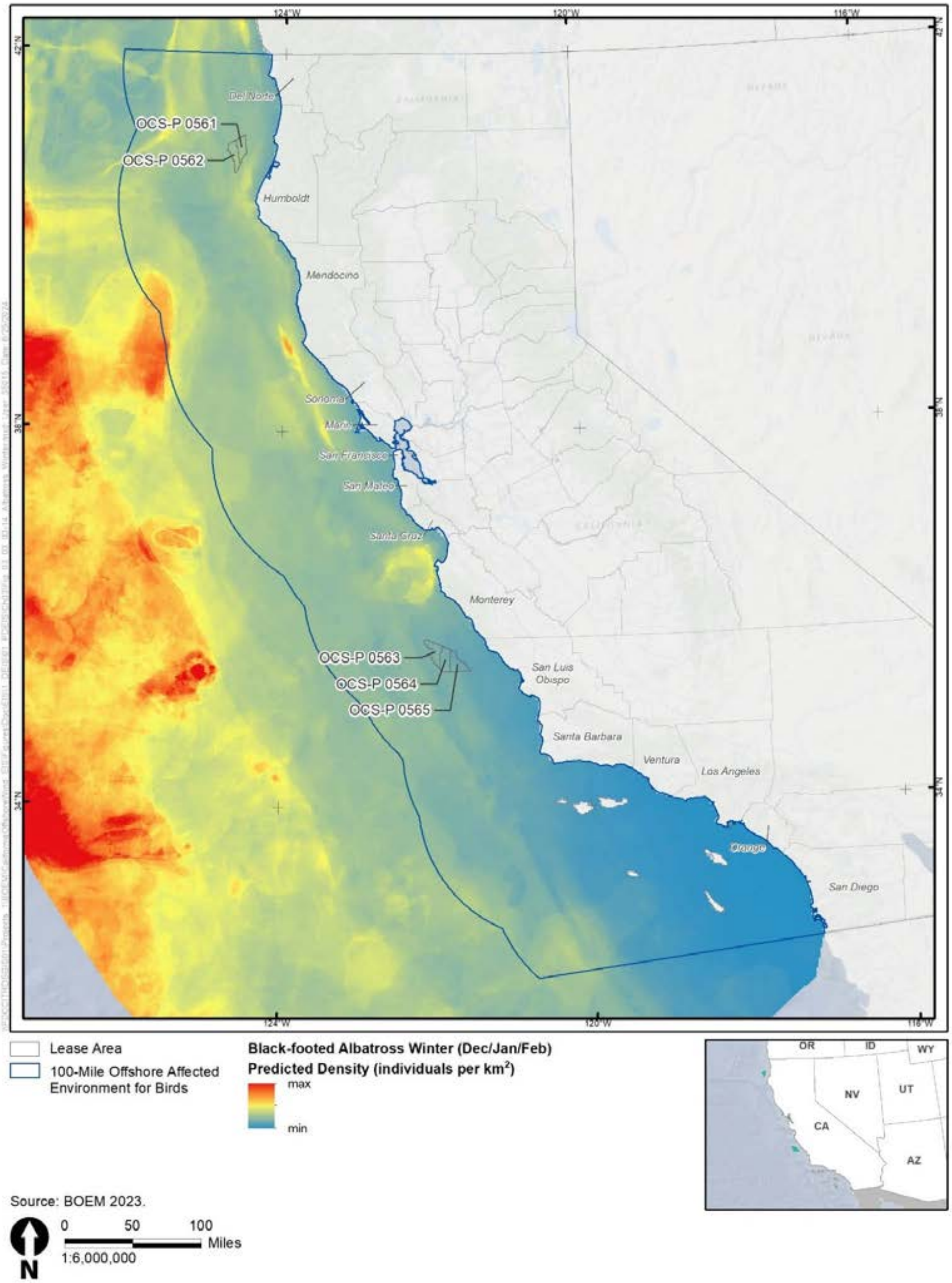

Figure 3.3.3-14. Modeled predicted density of Black-footed Albatross in the Affected Environment, winter

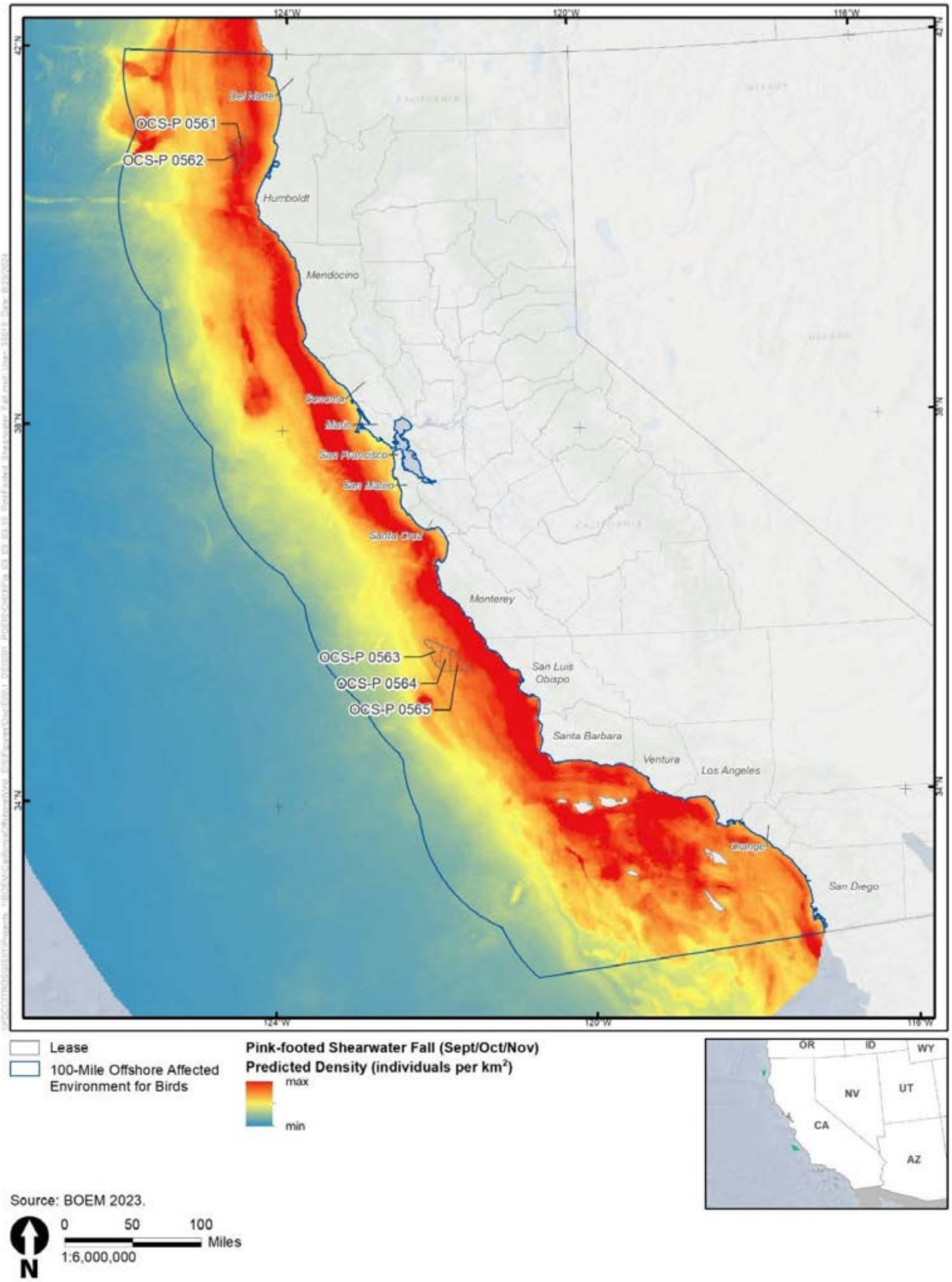

Figure 3.3.3-15. Modeled predicted density of Pink-footed Shearwater in the Affected Environment, fall

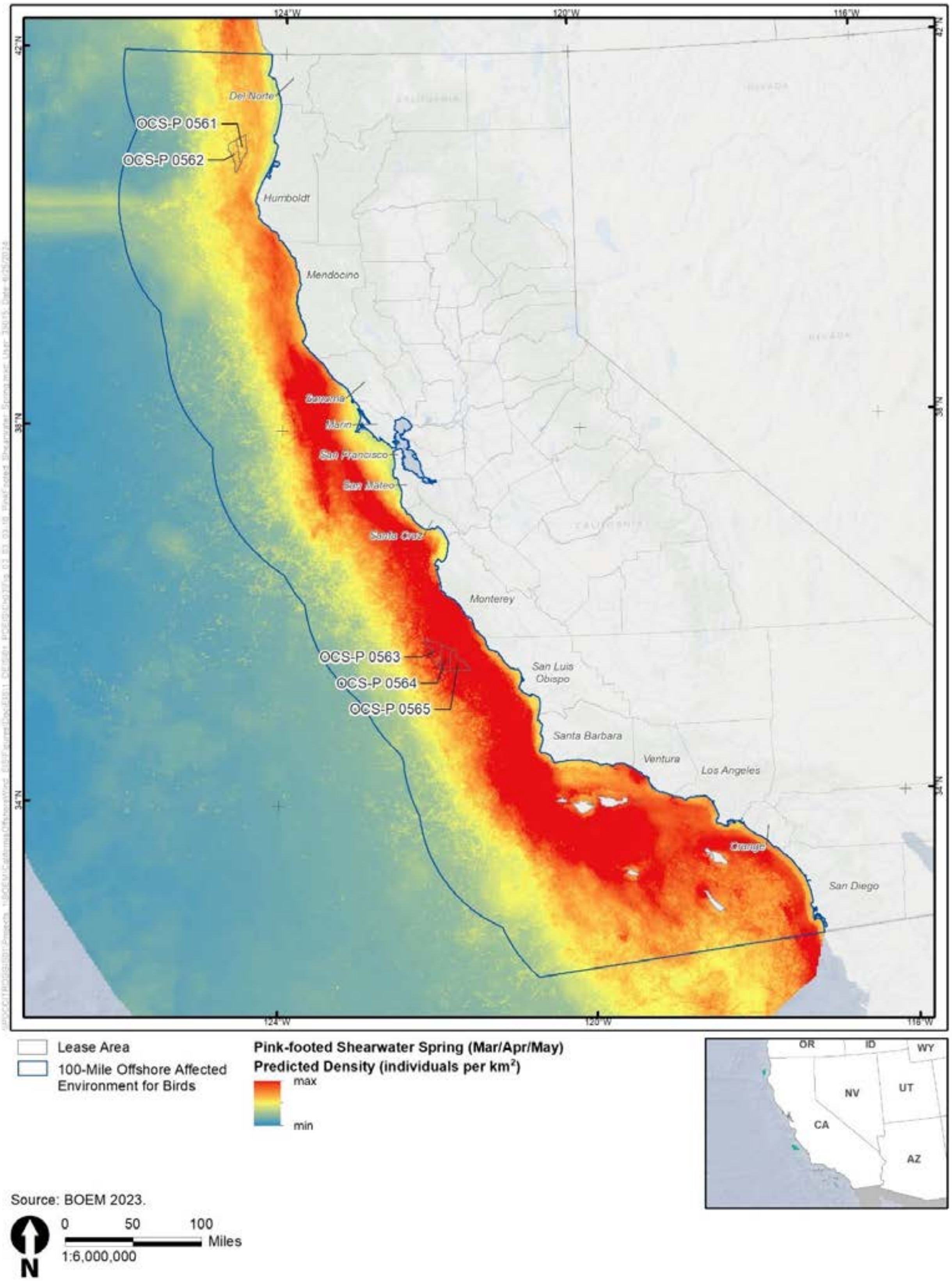

Figure 3.3.3-16. Modeled predicted density of Pink-footed Shearwater in the Affected Environment, spring

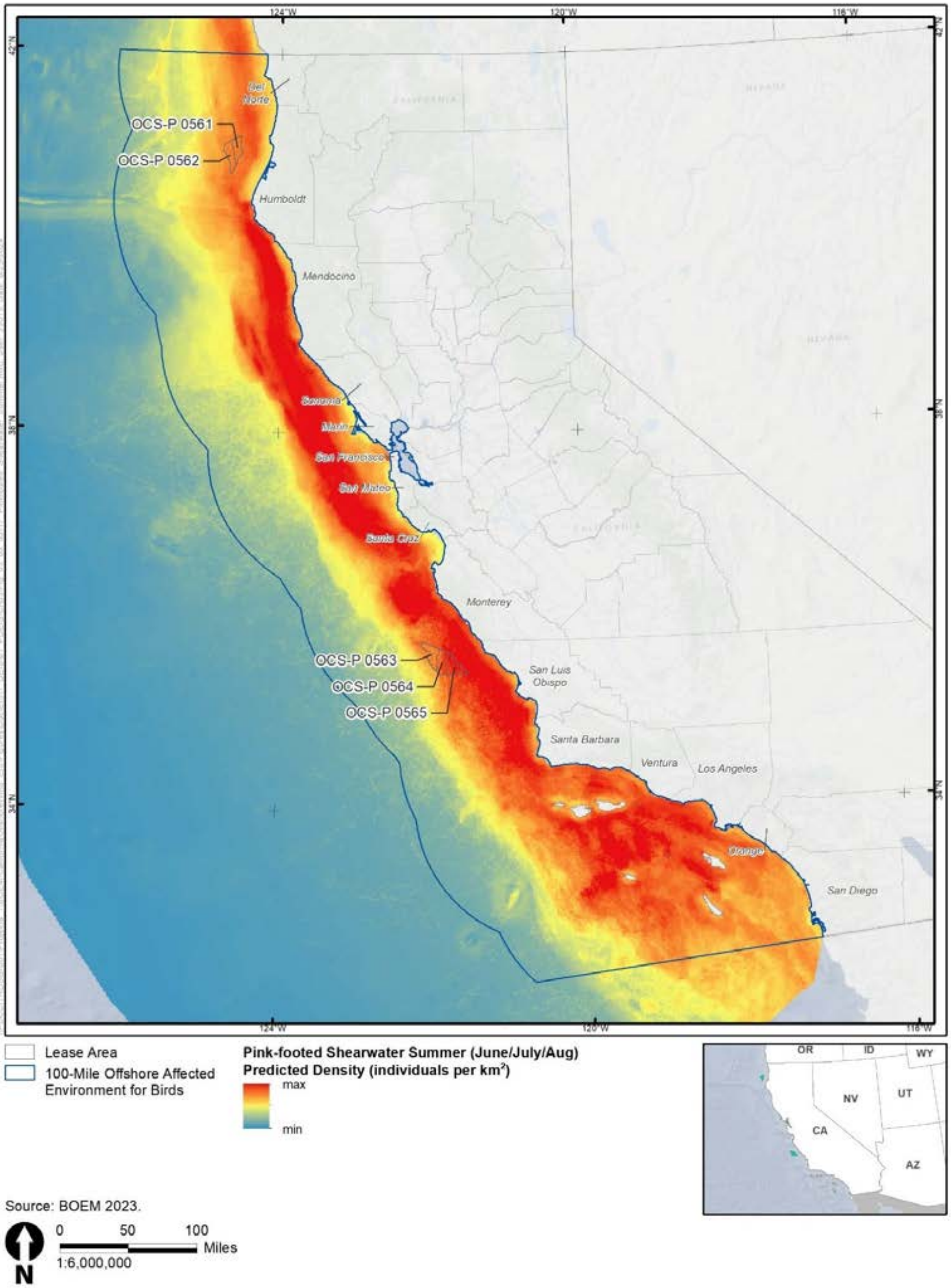

Figure 3.3.3-17. Modeled predicted density of Pink-footed Shearwater in the Affected Environment, summer

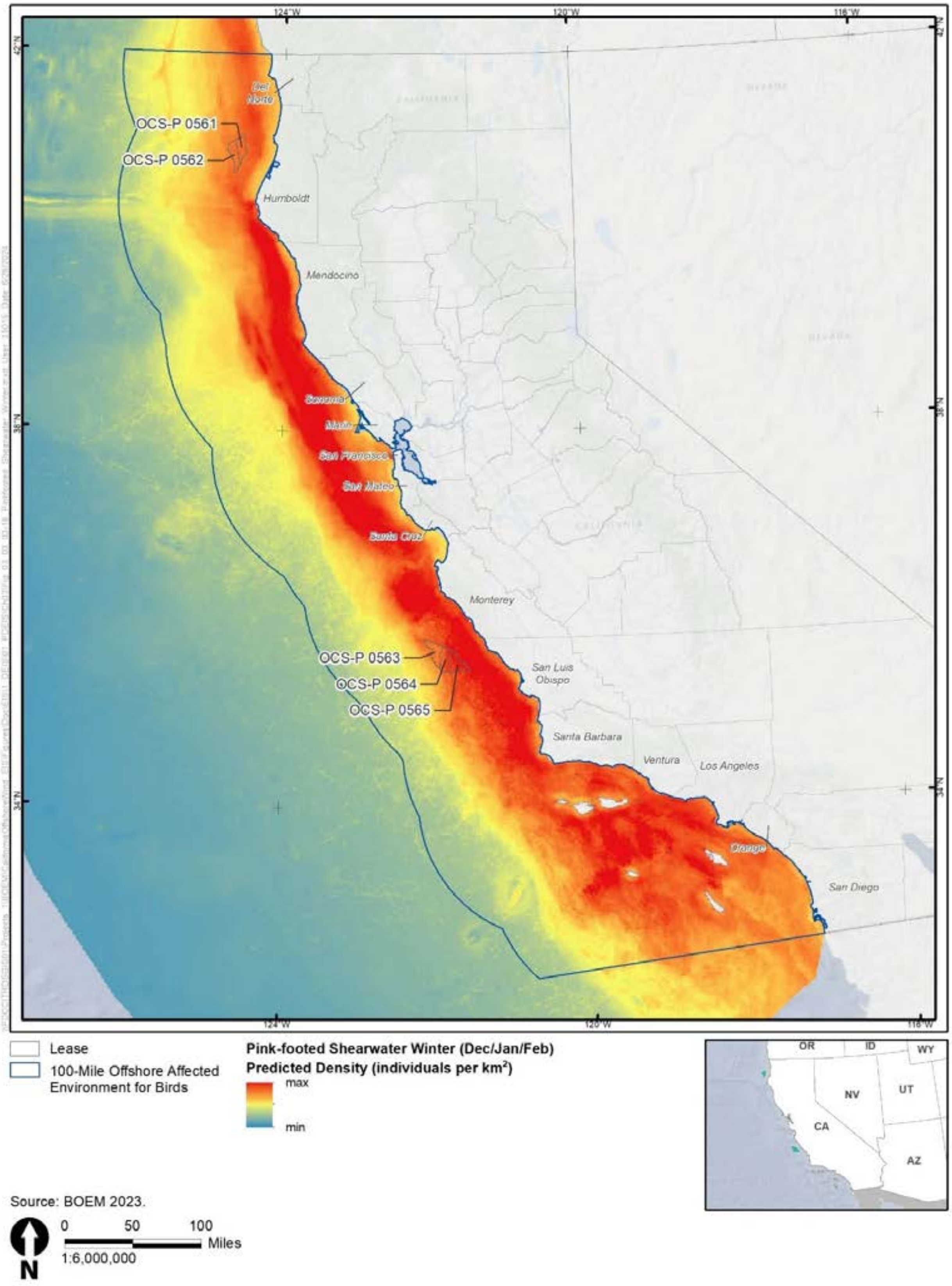

Figure 3.3.3-18. Modeled predicted density of Pink-footed Shearwater in the Affected Environment, winter

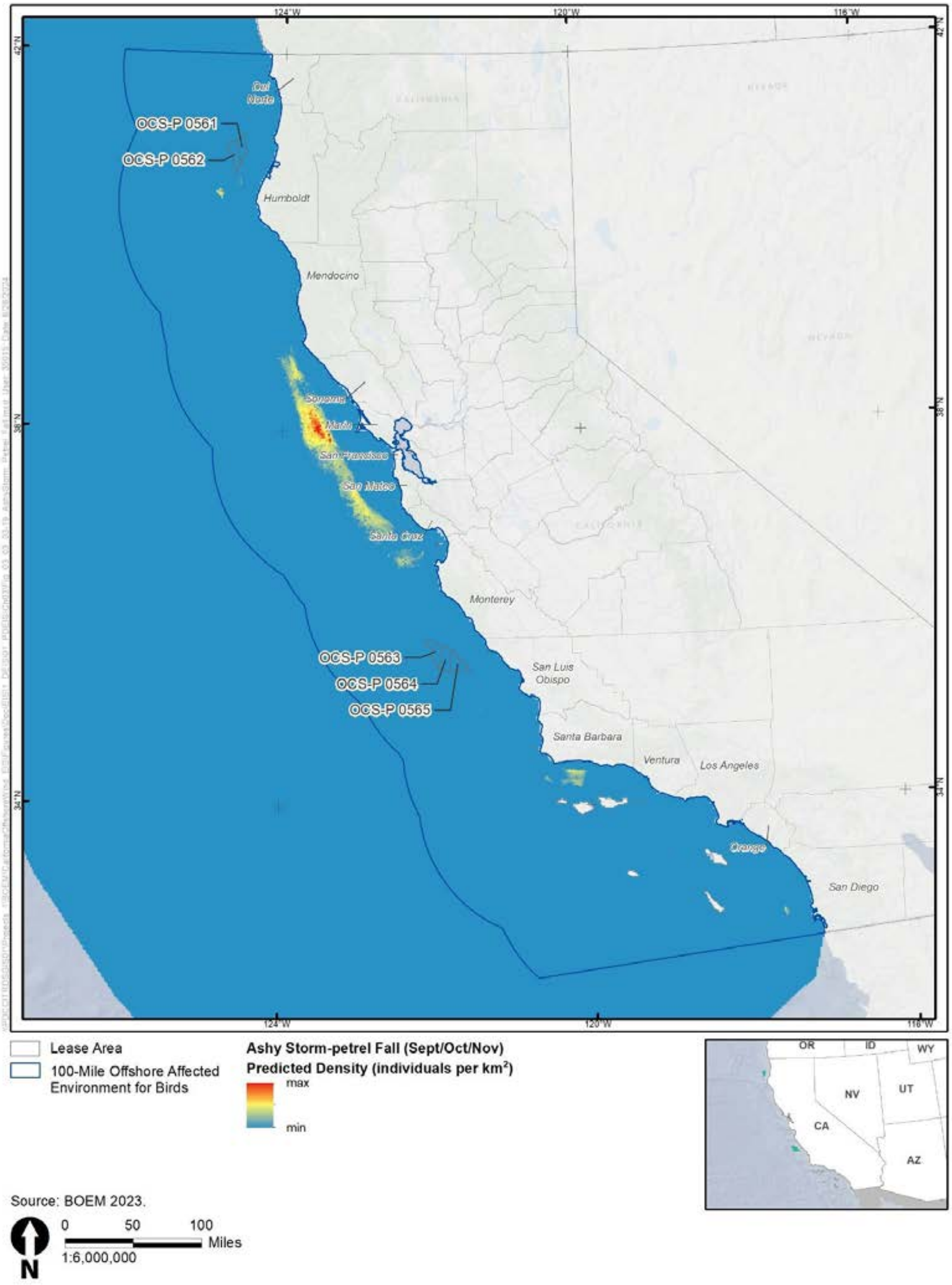

Figure 3.3.3-19. Modeled predicted density of Ashy Storm-petrel in the Affected Environment, fall

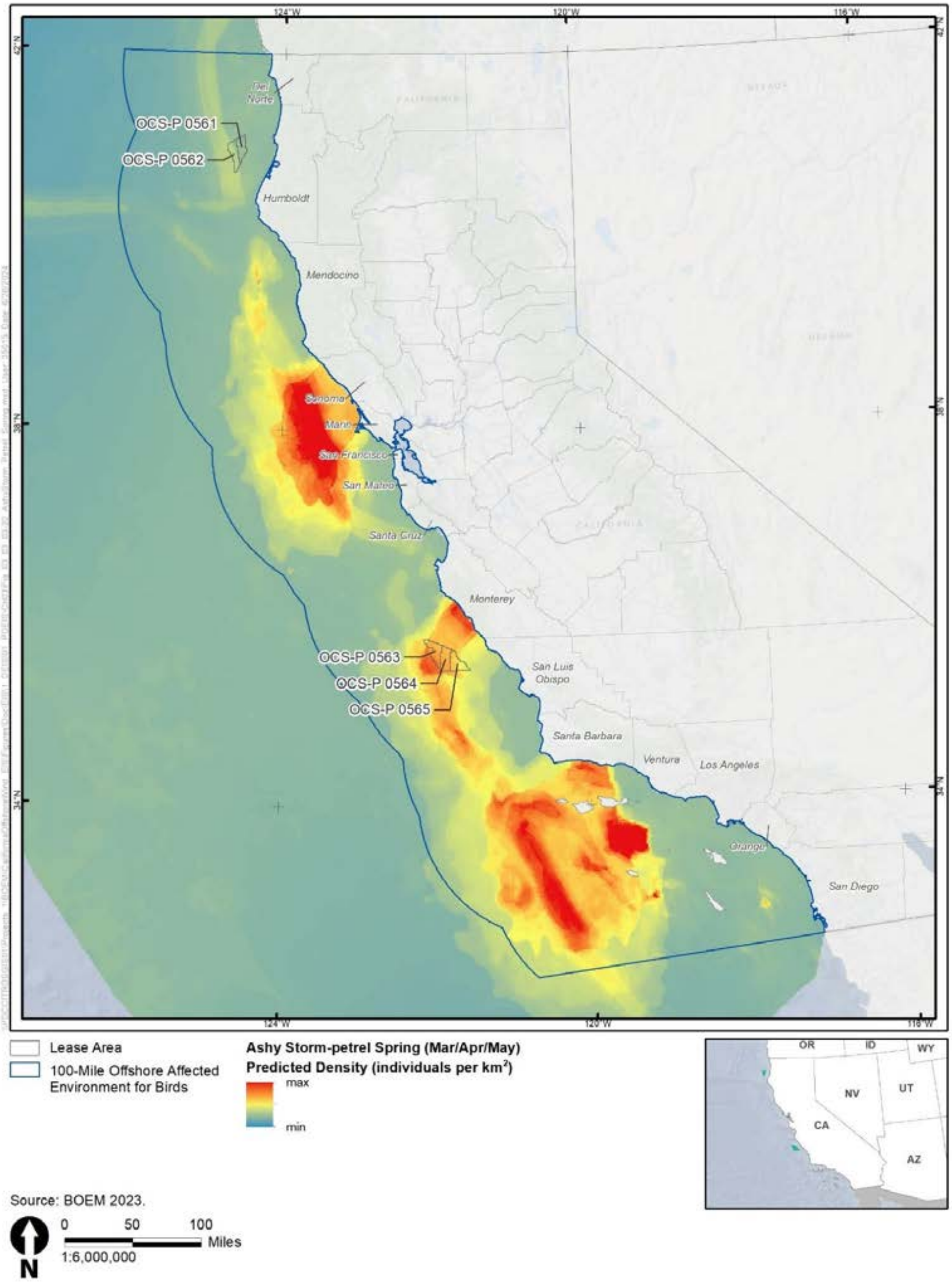

Figure 3.3.3-20. Modeled predicted density of Ashy Storm-petrel in the Affected Environment, spring

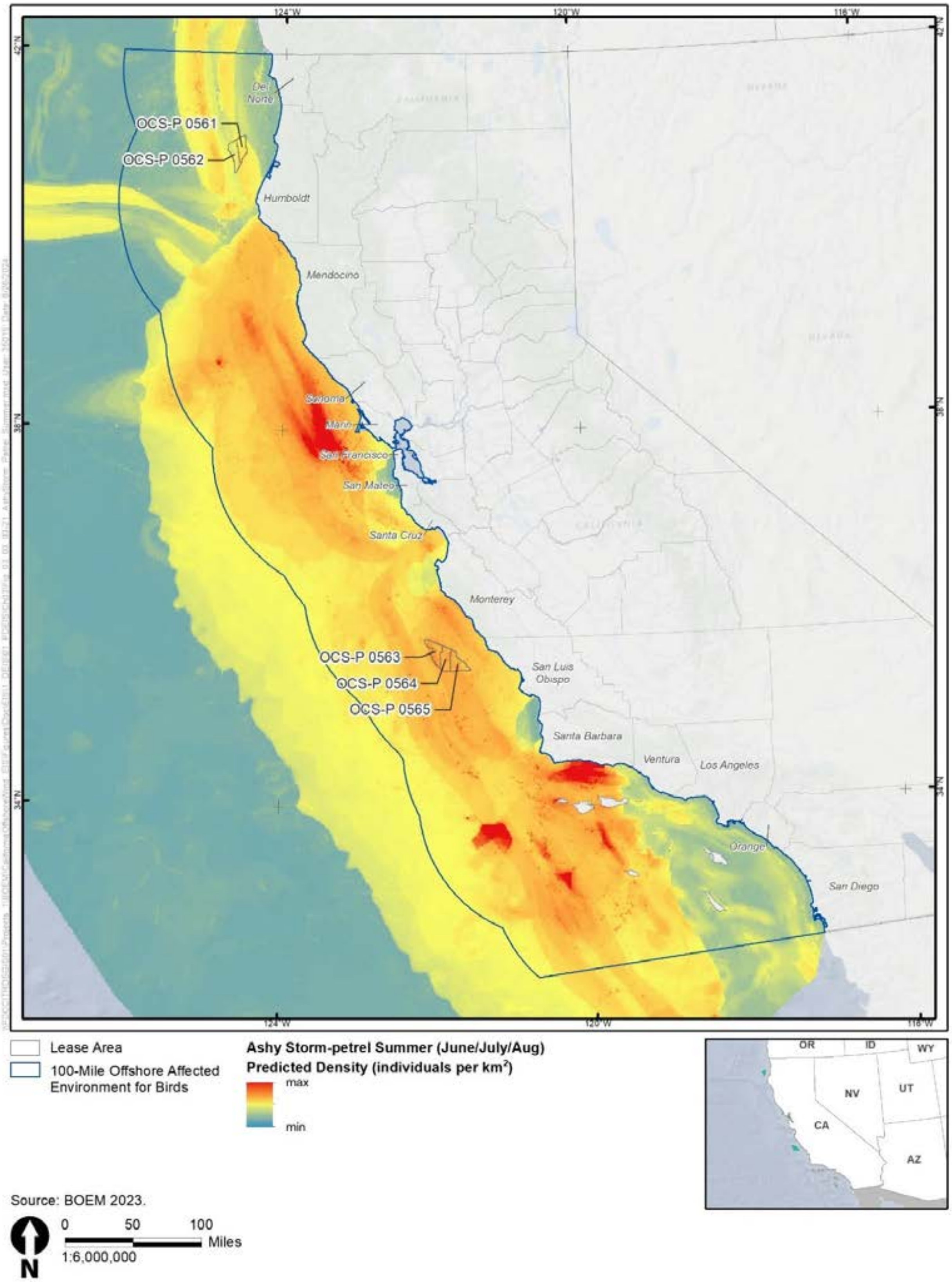

Figure 3.3.3-21. Modeled predicted density of Ashy Storm-petrel in the Affected Environment, summer

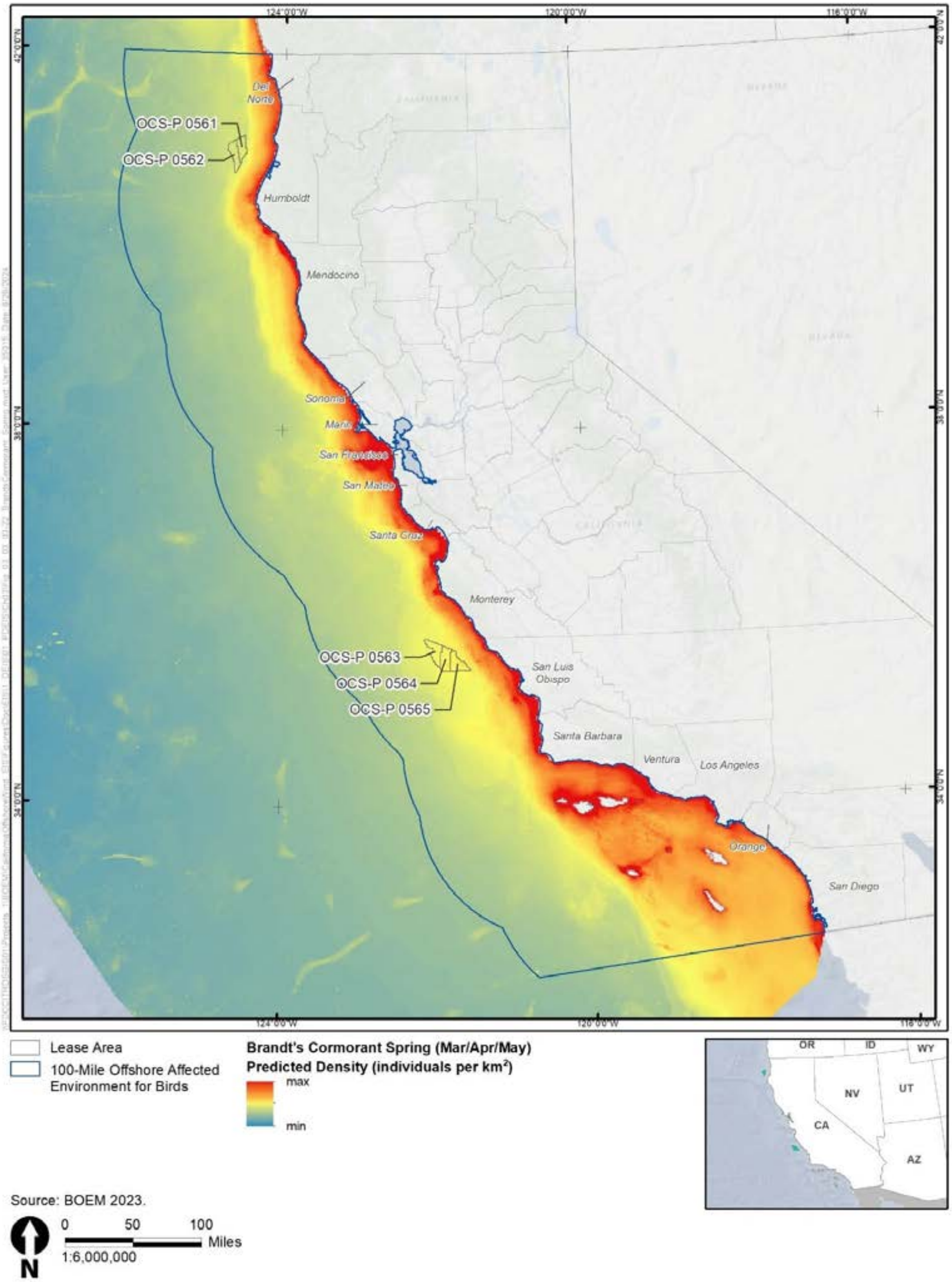

Figure 3.3.3-22. Modeled predicted density of Brandt's Cormorant in the Affected Environment, spring

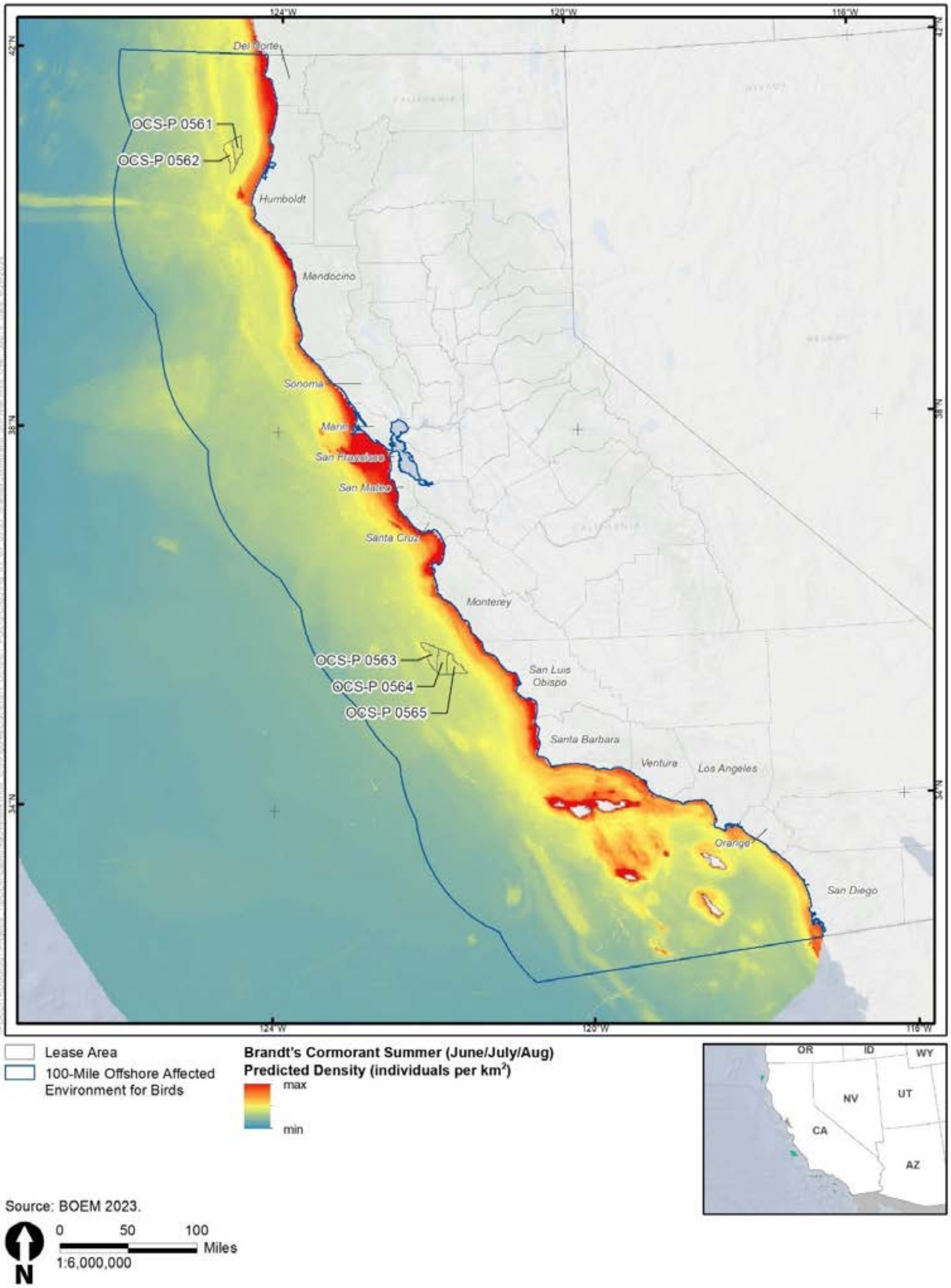

Figure 3.3.3-23. Modeled predicted density of Brandt's Cormorant in the Affected Environment, summer

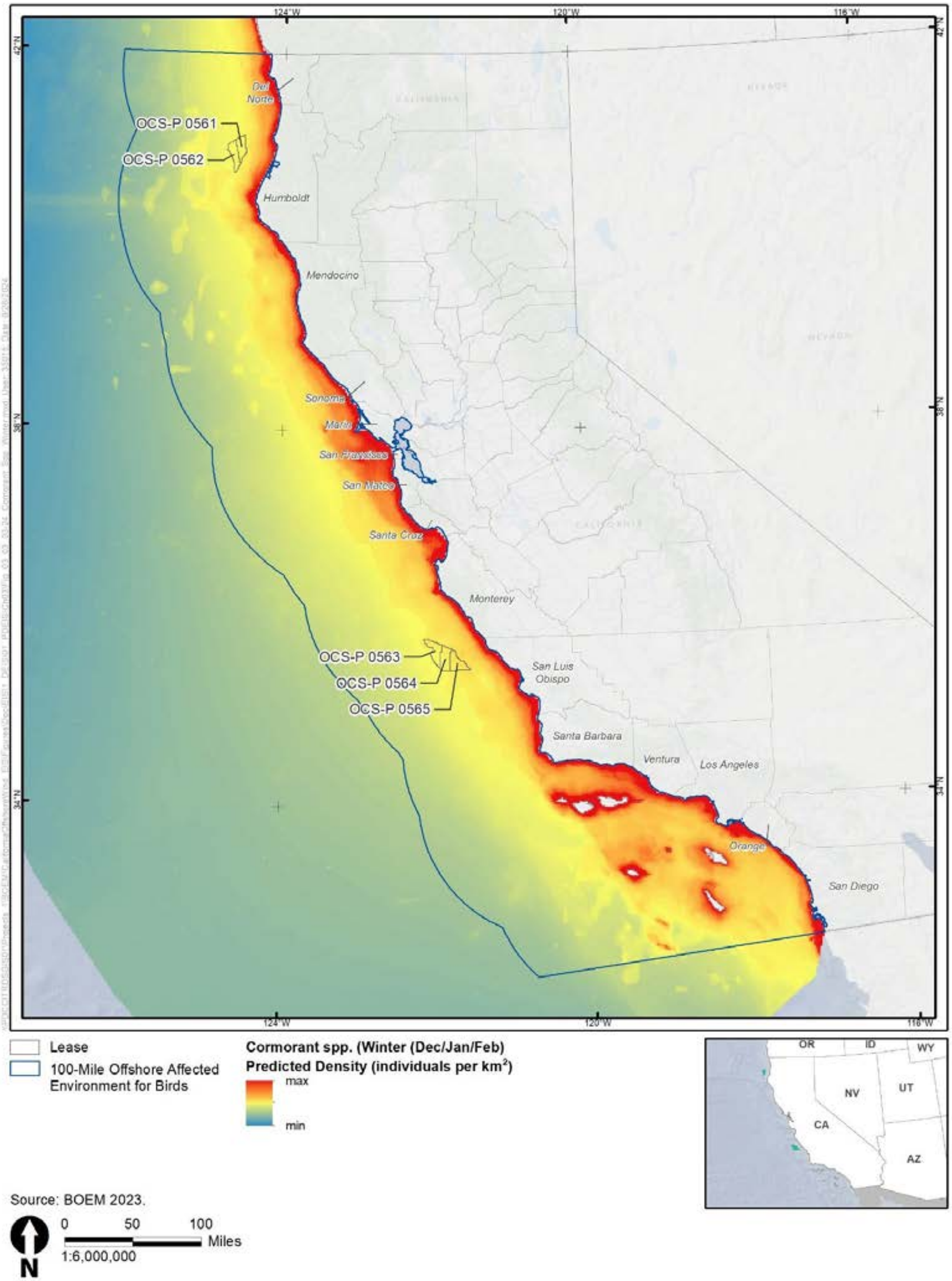

Figure 3.3.3-24. Modeled predicted density of Cormorant spp. in the Affected Environment, winter

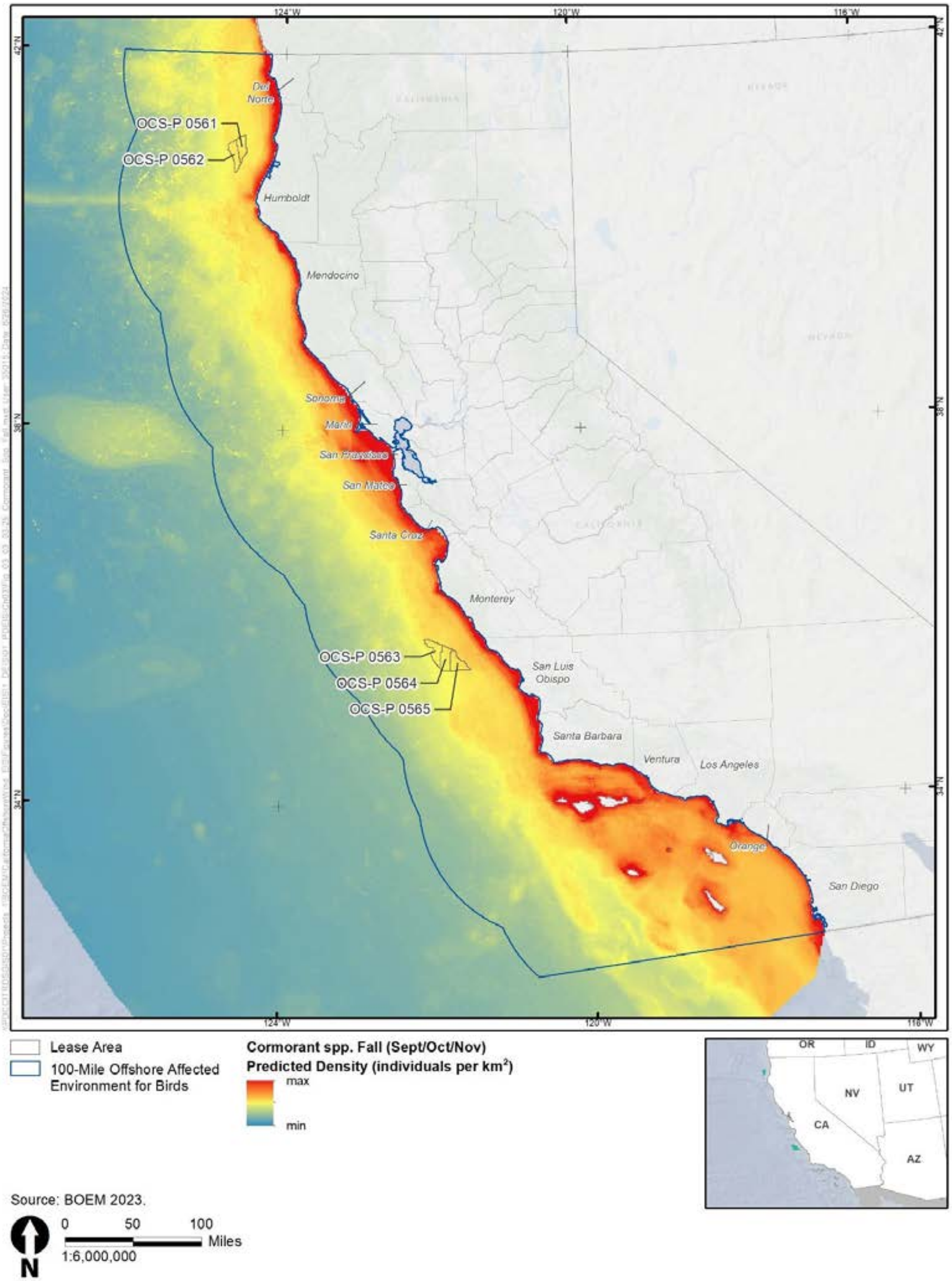

Figure 3.3.3-25. Modeled predicted density of Cormorant spp. in the Affected Environment, fall

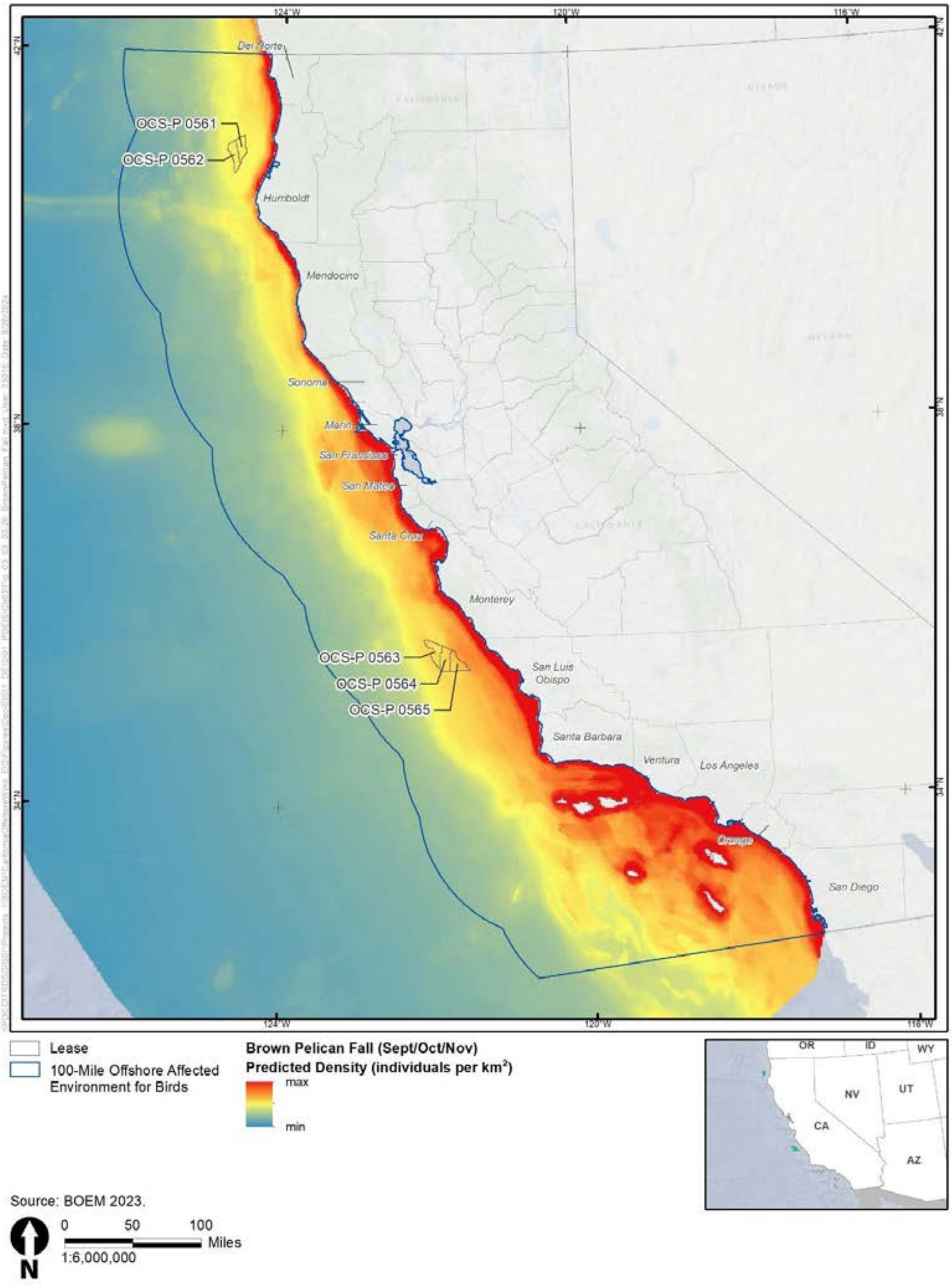

Figure 3.3.3-26. Modeled predicted density of Brown Pelican in the Affected Environment, fall

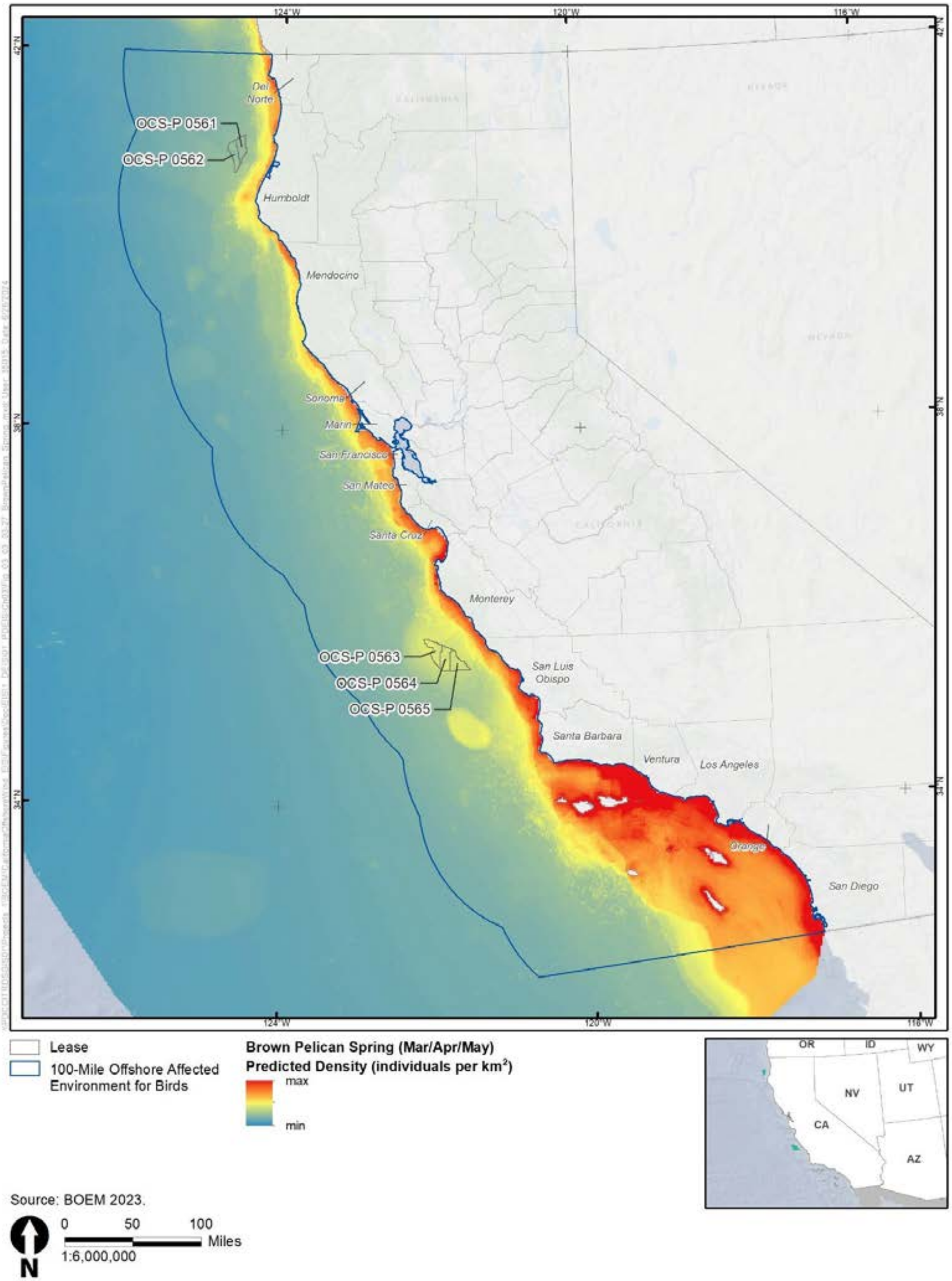

Figure 3.3.3-27. Modeled predicted density of Brown Pelican in the Affected Environment, spring

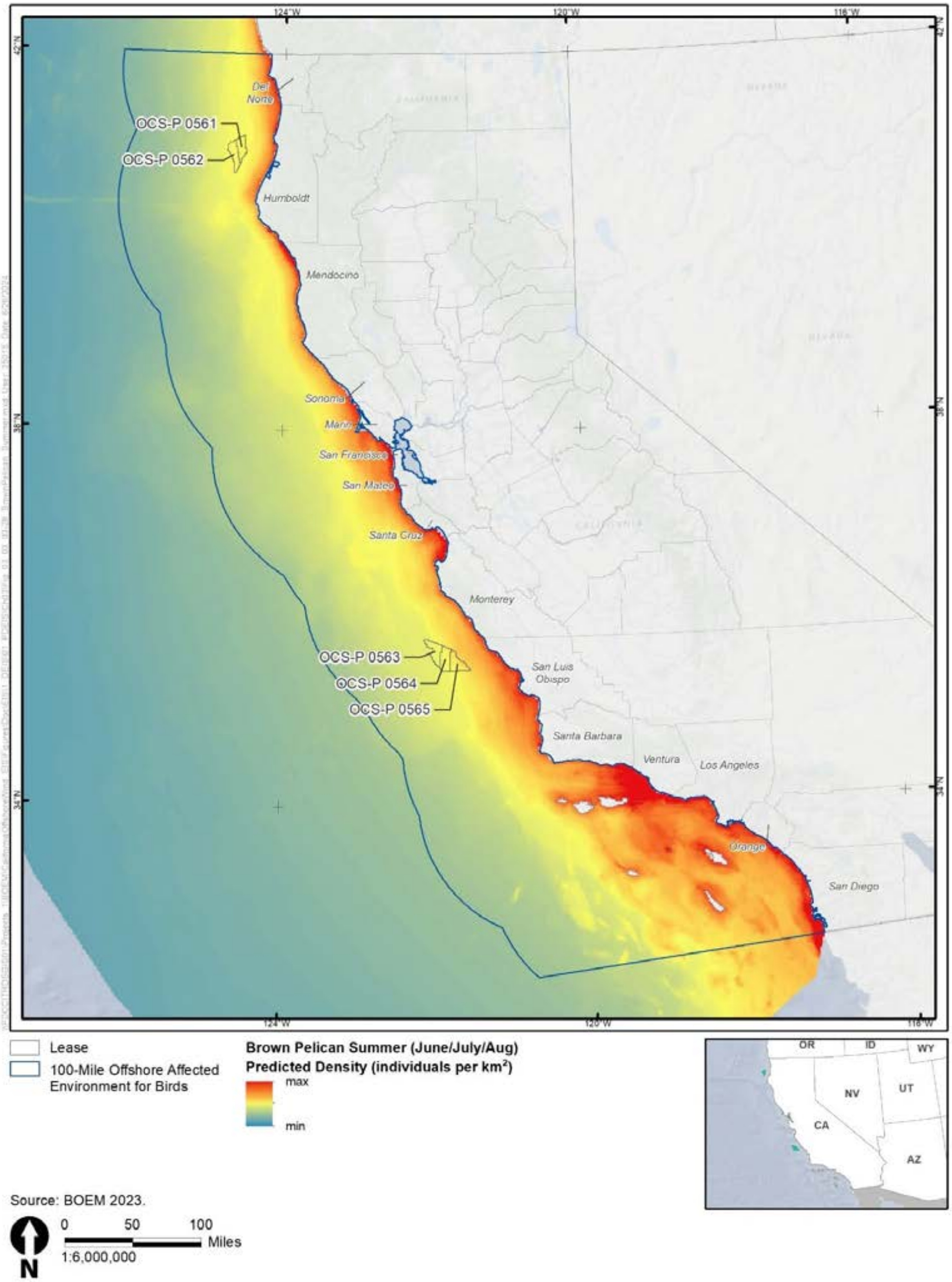

Figure 3.3.3-28. Modeled predicted density of Brown Pelican in the Affected Environment, summer

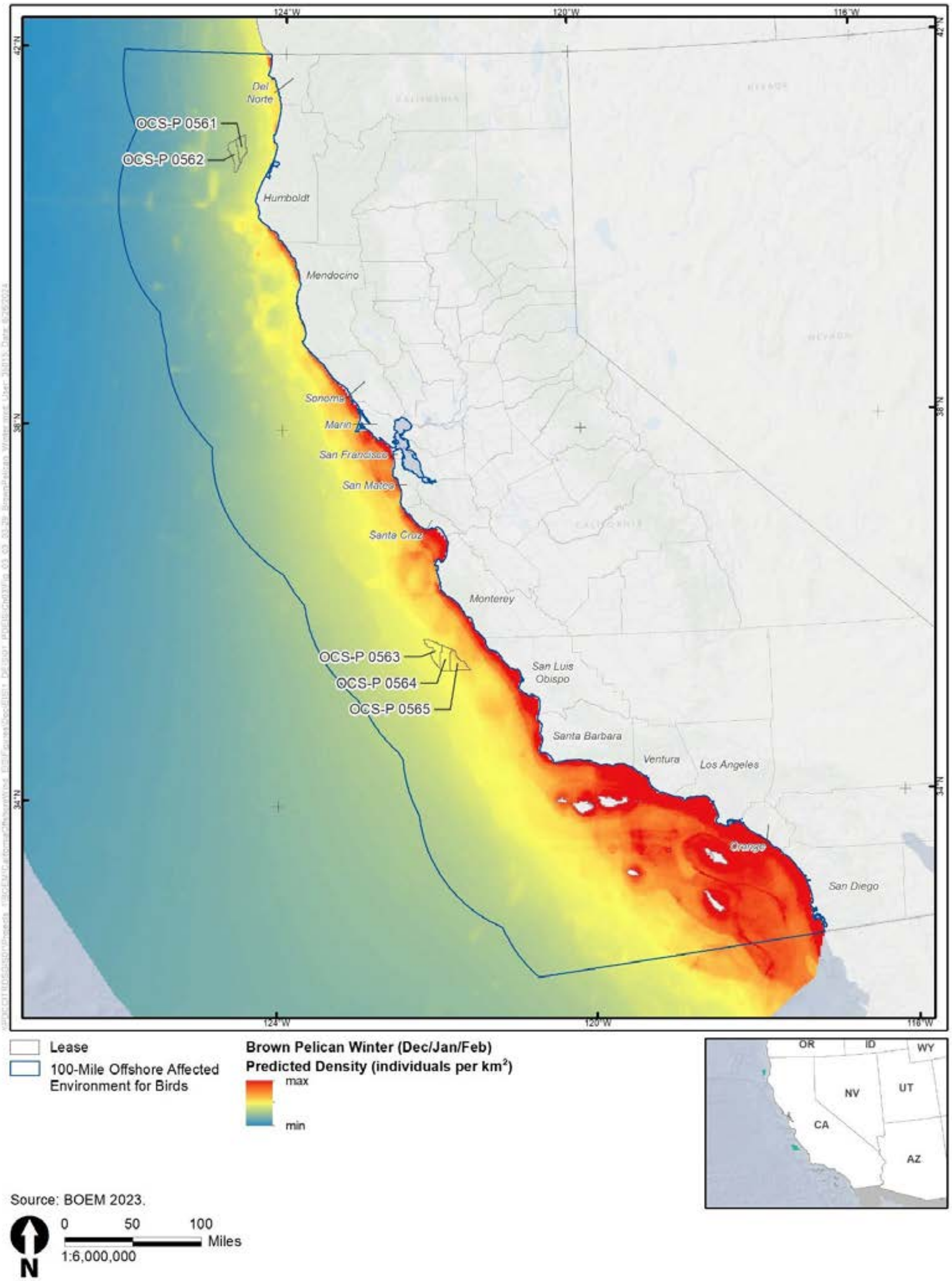

Figure 3.3.3-29. Modeled predicted density of Brown Pelican in the Affected Environment, winter

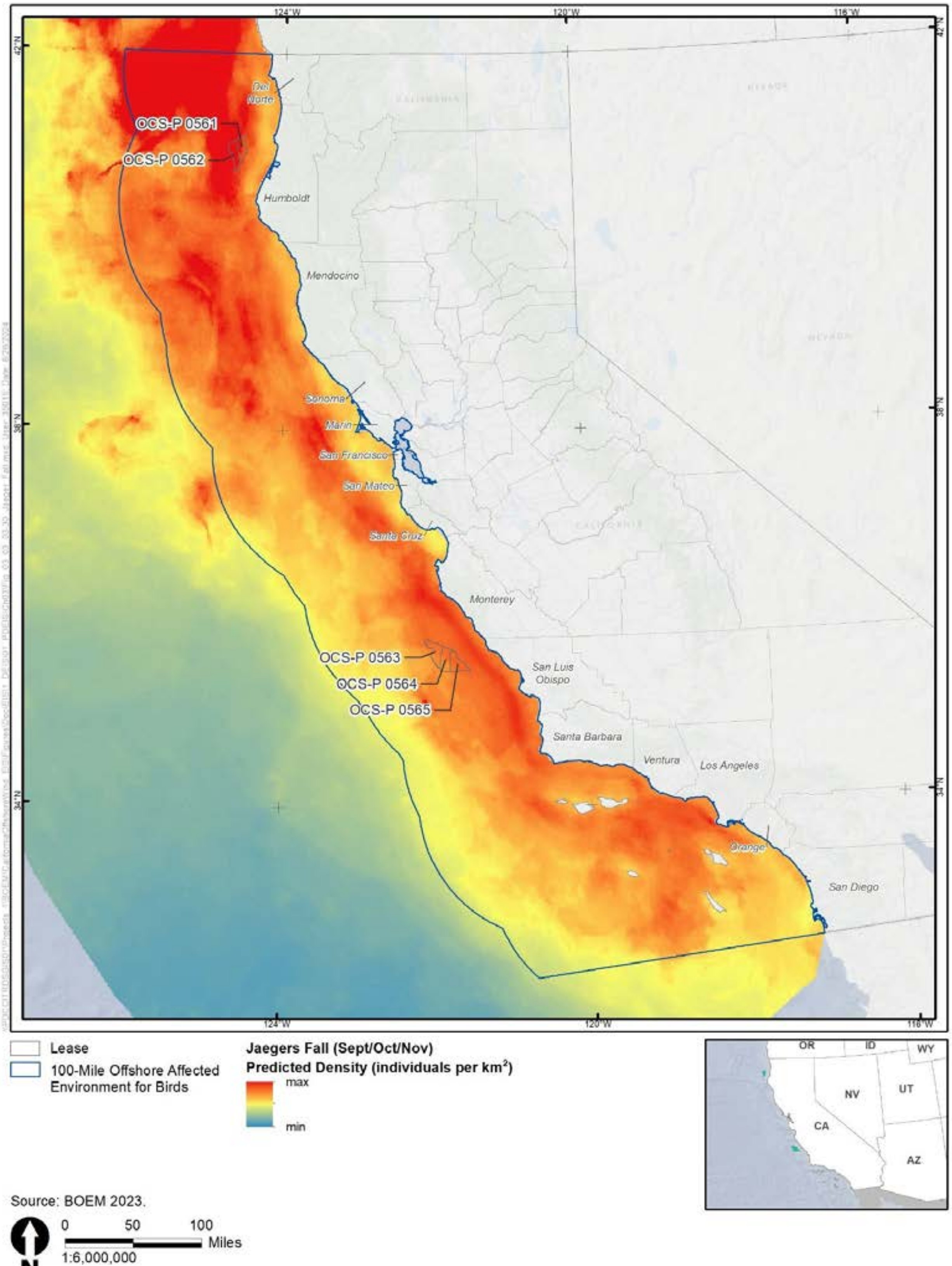

Figure 3.3.3-30. Modeled predicted density of Jaegers in the Affected Environment, fall

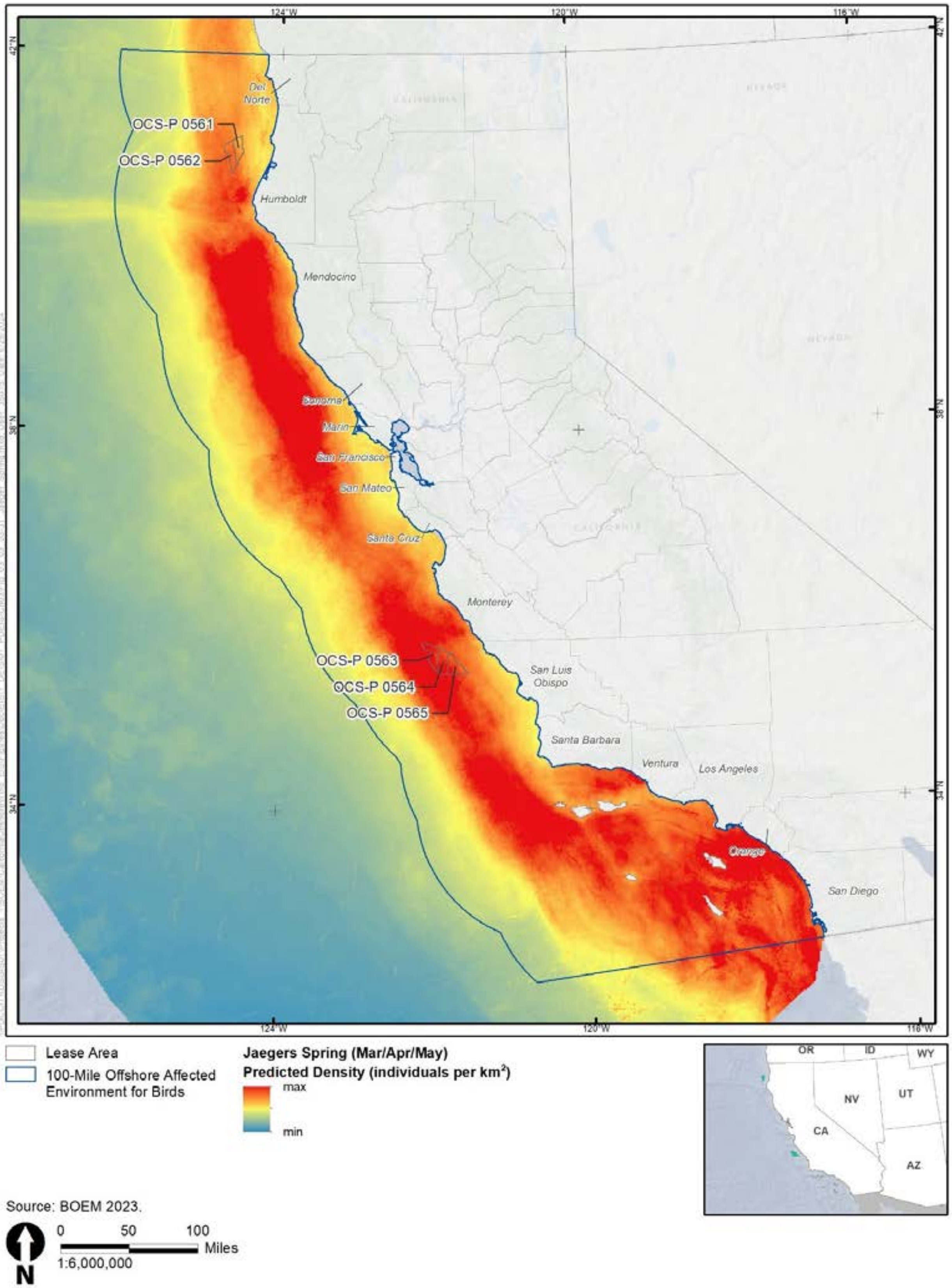

Figure 3.3.3-31. Modeled predicted density of Jaegers in the Affected Environment, spring

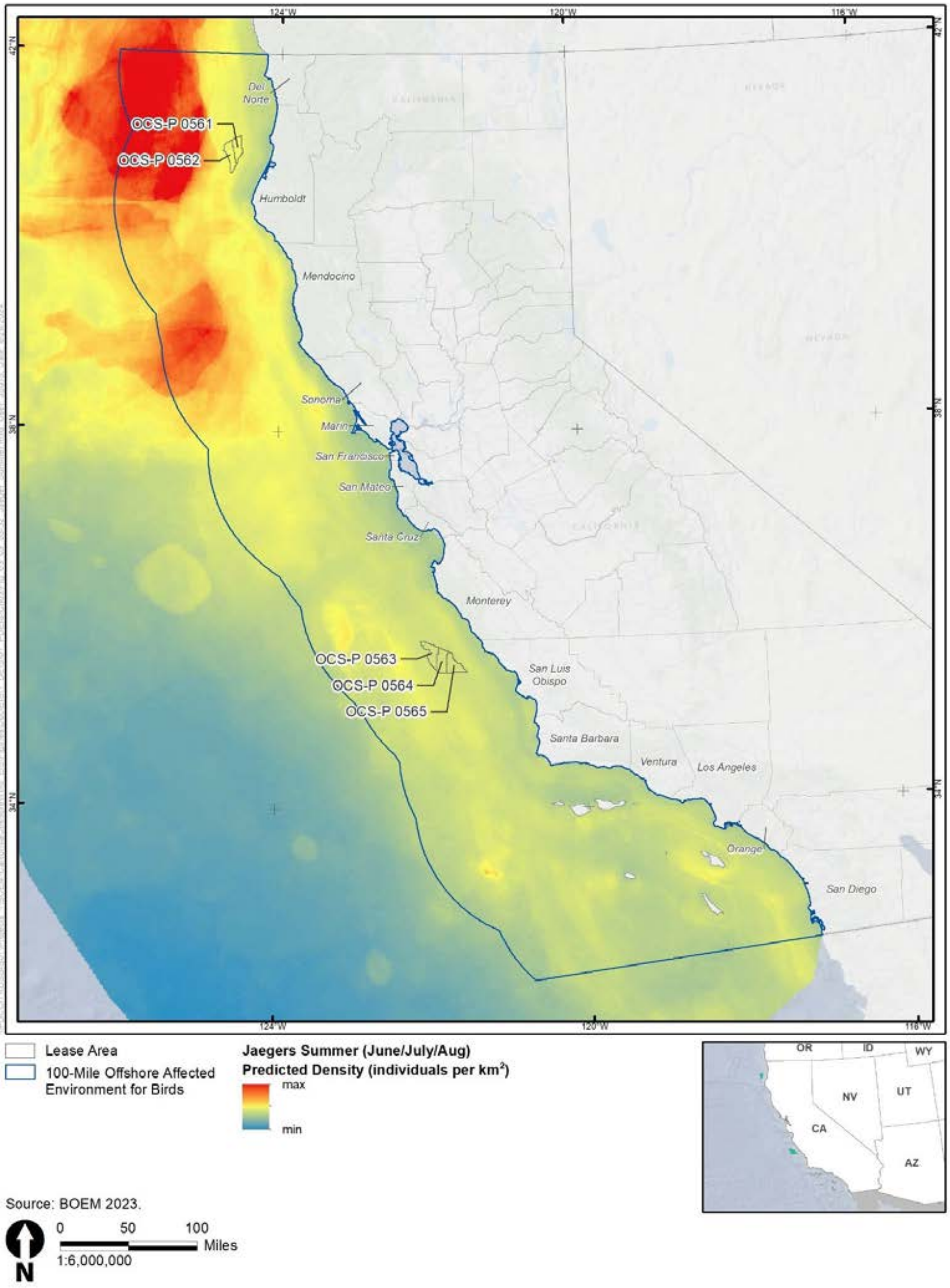

Figure 3.3.3-32. Modeled predicted density of Jaegers in the Affected Environment, summer

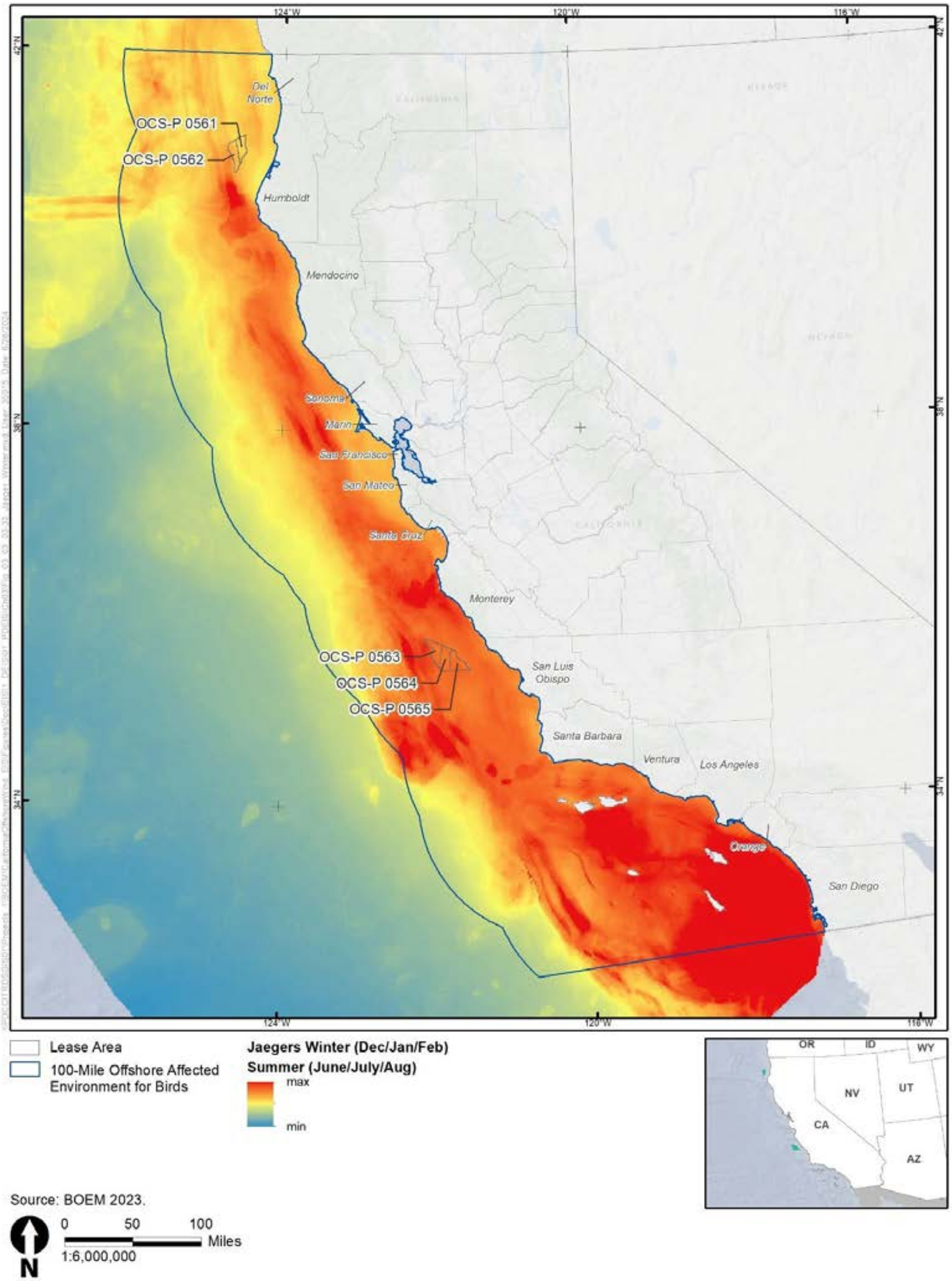

Figure 3.3.3-33. Modeled predicted density of Jaegers in the Affected Environment, winter

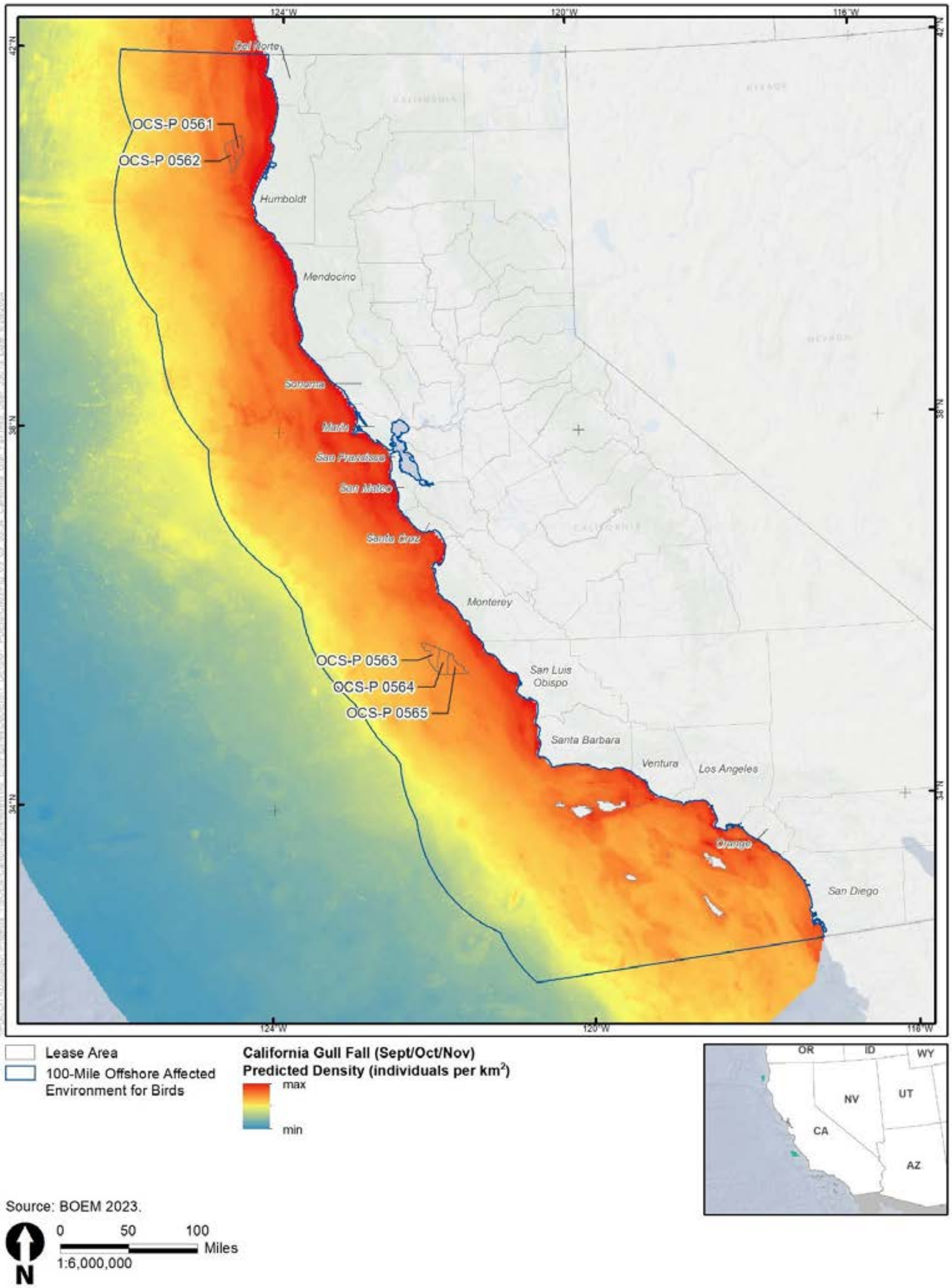

Figure 3.3.3-34. Modeled predicted density of California Gull in the Affected Environment, fall

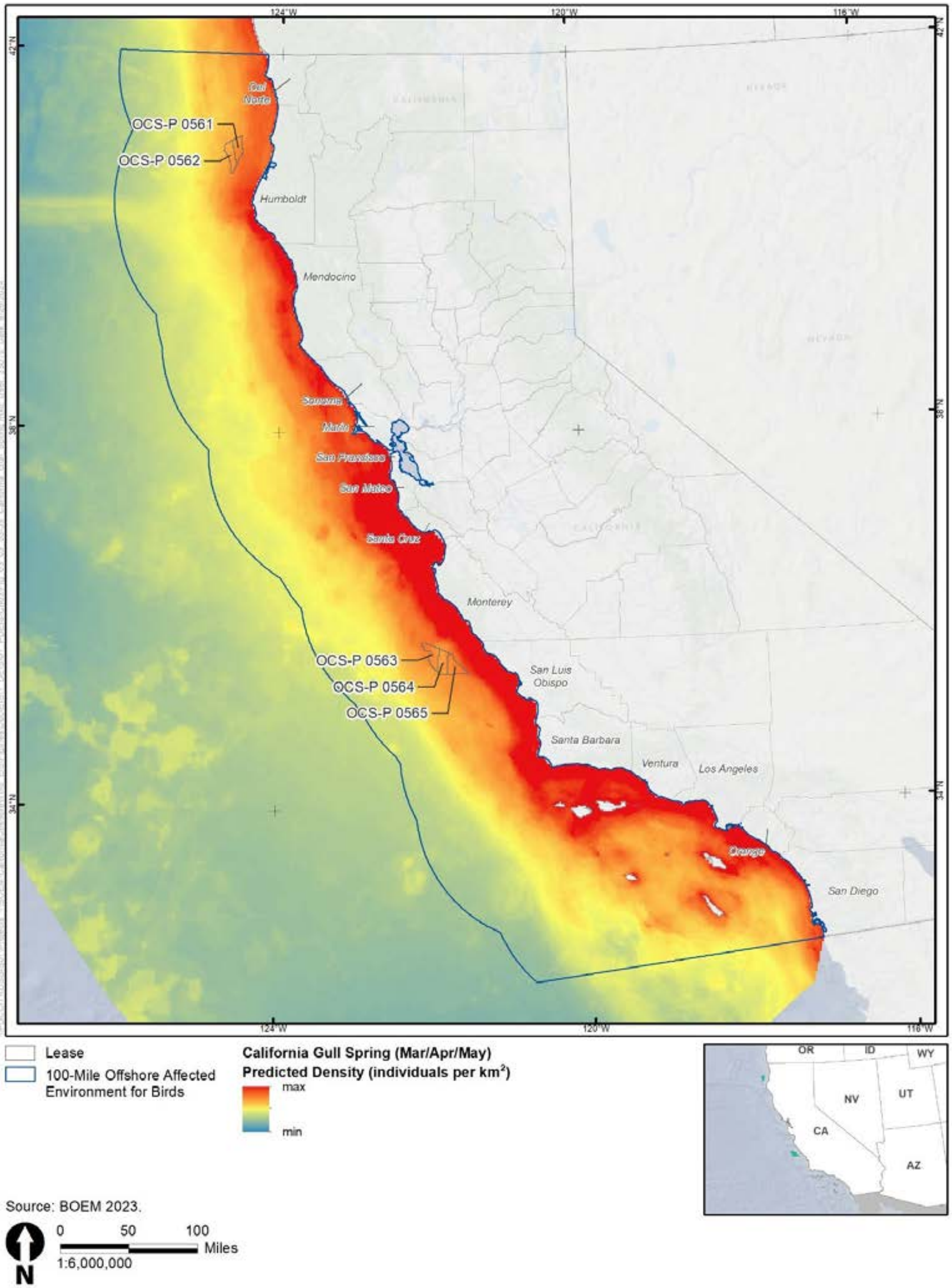

Figure 3.3.3-35. Modeled predicted density of California Gull in the Affected Environment, spring

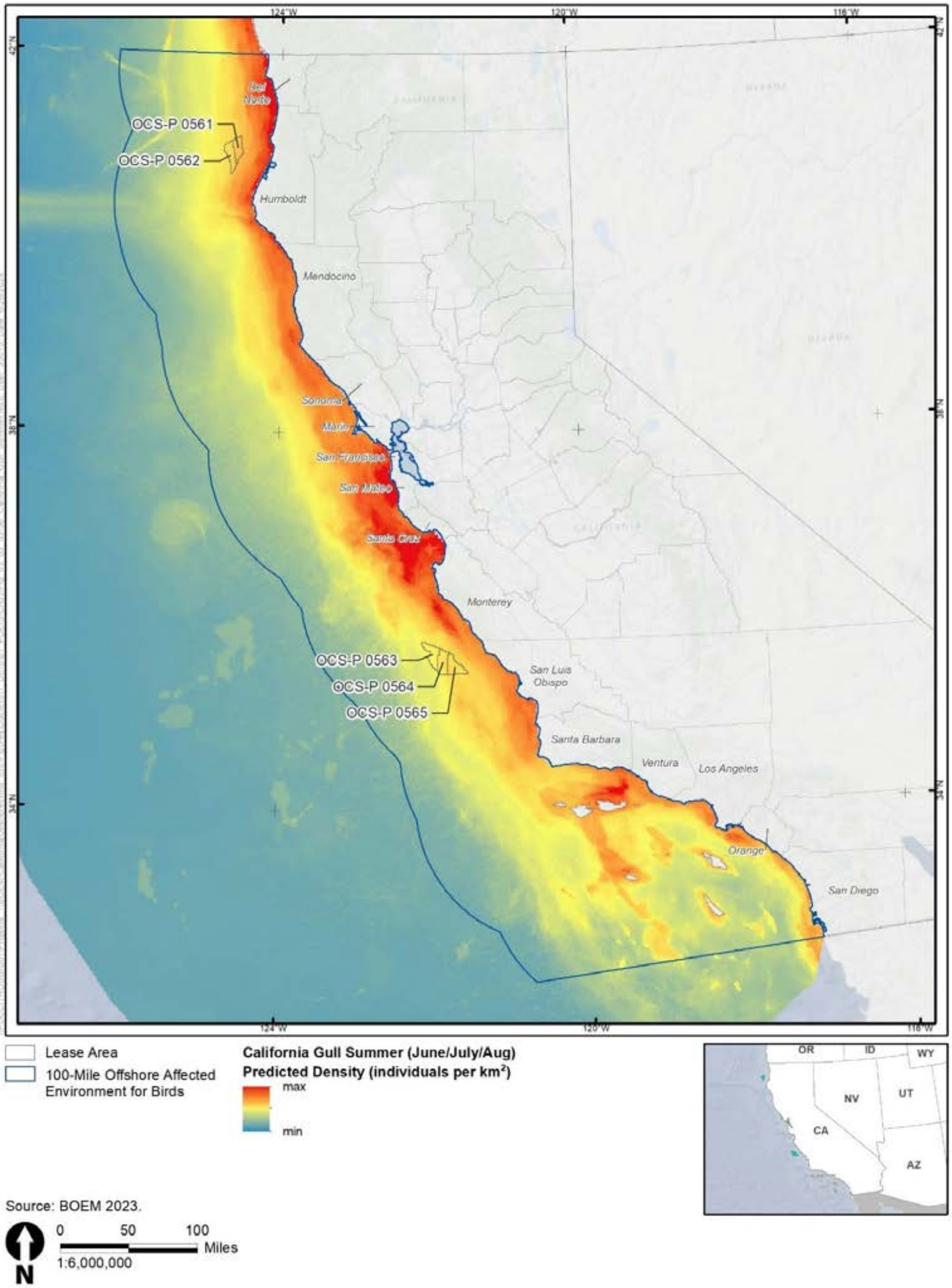

Figure 3.3.3-36. Modeled predicted density of California Gull in the Affected Environment, summer

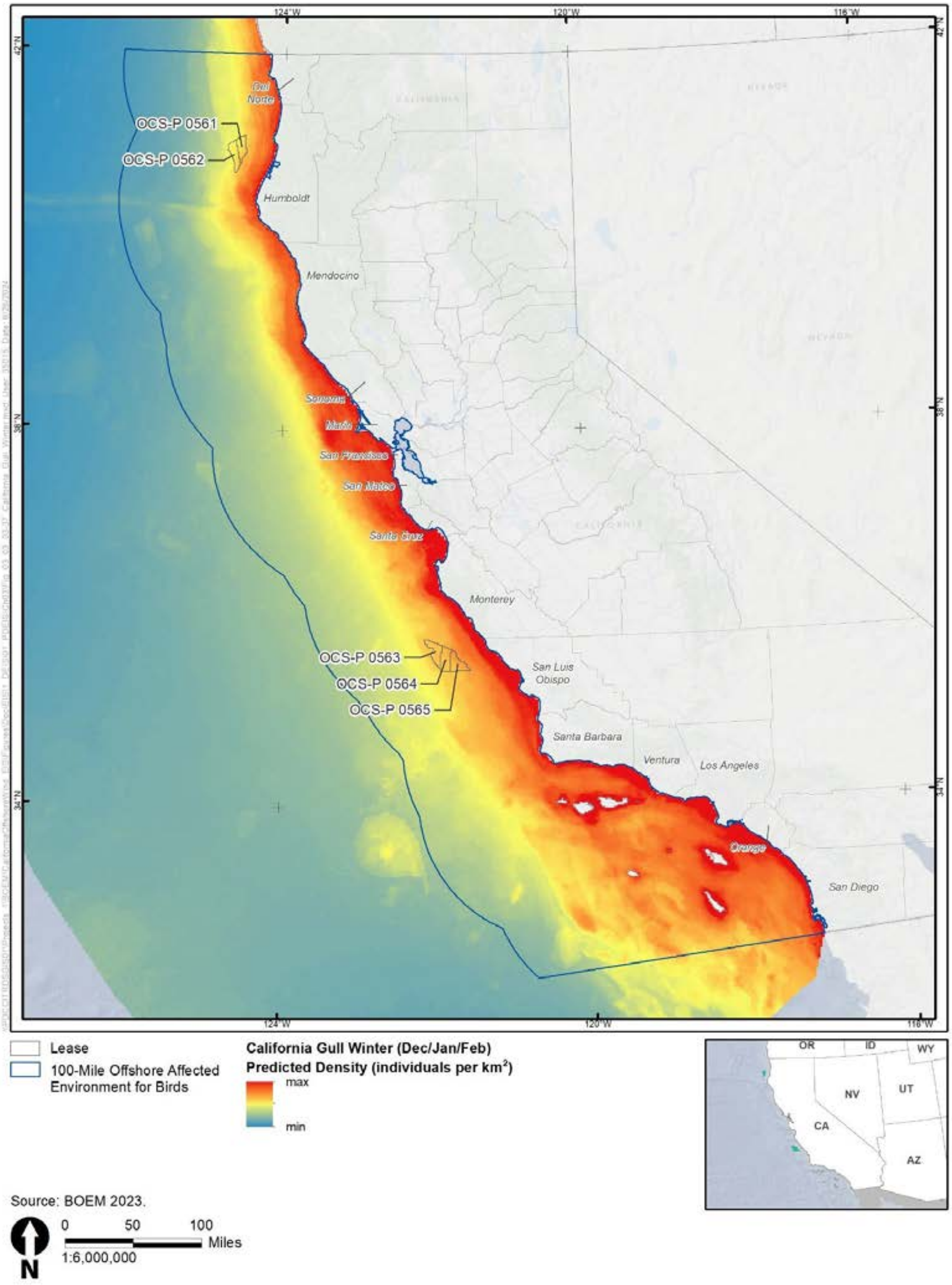

Figure 3.3.3-37. Modeled predicted density of California Gull in the Affected Environment, winter

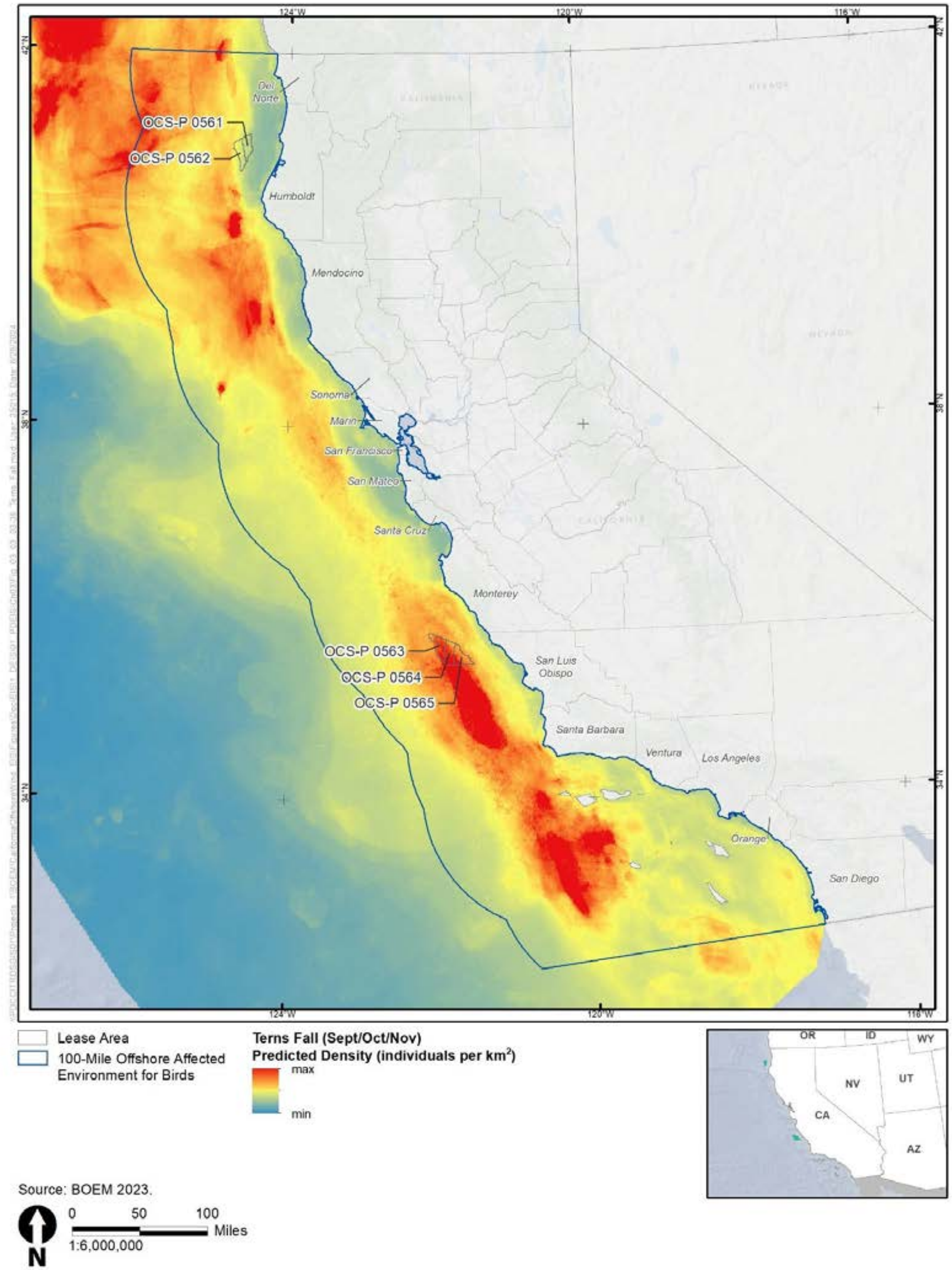

Figure 3.3.3-38. Modeled predicted density of terns in the Affected Environment, fall

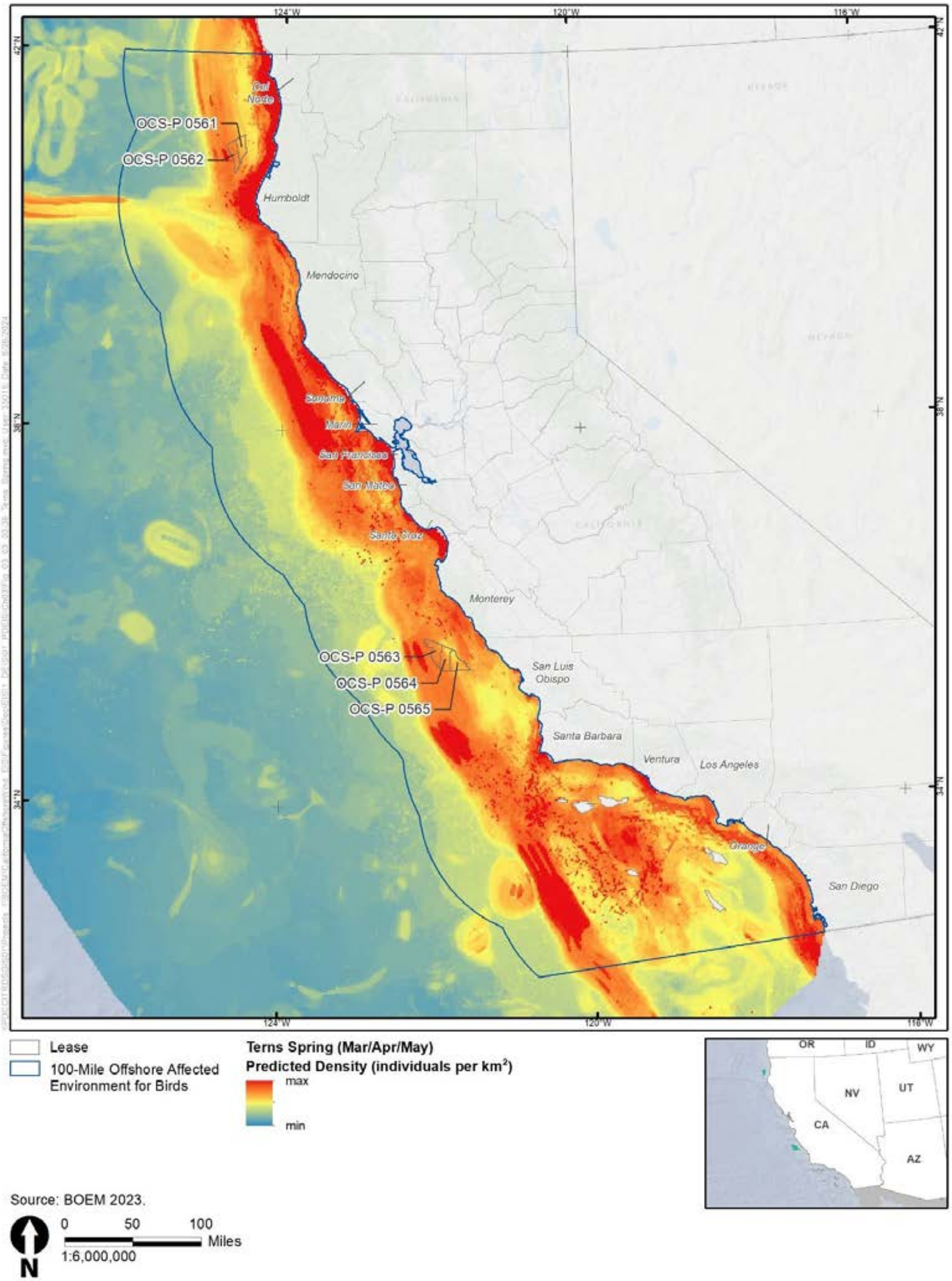

Figure 3.3.3-39. Modeled predicted density of terns in the Affected Environment, spring

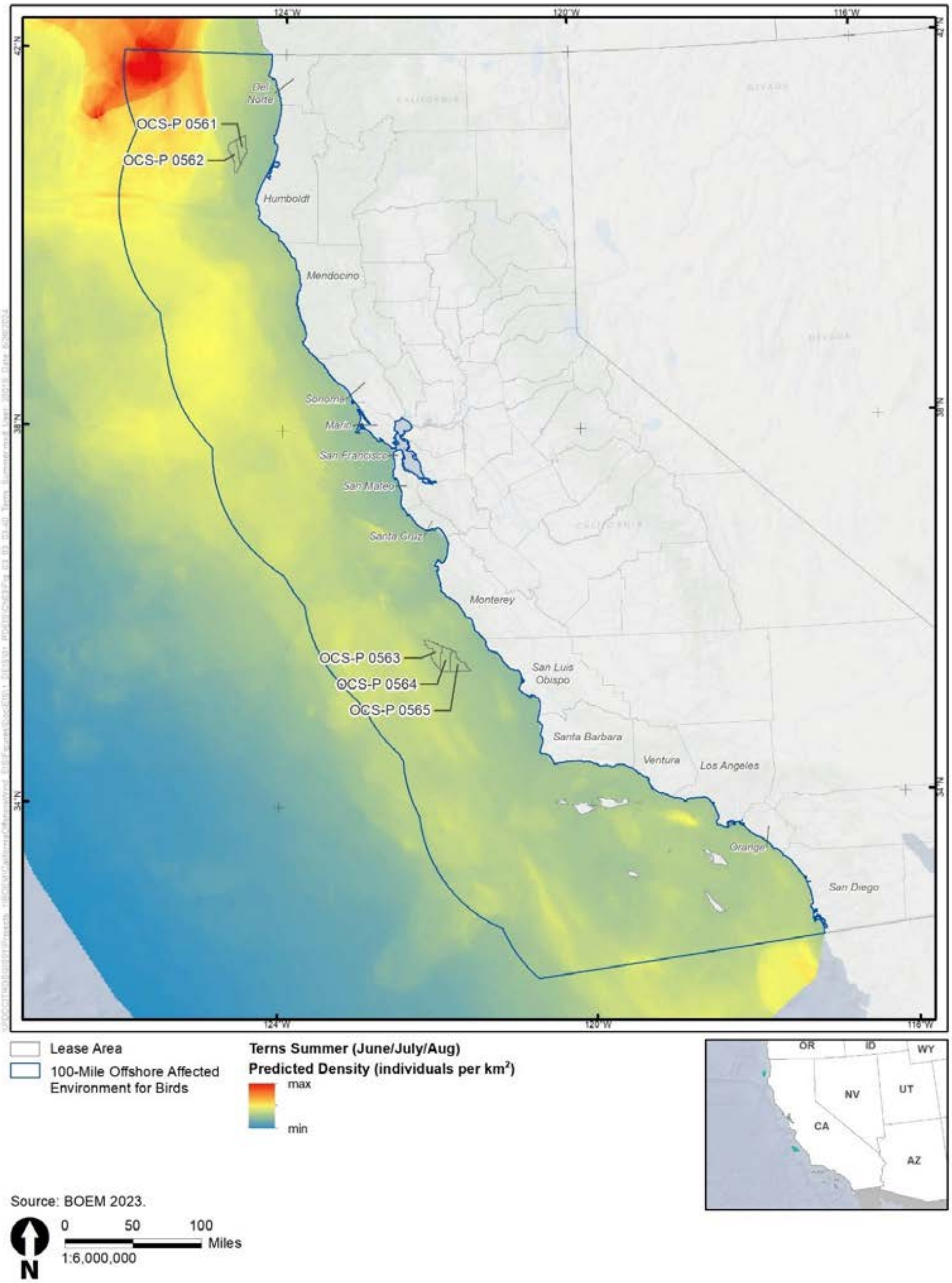

Figure 3.3.3-40. Modeled predicted density of terns in the Affected Environment, summer

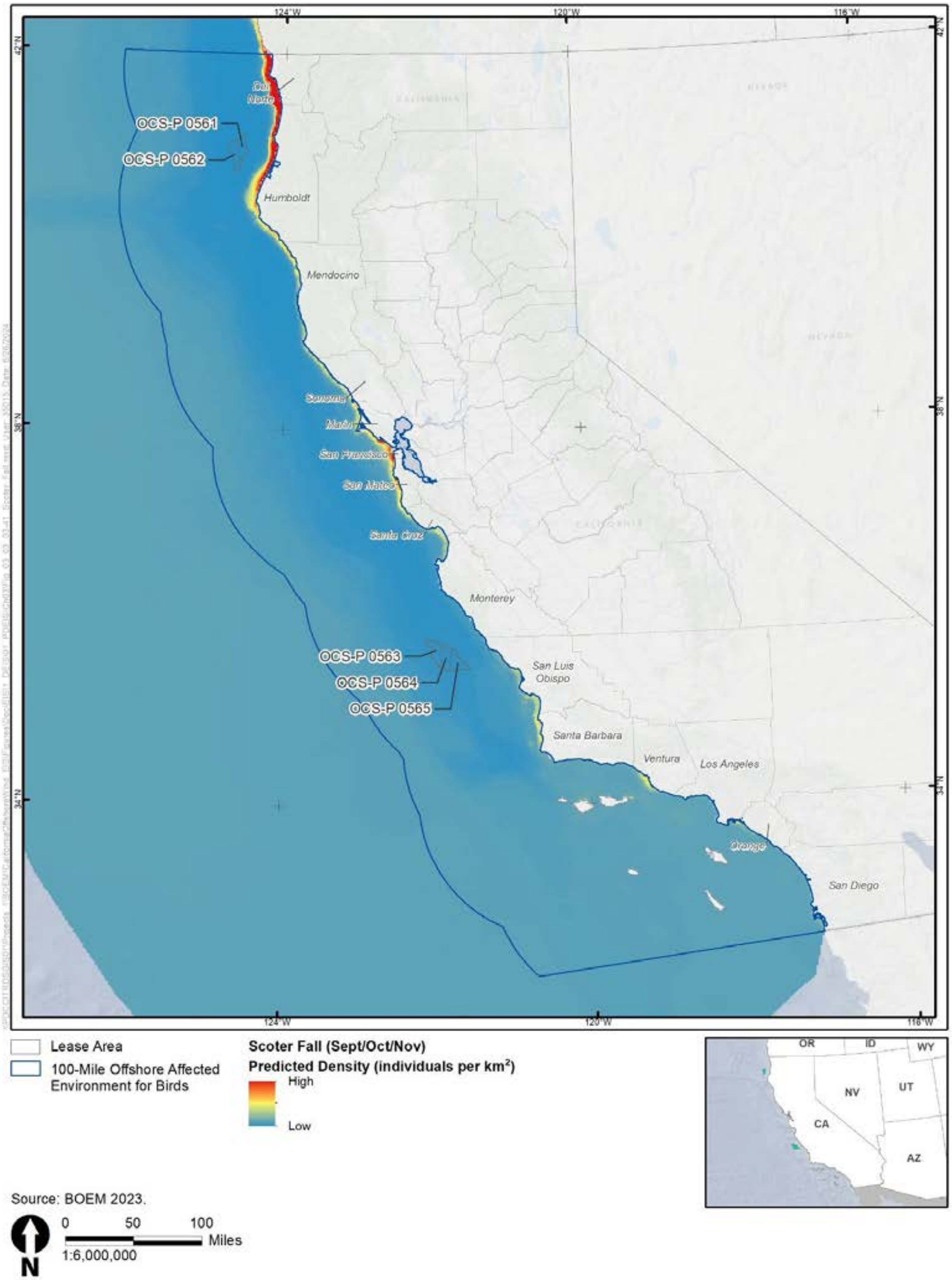

Figure 3.3.3-41. Modeled predicted density of scoter in the Affected Environment, fall

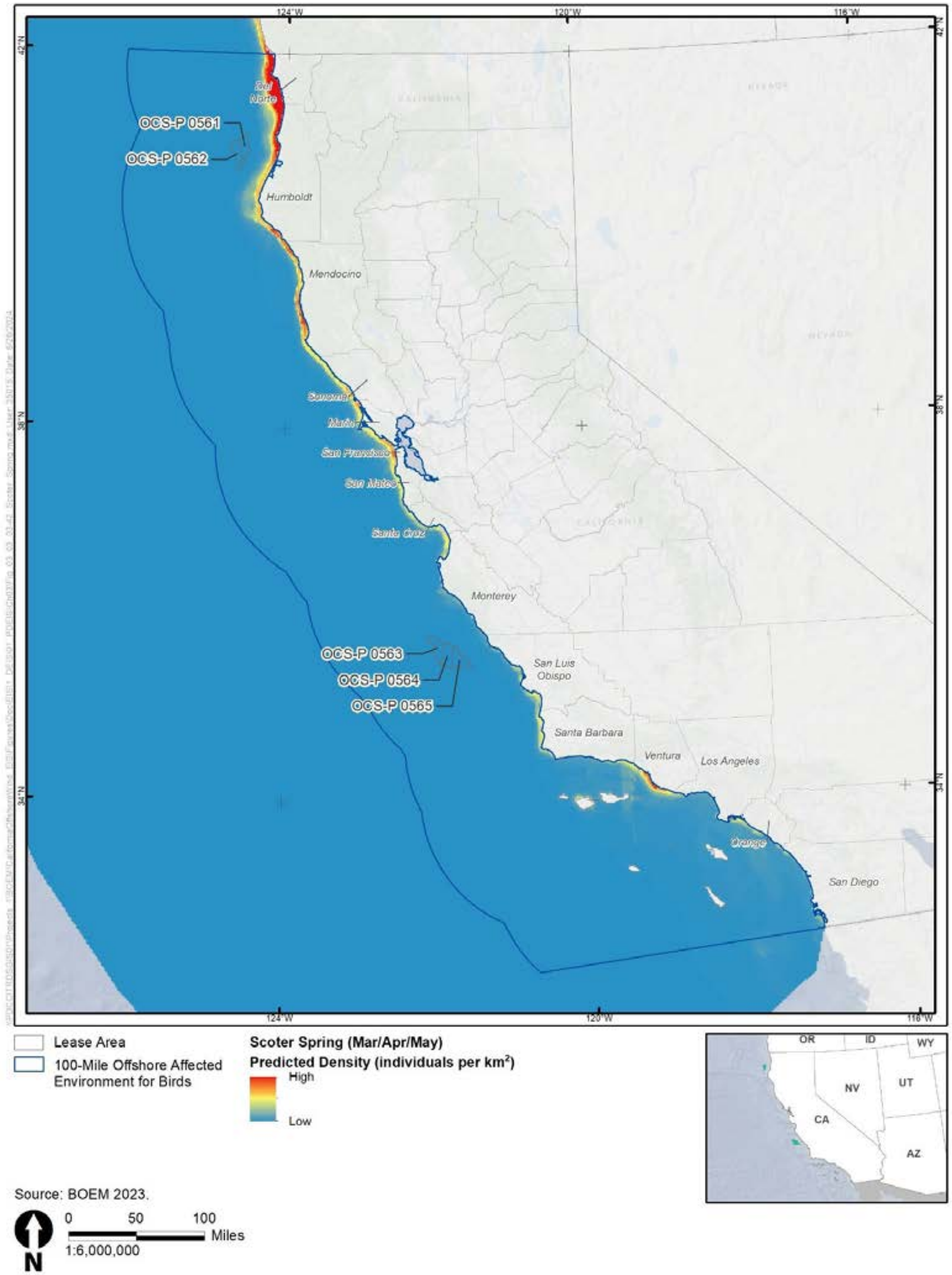

Figure 3.3.3-42. Modeled predicted density of scoter in the Affected Environment, spring

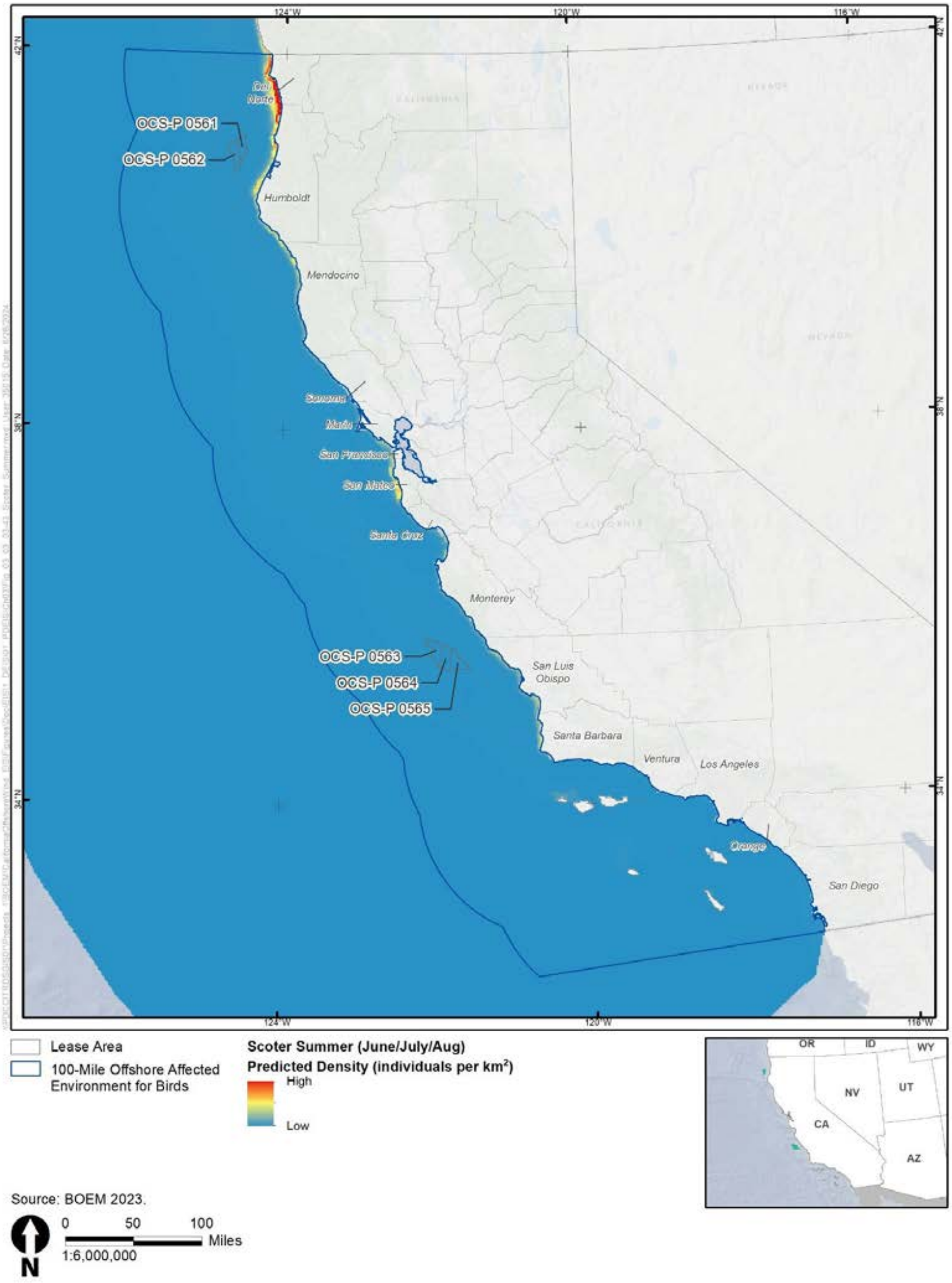

Figure 3.3.3-43. Modeled predicted density of scoter in the Affected Environment, summer

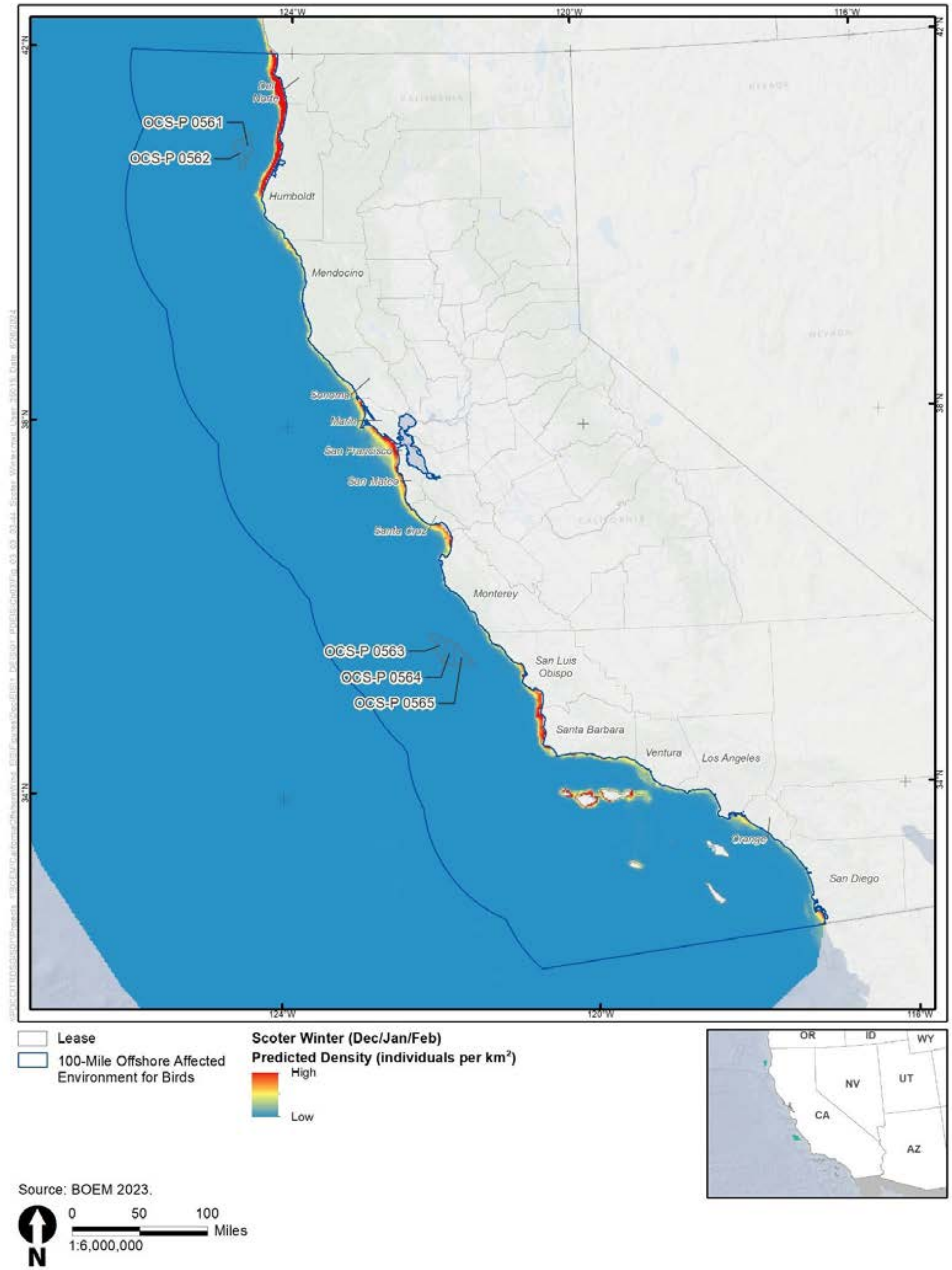

Figure 3.3.3-44. Modeled predicted density of scoter in the Affected Environment, winter

3.3 Biological Resources

3.3.4 Coastal Habitat, Fauna, and Wetlands

This section describes the Affected Environment for coastal habitat, fauna, and wetlands and discusses potential impacts on these resources from the Proposed Action and alternatives, including ongoing and planned activities. Figure 3.3.4-1 shows the Affected Environment for coastal habitat and fauna, which includes a 1-mile (1.6-kilometer) buffer of the coastline where coastal habitat and fauna can be found and where onshore infrastructure may reasonably be located (precise locations not known at this programmatic stage).[1] The Affected Environment includes foreshore, backshore, dune, and interdunal habitats, as well as numerous vegetation communities and wetlands. Figure 3.3.4-2 shows the Affected Environment for wetlands, which includes all 12-digit hydrologic unit code watersheds present in the coastal margin that are likely to host onshore components of wind energy development in the Humboldt and Morro Bay lease areas. For the Humboldt WEA, the Affected Environment for coastal habitat and fauna spans 15 miles (22.5 kilometers) along the Pacific Ocean and the Affected Environment for wetlands is approximately 23 miles (37 kilometers). For the Morro Bay WEA, the coastal habitat and fauna Affected Environment includes 20 miles (32 kilometers) of coastline bordering the Pacific Ocean and the wetland Affected Environment extends north and south for 38 miles (61 kilometers).

3.3.4.1 Description of the Affected Environment and Baseline Conditions

3.3.4.1.1 Coastal Habitat

Coastal resources of the Humboldt and Morro Bay shorelines include sandy beaches, rocky cliffs, coastal dune systems, and estuaries and wetlands (MMS 2007). In this area, the continental margin is often narrow; the ocean bottom drops precipitously from beaches to deep water.

The northern Humboldt coastline consists of fine- to coarse-grained sand beaches, sheltered and exposed rocky shores, human-made structures (e.g., docks, seawalls), and riprap for shoreline protection (ESI 2008). Within Humboldt Bay, the shoreline consists of tidal flats and tidal/brackish wetlands, riprap and human-made structures with pockets of freshwater marshes, swamps, and scrub-shrub wetlands (ESI 2008). Farther south, the shoreline is composed primarily of coarse-grained sand and gravel beaches and rocky, exposed cliffs (ESI 2008).

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[1] BOEM expects the fauna in this area to have small home ranges unlikely to be affected by impacts occurring outside of these ranges. Moreover, existing land uses more than 1 mile (1.6 kilometers) inland from potential landfall areas tend to be previously disturbed and include a more diverse mix of land uses.

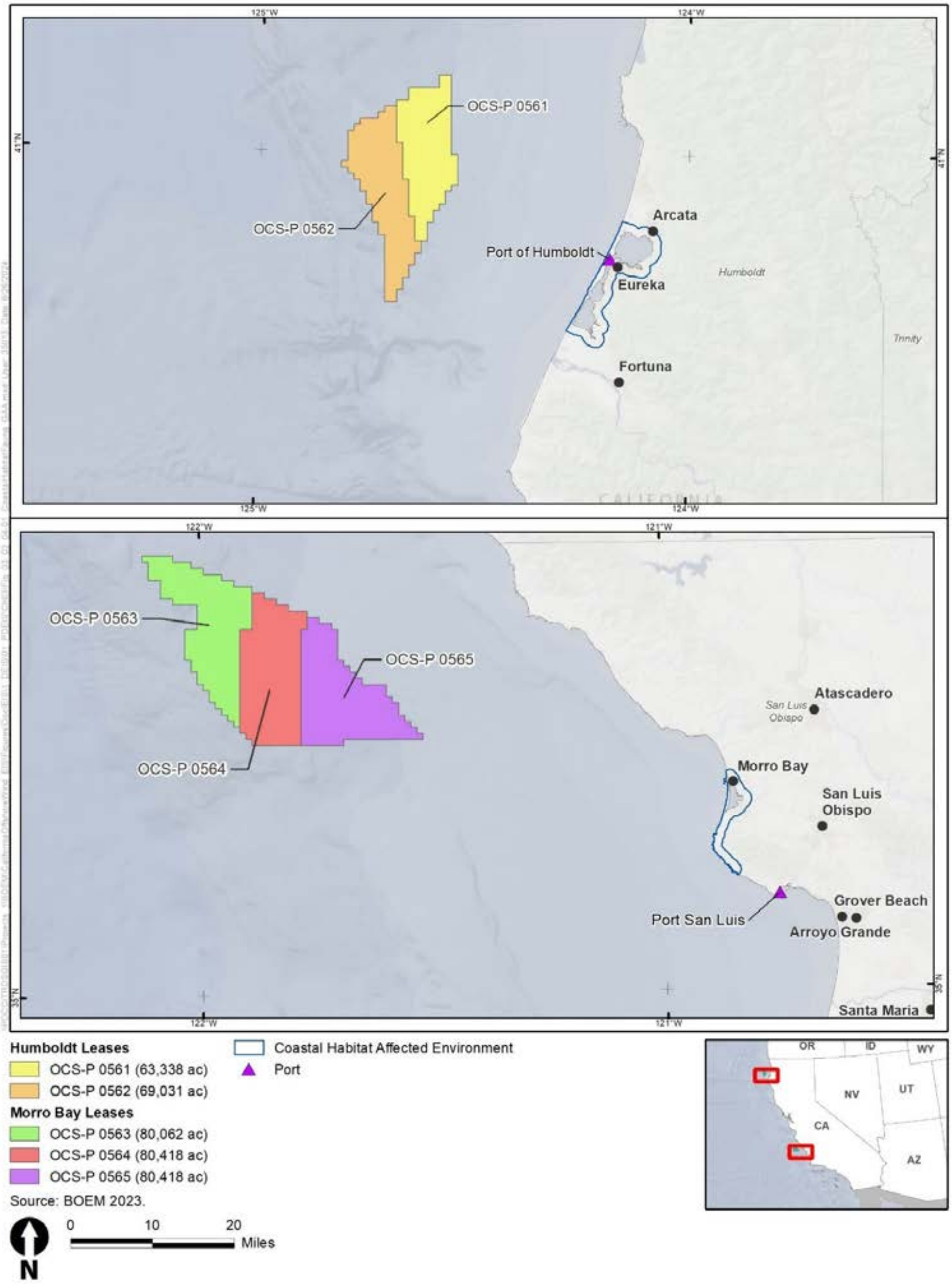

Figure 3.3.4-1. Humboldt and Morro Bay coastal habitat and fauna Affected Environment

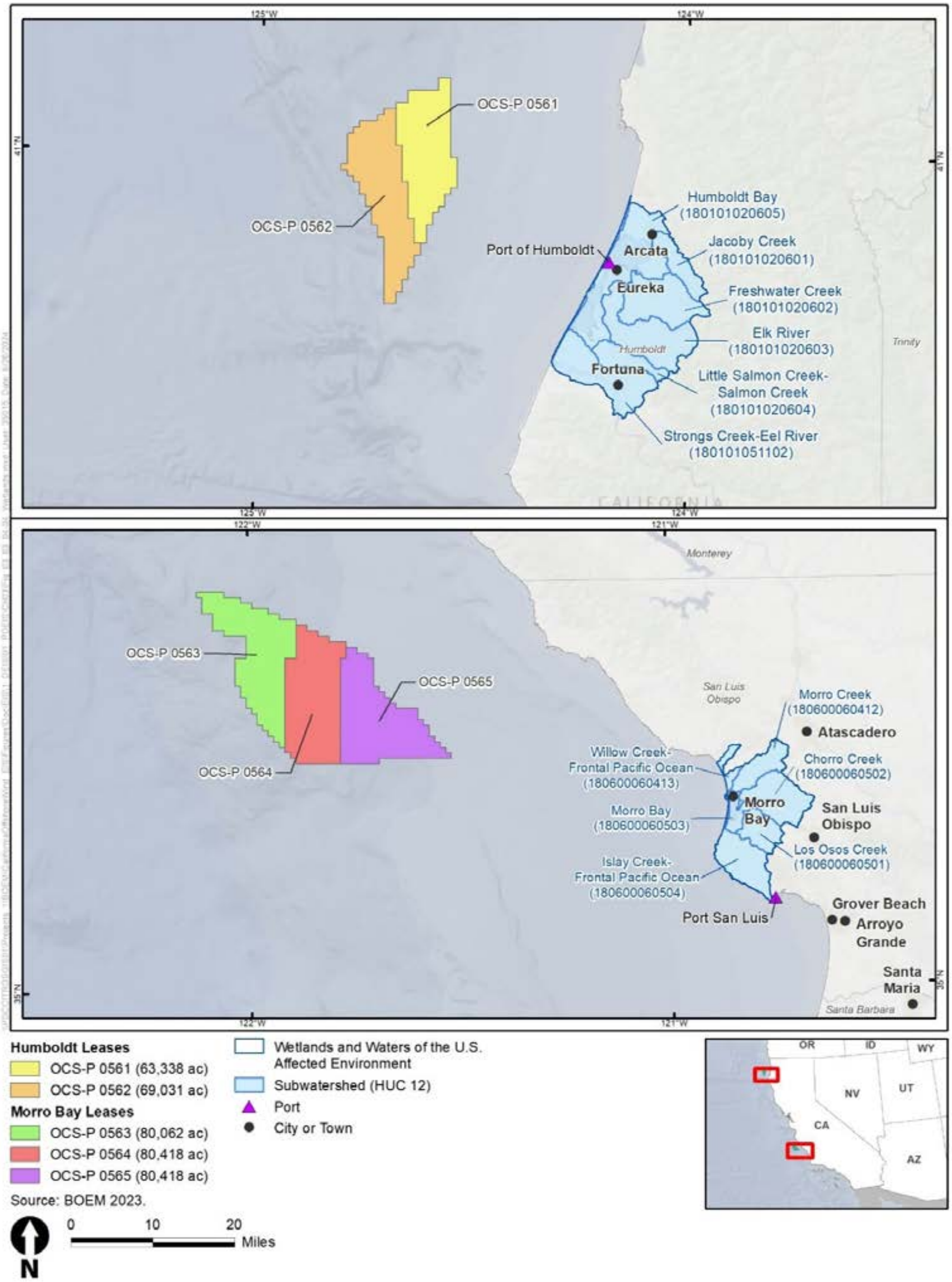

Figure 3.3.4-2. Humboldt and Morro Bay wetlands Affected Environment

North of Morro Bay, much of the shoreline is composed of gravel beaches with boulder rubble, wave-cut bedrock platforms, fine- to coarse-grained beaches, mixed sand and gravel, and occasional exposed tidal flats. At Morro Bay and points south, the shoreline is composed of fine- to coarse-grained beaches with occasional wave-cut bedrock platforms, exposed rocky shore, and riprap. Morro Bay's interior includes salt/brackish and freshwater marshes, as well as sheltered and exposed tidal flats (ESI 2006).

The National Coastal Condition Assessment (USEPA 2021) summarizes U.S. coastal waters conditions based on data from 2005 through 2015. Metrics including water quality, sediment quality, benthic habitat, human health, and fish tissue contaminants were measured and compared between regions and years. For the West region, biological condition and eutrophication measures were better than in other regions of the United States. However, sediment quality and ecological effects of contaminants on fish were rated poorly.

The coastal habitat index summarizes the health of coastal wetland habitats such as salt and brackish marshes, estuaries, kelp beds, and tidal flats. The West region, which includes the Humboldt and Morro Bay coasts, has an overall condition rated good to fair but was rated poor for coastal habitat. Drought effects and development have imperiled coastal wetlands (USEPA 2012). Offshore, the primary coastal habitats of the Affected Environment include emergent aquatic vegetation and soft-bottom and hard-bottom habitats.

3.3.4.1.2 Terrestrial Vegetation

Information on vegetation types is drawn from the LANDFIRE mapping program[2] (LANDFIRE 2016), with the CNDDB adding detail about sensitive natural communities (CDFW 2023). Table 3.3.4-1 reflects vegetation types present in the Affected Environment from LANDFIRE's Existing Vegetation Type database. Natural vegetation types include woodlands and forest, shrub communities, and herbaceous communities. Other land cover types are anthropogenic and include agriculture and urban/developed areas (Figure 3.3.4-3 and Figure 3.3.4-4).

In the Humboldt Bay Affected Environment, predominant vegetation types are California Mixed Evergreen Forest and Woodland, Redwood Forest and Woodland, and Western Riparian Woodland and Shrubland. The CNDDB maps four sensitive natural communities in the Affected Environment: Northern Foredune Grassland, Sitka Spruce Forest, Coastal Terrace Prairie, and Northern Coastal Salt Marsh.

In the Morro Bay Affected Environment, the predominant vegetation types are Oak Woodland, Coastal Scrub, and Chaparral. The CNDDB maps five sensitive communities in the Affected Environment: Central Dune Scrub, Valley Needlegrass Grassland, Central Maritime Chaparral, Northern Coastal Salt Marsh, and Coastal Brackish Marsh.

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[2] LANDFIRE is a shared program between the wildland fire management programs of the U.S. Forest Service and U.S. Department of the Interior providing landscape-scale geospatial products to support cross-boundary planning, management, and operations.

Table 3.3.4-1. Affected Environment vegetation types and amounts (LANDFIRE)

Landcover Category	Landcover Type	Coastal Habitat and Fauna (Humboldt Bay)	Coastal Habitat and Fauna (Morro Bay)	Grand Total
		Acres	Acres	
Agricultural	Agricultural-Fallow	70.3	0.2	70.5
	Agricultural-Orchard	0.2	3.0	3.2
	Agricultural-Pasture	6,711.5	62.4	6,773.8
	Agricultural-Row Crop	71.4	36.6	108.0
Agricultural Total		**6,853.3**	**102.2**	**6,955.5**
Conifer	California Mixed Evergreen Forest and Woodland	1,292.4	41.2	1,333.5
	Conifer-Oak Forest and Woodland	369.7	46.1	415.7
	Douglas-fir-Ponderosa Pine-Lodgepole Pine Forest		1.6	1.6
	Redwood Forest and Woodland	752.2		752.2
Conifer Total		**2,414.3**	**88.8**	**2,503.1**
Conifer-Hardwood	Conifer-Oak Forest and Woodland		24.0	24.0
Conifer-Hardwood Total			**24.0**	**24.0**
Developed	Developed-High Intensity	538.5	219.8	758.3
	Developed-Low Intensity	1,338.4	674.6	2,013.1
	Developed-Medium Intensity	1,579.1	722.6	2,301.7
	Developed-Roads	3,579.5	1,476.4	5,055.9
	Developed-Upland Deciduous Forest	38.4	9.8	48.2
	Developed-Upland Evergreen Forest	969.3	182.8	1,152.1
	Developed-Upland Herbaceous	177.4	219.5	396.9
	Developed-Upland Mixed Forest	119.6	83.3	202.8
	Developed-Upland Shrubland	610.4	806.0	1,416.5
Developed Total		**8,950.6**	**4,394.7**	**13,345.4**
Exotic Herbaceous	Introduced Annual and Biennial Forbland	125.8	902.5	1,028.3

Landcover Category	Landcover Type	Coastal Habitat and Fauna (Humboldt Bay)	Coastal Habitat and Fauna (Morro Bay)	Grand Total
		Acres	Acres	
Exotic Herbaceous Total		**125.8**	**902.5**	**1,028.3**
Exotic Tree-Shrub	Introduced Upland Vegetation-Shrub		145.8	145.8
	Introduced Upland Vegetation-Treed		30.4	30.4
Exotic Tree-Shrub Total			**176.2**	**176.2**
Grassland	Grassland	148.0	369.7	517.7
Grassland Total		**148.0**	**369.7**	**517.7**
Hardwood	Western Oak Woodland and Savanna	117.0	714.4	831.4
Hardwood Total		**117.0**	**714.4**	**831.4**
Open Water	Open Water	16,811.7	2,328.1	19,139.8
Open Water Total		**16,811.7**	**2,328.1**	**19,139.8**
Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads		0.7	0.7
Quarries-Strip Mines-Gravel Pits-Well and Wind Pads Total			**0.7**	**0.7**
Riparian	Freshwater Marsh	0.9	0.8	1.7
	Introduced Herbaceous Wetland Vegetation		41.8	41.8
	Introduced Woody Wetland Vegetation		124.8	124.8
	Tidal Marsh	1,349.6	79.2	1,428.7
	Western Riparian Woodland and Shrubland	2,152.8	138.9	2,291.8
Riparian Total		**3,503.3**	**385.5**	**3,888.8**
Shrubland	Chaparral	25.1	1,204.0	1,229.1
	Pacific Coastal Scrub	605.1	2,137.2	2,742.3
Shrubland Total		**630.3**	**3,341.2**	**3,971.5**
Sparsely Vegetated	Sparse Vegetation	848.4	683.5	1,531.8
Sparsely Vegetated Total		**848.4**	**683.5**	**1,531.8**
Grand Total		**40,402.7**	**13,511.4**	**53,914.2**

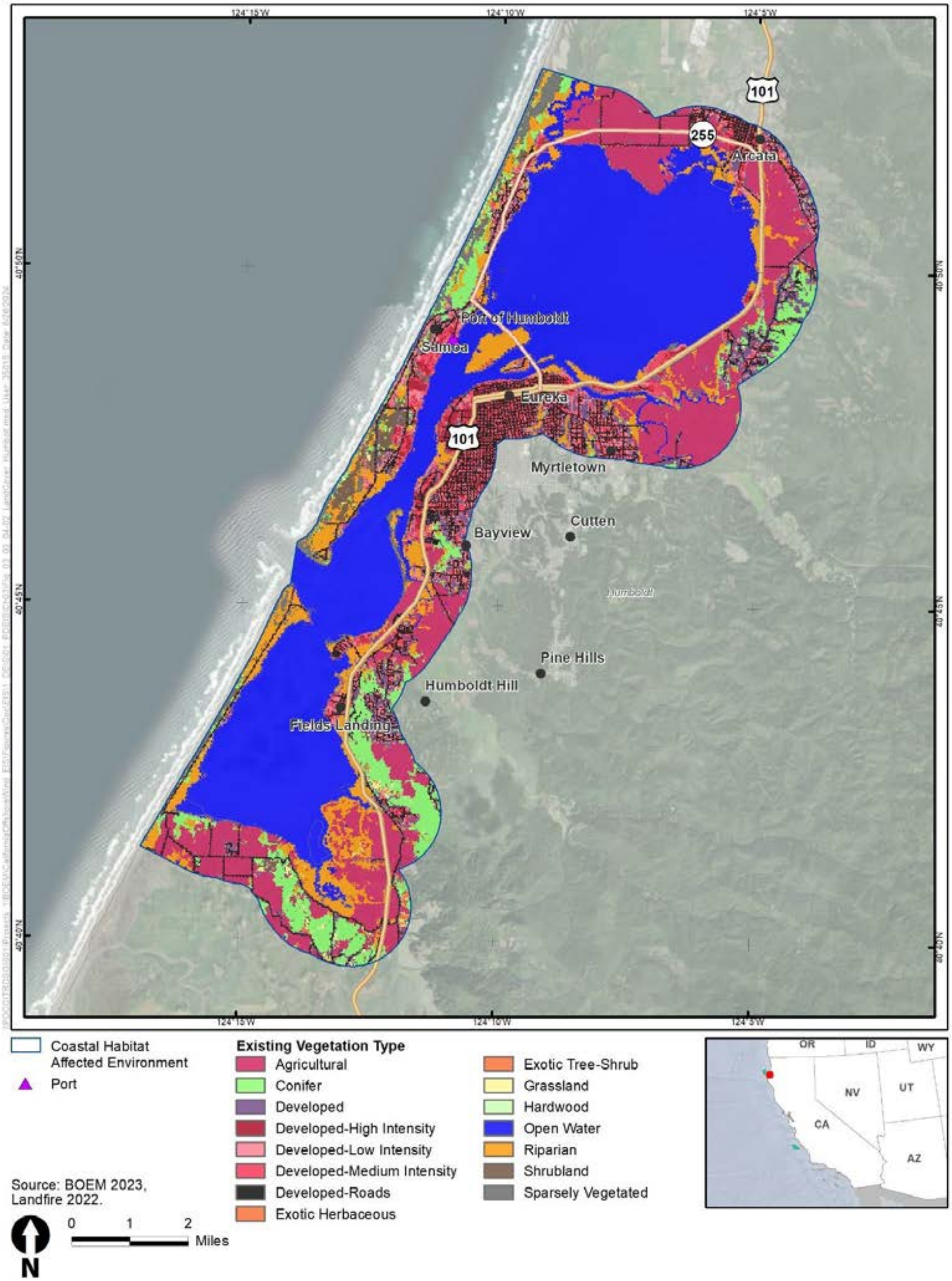

Figure 3.3.4-3. Landcover types in the Humboldt Affected Environment

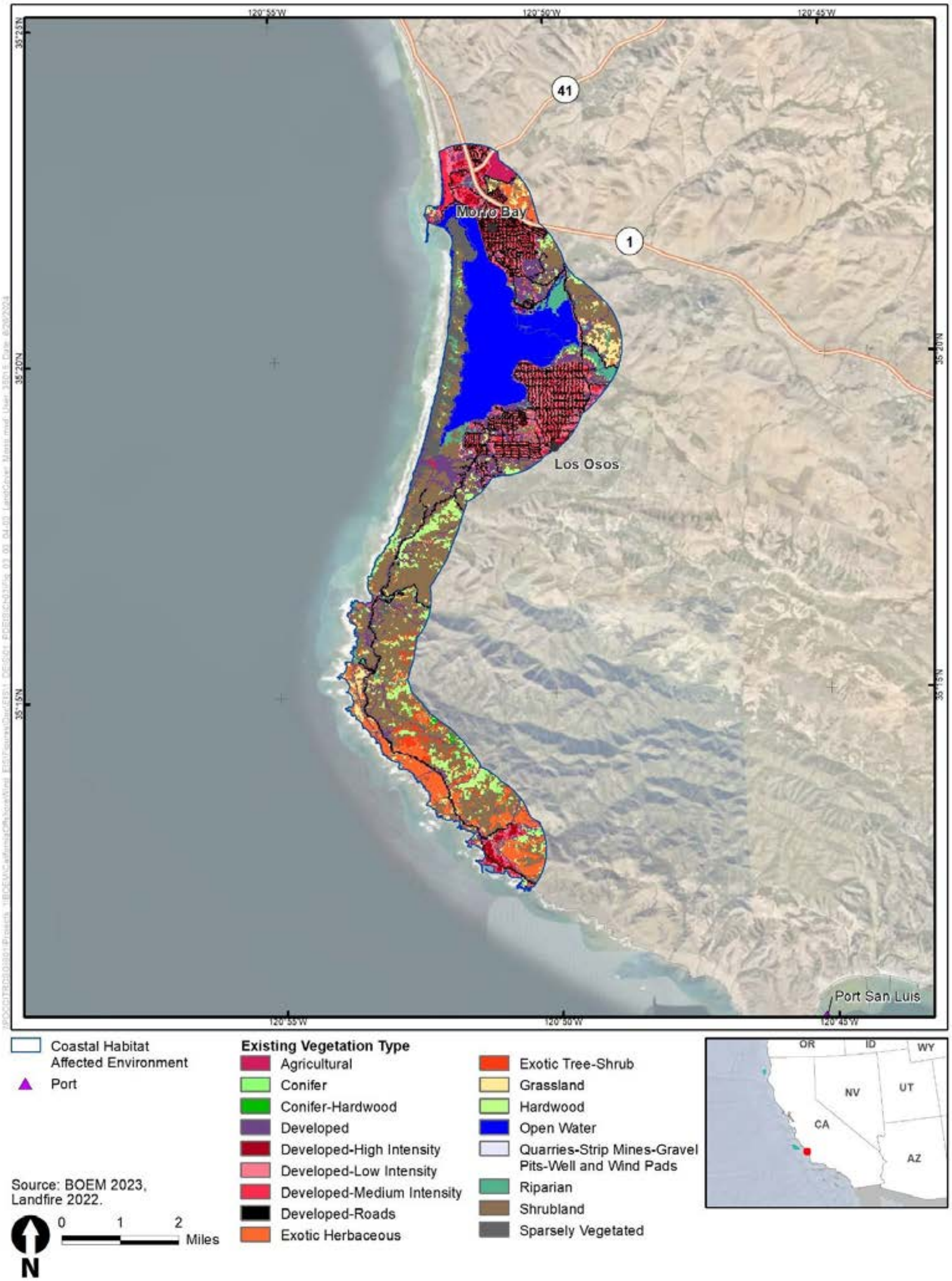

Figure 3.3.4-4. Landcover types in the Morro Bay Affected Environment

3.3.4.1.3 Wetlands

Wetlands include waters of the United States as defined under the 2023 Rule (40 CFR 120.2(a)) and USACE's identical definition (33 CFR 328.3(c)(16)). *Waters of the United States* means waters that are: (1) Currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide; (2) Impoundments of waters otherwise defined as waters of the United States under this definition; (3) Tributaries of waters that are relatively permanent, standing or continuously flowing bodies of water; (4) Wetlands adjacent to waters; and (5) Intrastate lakes and ponds, streams, or wetlands that are relatively permanent, standing or continuously flowing bodies of water with a continuous surface connection to the waters identified in 33 CFR 328.3(c)(16).

Wetlands provide numerous beneficial services or functions. Some of these include protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters, providing aesthetic value, ensuring biological productivity, filtering pollutant loads, and maintaining surface water flow during dry periods. In the Affected Environment estuarine, marine, and freshwater emergent wetlands (e.g., tidally influenced salt marshes) provide shelter, food, and nursery grounds for shrimp, crab, and many fish species (USFWS 2009; MBNEP 2022). Wetlands also protect shorelines from erosion by creating a buffer against wave action and by trapping soils. In flood-prone areas, wetlands reduce the flow of floodwater and absorb rainwater. Tidal wetlands also serve as carbon sinks, holding carbon that would otherwise be released into the atmosphere and contribute to climate change (Callaway et al. 2012). Coastal wetlands in the Affected Environment also protect coastal water quality by acting as a sink for land-derived nutrients and contaminants, constitute an important component of coastal food webs, provide valuable habitat for rare species, and protect upland and shoreline areas from flooding and erosion.

BOEM reviewed the National Wetlands Inventory and California Aquatic Resource Inventory datasets to identify potential wetlands in the Affected Environment. Both datasets, which map various aquatic environments, were identical. The more commonly used National Wetlands Inventory data is discussed here.

Tidal wetlands, located where the Pacific Ocean and estuaries meet land, are subject to regular tidal flooding and are divided into high and low marsh zones. Non-tidal or freshwater wetlands, unaffected by tides, are classified by their hydrology and dominant vegetation.

Determination of wetlands impacts first requires delineation of aquatic resources within construction footprints. Such delineations will be conducted in association with the lessee's preparation of COPs that will identify locations for needed onshore facilities. Aquatic resources delineations would potentially be under the jurisdiction of USACE, RWQCB, CCC, and CDFW, each with their own wetland definitions. At this programmatic stage, however, no specific onshore facilities or their locations are known.

The Humboldt Affected Environment contains about 36,000 acres (14,568 hectares) of shallow wetlands (Table 3.3.4-2 and Figure 3.3.4-5) (NWI 2023). California's second largest estuary, Humboldt Bay has several designated areas to protect wildlife, including the Humboldt Bay National Wildlife Refuge and

South Humboldt Bay SMRMA. The South Humboldt Bay SMRMA contains extensive eelgrass beds, which provide beneficial ecosystem services for fish, invertebrates, and fauna (Sherman and DeBruyckere 2017).

Threats to the state's wetlands include development, dredging, nutrient overload, and sea level rise due to climate change (USEPA 2021). Sea level rise, exacerbated by land subsidence, is considered the largest climate-related threat to salt marshes in the Humboldt Affected Environment (Thorne et al. 2018). Higher water levels may erode beaches, submerge lowlands, exacerbate coastal flooding, and increase the salinity of estuaries and aquifers. Sea level is rising more rapidly along the Humboldt area than in most coastal areas because of land subsidence (Montillet et al. 2018; Ocean Protection Council 2018).

The Morro Bay Affected Environment contains about 3,700 acres (1,512 hectares) of shallow wetlands (tidal and freshwater; Table 3.3.4-3 and Figure 3.3.4-6) (NWI 2023). Morro Bay includes two Marine Protected Areas: Morro Bay State Marine Reserve and SMRMA. Tidal wetlands occur around the interior of Morro Bay; freshwater wetlands occur inland typically along river and lake floodplains (i.e., outside the influence of tidal waters) (Figure 3.3.4-6). Morro Bay's wetlands face threats similar to those discussed for Humboldt. Although sea level rise effects are expected to be less severe than those projected for Humboldt, Morro Bay wetlands are expected to undergo significant subsidence and habitat conversion (Thorne et al. 2018).

Table 3.3.4-2. Wetlands in the Humboldt Affected Environment

Wetland Community	Acres	Percent of Total
Estuarine and Marine Wetland	15,687.0	42.8%
Freshwater Emergent Wetland	16,956.7	46.3%
Freshwater Forested/Shrub Wetland	3,999.9	10.9%
Total	**36,643.6**	**100.0**

Source: NWI 2023.

Table 3.3.4-3. Wetlands in the Morro Bay Affected Environment

Wetland Community	Acres	Percent of Total
Estuarine and Marine Wetland	2,103.0	56.6%
Freshwater Emergent Wetland	446.4	12.0%
Freshwater Forested/Shrub Wetland	1,167.1	31.4%
Total	**3,716.5**	**100.0**

Source: NWI 2023.

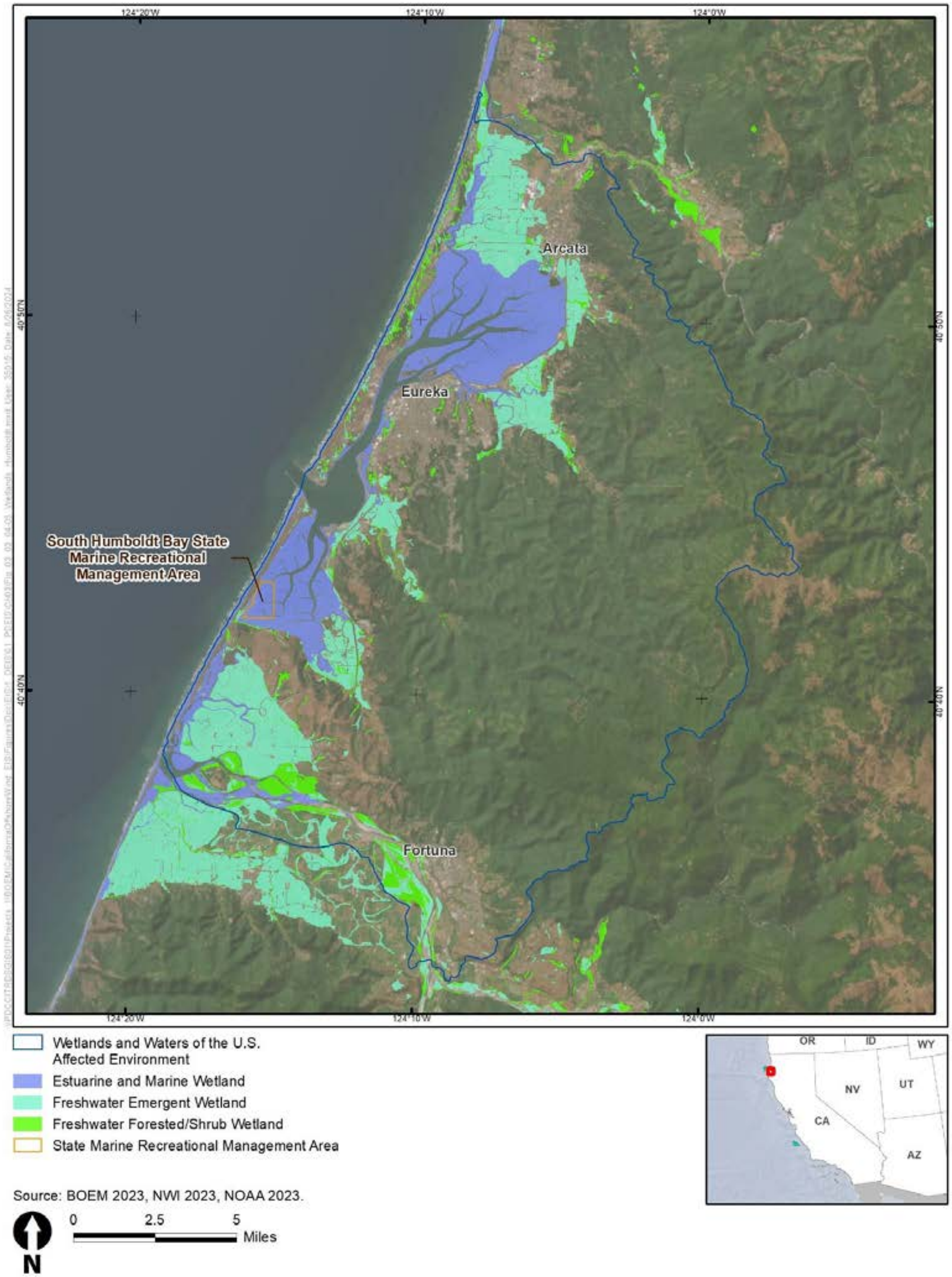

Figure 3.3.4-5. Wetlands in the Humboldt Affected Environment

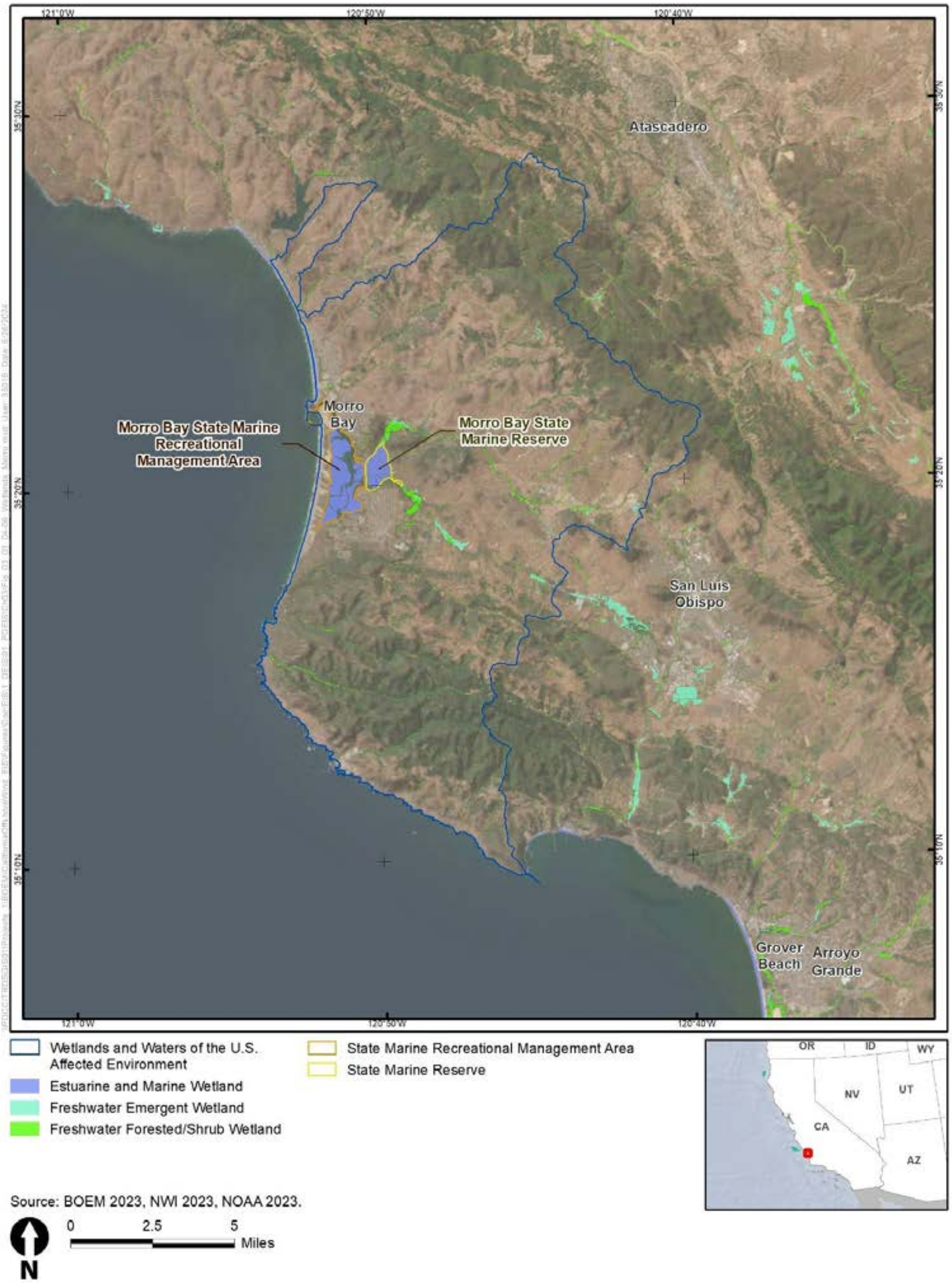

Figure 3.3.4-6. Tidal and freshwater wetlands in the Morro Bay Affected Environment

3.3.4.1.4 Coastal Fauna

Coastal areas provide habitat for many different types of fauna. Common macrofauna of the inner continental shelf include benthic invertebrates; flatfish; rockfish; pelagic species such as sharks, squid, and tuna; and salmonid species that utilize adjacent estuaries for nursery habitat.

Beaches and dunes are important habitats for migrating and nesting shorebirds and songbirds. The beaches, dunes, and scrub-shrub habitats along the shoreline may support the American avocet (*Recurvirostra americana*), long-billed curlew (*Numenius americanus*), marbled godwit (*Limosa fedoa*), semipalmated plover (*Charadrius semipalmatus*), and western sandpiper (*Calidris mauri*) (ESI 2008).

Wildlife expected to be present in onshore portions of the Affected Environment include species known to inhabit forested wetlands, forested lowlands, and upland habitats, coastal wetlands, beaches, and estuarine habitats. Tables 3.3.4-4 and 3.3.4-5 show typical species found in coastal areas of Humboldt and Morro Bays.

Table 3.3.4-4. Species typically found in coastal areas of Humboldt

Common Name	Scientific Name	Common Name	Scientific Name
Sierran treefrog	*Pseudacris sierra*	Osprey	*Pandion haliaetus*
Northern red-legged frog	*Rana aurora*	Pacific lamprey	*Entosphenus tridentatus*
Foothill yellow-legged frog: north coast DPS	*Rana boylii pop. 1*	Western brook lamprey	*Lampetra richardsoni*
Southern torrent salamander	*Rhyacotriton variegatus*	Coast cutthroat trout	*Oncorhynchus clarkii clarkii*
Great egret	*Ardea alba*	California floater	*Anodonta californiensis*
Great blue heron	*Ardea herodias*	Obscure bumble bee	*Bombus caliginosus*
Northern harrier	*Circus hudsonius*	Sandy beach tiger beetle	*Cicindela hirticollis gravida*
Gull species	*Larus* spp.	Behrens' snail-eating beetle	*Scaphinotus behrensi*
Snowy egret	*Egretta thula*	Humboldt mountain beaver	*Aplodontia rufa humboldtiana*
White-tailed kite	*Elanus leucurus*	White-footed vole	*Arborimus albipes*
Western gull	*Larus occidentalis*	Sonoma tree vole	*Arborimus pomo*
Double-crested cormorant	*Nannopterum auritum*	Townsend's big-eared bat	*Corynorhinus townsendii*
Black-crowned night heron	*Nycticorax nycticorax*	North American porcupine	*Erethizon dorsatum*

DPS = distinct population segment

Table 3.3.4-5. Species typically found in coastal areas of Morro Bay

Common Name	Scientific Name	Common Name	Scientific Name
Sierran treefrog	*Pseudacris sierra*	Morro Bay blue butterfly	*Icaricia icarioides moroensis*
Northern California legless lizard	*Anniella pulchra*	Morro Bay June beetle	*Polyphylla morroensis*
Coast horned lizard	*Phrynosoma blainvillii*	Mimic tryonia	*Tryonia imitator*
Cooper's hawk	*Accipiter cooperii*	Pallid bat	*Antrozous pallidus*
Obscure bumble bee	*Bombus caliginosus*	Steller sea lion	*Eumetopias jubatus*
Sandy beach tiger beetle	*Cicindela hirticollis gravida*	Desert woodrat	*Neotoma lepida intermedia*
Globose dune beetle	*Coelus globosus*	Big free-tailed bat	*Nyctinomops macrotis*

For any onshore project components that would be in developed lands, expected species include those common to urban environments, such as opossum, cottontail, gray squirrel, meadow vole, Norway rat, house mouse, raccoon, and striped skunk. Bird species likely to utilize these urban habitats include house sparrow (*Passer domesticus*), European starling (*Sturnus vulgaris*), gulls, and rock pigeon (*Columba livia*).

3.3.4.1.5 Federally and State-Listed Coastal Species

Under the ESA and California Endangered Species Act, species and their habitats potentially affected by construction and operation of offshore wind projects would require further evaluation to determine presence of habitat and individuals.

Special concern species that could potentially occur in the Humboldt Affected Environment include but are not limited to marbled murrelet (*Brachyramphus marmoratus*), northern spotted owl (*Strix occidentalis caurina*), and tidewater goby (*Eucyclogobius newberryi*). Special-status plants known to occur in the area include beach layia (*Layia carnosa*), Menzies' wallflower (*Erysimum menziesii*), and western lily (*Lilium occidentale*). Table 3.3.4-6 identifies federally and state-listed threatened and endangered species found in or near the Humboldt Affected Environment. The Affected Environment includes designated critical habitat for federally listed tidewater goby and western snowy plover (*Charadrius alexandrinus nivosus*).

Special concern species that could potentially occur in the Morro Bay Affected Environment include but are not limited to least Bell's vireo (*Vireo bellii pusillus*), marbled murrelet, and southwestern willow flycatcher (*Empidonax traillii extimus*). Special-status plants here include salt marsh bird's-beak (*Cordylanthus maritimus* ssp. *maritimus*), beach spectaclepod (*Dithyrea maritima*), and morro manzanita. Table 3.3.4-7 identifies federally and state-listed threatened and endangered species found in or near the Morro Bay Affected Environment. The Affected Environmental includes designated critical habitat for federally listed California red-legged frog (*Rana draytonii*), Morro Bay kangaroo rat (*Dipodomys heermanni morroensis*), Morro shoulderband snail (*Helminthoglypta walkeriana*), tidewater goby, and western snowy plover.

Table 3.3.4-6. Summary of potential threatened and endangered species in or near the Humboldt Affected Environment for coastal habitat and fauna[1]

Common Name	Scientific Name	Taxonomic Group	Federal Status	State Status[2]
Flora				
Beach layia	*Layia carnosa*	Plants	Threatened	Endangered, CRPR 1B.1
Menzies' wallflower	*Erysimum menziesii*	Plants	Endangered	Endangered, CRPR 1B.1
Western lily	*Lilium occidentale*	Plants	Endangered	Endangered, CRPR 1B.1
Fauna				
Bald eagle	*Haliaeetus leucocephalus*	Birds	Delisted	Endangered
California Ridgway's rail	*Rallus obsoletus obsoletus*	Birds	Endangered	Endangered
Bank swallow	*Riparia riparia*	Birds	None	Threatened
Marbled murrelet	*Brachyramphus marmoratus*	Birds	Threatened	Endangered
Northern spotted owl	*Strix occidentalis caurina*	Birds	Threatened	Threatened
Western snowy plover	*Charadrius nivosus nivosus*	Birds	Threatened	None
Yellow-billed cuckoo	*Coccyzus americanus*	Birds	Threatened	Endangered
Longfin smelt	*Spirinchus thaleichthys*	Fish	Candidate	Threatened
Tidewater goby	*Eucyclogobius newberryi*	Fish	Endangered	None
Coho salmon: Southern Oregon/ Northern California ESU	*Oncorhynchus kisutch*	Fish	Threatened	Threatened
Chinook salmon: Central Coast ESU	*Oncorhynchus tshawytscha*	Fish	Threatened	None
Steelhead: north coast DPS	*Oncorhynchus mykiss irideus*	Fish	Threatened	None
Eulachon	*Thaleichthys pacificus*	Fish	Threatened	None
Green sturgeon: southern DPS	*Acipenser medirostris*	Fish	Threatened	None
Western bumble bee	*Bombus occidentalis*	Insects	None	Candidate
Monarch butterfly	*Danaus plexippus*	Insects	Candidate	None
Pacific marten	*Martes caurina*	Mammals	Threatened	None
Western pond turtle	*Emys marmorata*	Reptiles	Candidate	None

[1] Marine species identified through agency consultations as potentially occurring in the vicinity of the Affected Environment are discussed in Section 3.3.6, *Marine Mammals*; and Section 3.3.7, *Sea Turtles.*

[2] CRPR 1B.1 = Plants rare, threatened, or endangered in California and elsewhere, seriously threatened in California (CDFW 2023).

CRPR = California Rare Plant Rank; ESU = evolutionarily significant unit

Table 3.3.4-7. Summary of potential threatened and endangered species in or near the Morro Bay Affected Environment for coastal habitat and fauna[1]

Common Name	Scientific Name	Taxonomic Group	Federal Status	State Status[2]
Flora				
Marsh sandwort	*Arenaria paludicola*	Plants	Endangered	Endangered, CRPR 1B.1
Indian Knob mountainbalm	*Eriodictyon altissimum*	Plants	Endangered	Endangered, CRPR 1B.1
California seablite	*Suaeda californica*	Plants	Endangered	CRPR 1B.1
Beach spectaclepod	*Dithyrea maritima*	Plants	None	Threatened, CRPR 1B.1
Morro manzanita	*Arctostaphylos morroensis*	Plants	Threatened	CRPR 1B.1
California jewelflower	*Caulanthus californicus*	Plants	Endangered	Endangered, CRPR 1B.1
Chorro Creek bog thistle	*Cirsium fontinale* var. *obispoense*	Plants	Endangered	Endangered, CRPR 1B.2
Marsh sandwort	*Arenaria paludicola*	Plants	Endangered	Endangered, CRPR 1B.1
Pismo clarkia	*Clarkia speciosa* ssp. *immaculata*	Plants	Endangered	Rare, CRPR 1B.1
Salt marsh bird's-beak	*Cordylanthus maritimum* ssp. *maritimum*	Plants	Endangered	Endangered, CRPR 1B.2
Fauna				
California red-legged frog	*Rana draytonii*	Amphibians	Threatened	None
California tiger salamander	*Ambystoma californiense*	Amphibians	Threatened	Threatened
Foothill yellow-legged frog	*Rana boylii*	Amphibians	Endangered	Endangered
California Ridgway's rail	*Rallus obsoletus obsoletus*	Birds	Endangered	Endangered
Western snowy plover	*Charadrius nivosus nivosus*	Birds	Threatened	None
California black rail	*Laterallus jamaicensis coturniculus*	Birds	None	Threatened
California clapper rail	*Rallus longirostris obsoletus*	Birds	Endangered	Fully Protected
California condor	*Gymnogyps californianus*	Birds	Endangered	Endangered
California least tern	*Sterna antillarum browni*	Birds	Endangered	Endangered
Least Bell's vireo	*Vireo bellii pusillus*	Birds	Endangered	Endangered
Marbled murrelet	*Brachyramphus marmoratus*	Birds	Threatened	Endangered
Southwestern Willow flycatcher	*Empidonax traillii extimus*	Birds	Endangered	Endangered
Western snowy plover	*Charadrius nivosus nivosus*	Birds	Threatened	None
Yellow-billed cuckoo	*Coccyzus americanus*	Birds	Threatened	Endangered
Vernal pool fairy shrimp	*Branchinecta lynchi*	Crustaceans	Threatened	None
Tidewater goby	*Eucyclogobius newberryi*	Fish	Endangered	None

Common Name	Scientific Name	Taxonomic Group	Federal Status	State Status[2]
Steelhead: south-central California coast DPS	*Oncorhynchus mykiss irideus pop. 9*	Fish	Threatened	None
Green sturgeon: southern DPS	*Acipenser medirostris*	Fish	Threatened	None
Monarch: California overwintering population	*Danaus plexippus plexippus pop. 1*	Insects	Candidate	None
Steller sea lion eastern DPS	*Eumetopias jubatus*	Mammals	Delisted	None
Morro Bay kangaroo rat	*Dipodomys heermanni morroensis*	Mammals	Endangered	Endangered
Morro shoulderband	*Helminthoglypta walkeriana*	Mollusks	Threatened	None
Giant kangaroo rat	*Dipidomys ingens*	Mammals	Endangered	Endangered
San Joaquin kit fox	*Vulpes macrotis mutica*	Mammals	Endangered	Threatened
Southern sea otter	*Enhydra lutris nereis*	Mammals	Threatened	None

[1] Marine species identified through agency consultations as potentially occurring in the vicinity of the Affected Environment are discussed in Section 3.3.6 and Section 3.3.7.
[2] CRPR 1B.1 = Plants rare, threatened, or endangered in California and elsewhere; .1 = Seriously threatened in California; .2 = Moderately threatened in California (CDFW 2023).

3.3.4.2 Impact Background for Coastal Habitat, Fauna, and Wetlands

BOEM defines wetlands impacts differently than federal, state, and local jurisdictions due to different requirements under the CWA, Section 10 of the Rivers and Harbors Act, the Coastal Zone Management Act, and each county's or municipality's Local Coastal Plan, Coastal Development Permit, or Conditional Use Permit.[3]

Accidental releases and land disturbance are contributing IPFs to coastal habitat, fauna, and wetland impacts; noise and traffic may further affect coastal habitat and fauna, though they may not necessarily contribute to each individual issue outlined in Table 3.3.4-8. The impact analysis in this section may overlap with the analysis presented in the following sections: Section 3.3.1, *Bats*; Section 3.3.2, *Benthic Resources*; Section 3.3.3, *Birds*; Section 3.3.5, *Fishes, Invertebrates, and Essential Fish Habitat*; Section 3.4.1, *Commercial Fisheries and For-Hire Recreational Fishing*; Section 3.3.6, *Marine Mammals*; Section 3.3.7, *Sea Turtles*; and Section 3.2.2, *Water Quality*.

Refer to Section 3.1, *Impact Analysis Terms and Definitions*, regarding beneficial impacts.

[3] For example, USACE defines temporary impacts as those that are restored to preconstruction contours and functions when construction activities are complete (e.g., stockpile, temporary access). Fill that results in a permanent loss or permanent conversion of a wetland to dry land or a non-wetland is considered a permanent impact. CCC considers wetland impacts to be temporary if there is no significant ground disturbance or destruction of native vegetation and if vegetation returns to pre-project functions within 12 months of the start of disturbance; long-term, temporary impacts may be considered and may require vegetation recovery within 12 months of the conclusion of disturbance if the impacts occur over 24 months.

Table 3.3.4-8. Issues and indicators to assess coastal habitat, fauna, and wetlands impacts

Issue	Impact Indicator
Habitat loss/modification	Area of affected habitat
Disturbance/displacement	Changes to noise levels Projected traffic patterns/volume changes Qualitative assessment of potential ingestion or ensnarement from trash/debris
Collision/injury	Qualitative estimate of collision risk

3.3.4.3 Impacts of Alternative A – No Action – Coastal Habitat, Fauna, and Wetlands

When analyzing the impacts of the No Action Alternative on coastal habitat, fauna, and wetlands, BOEM considers the impacts of ongoing activities, including ongoing non-offshore-wind activities, on the baseline conditions for coastal habitat, fauna, and wetlands.

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative on existing baseline trends, including other planned activities, which are described in Appendix C, *Planned Activities Scenario*.

3.3.4.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for coastal habitat, fauna, and wetlands would continue to follow current regional trends and respond to impacts from other ongoing activities. Relevant ongoing activities would include onshore and nearshore development and activities, including residential, commercial, and industrial development; but also include impacts from invasive species and climate change.

Any new structures along the coast, including developments, roads, utilities, marinas and ports, and shoreline protection measures, are anticipated to increase incrementally, altering coastal habitat, fauna, and wetlands through temporary and permanent habitat removal or conversion; temporary noise impacts during construction; impacts on water quality and lighting (which could cause animal displacement and/or behavior change); and injury or mortality of individual animals or loss and alteration of vegetation and individual plants. Increases in ship activity may also cause longer-term impacts in the form of increased sedimentation.

Under the No Action Alternative, climate change and associated sea level rise are expected to induce significant changes to coastal habitat in 14 estuaries along the West Coast. Under a moderate sea level rise scenario of roughly 3 feet (+93 centimeters), approximately 36 percent of middle and high marsh habitats along the West Coast are expected to be converted into intertidal mudflat and open water by 2110. Under a high sea level rise scenario of roughly 5 feet (+166 centimeters), approximately 83 percent of middle and high marsh habitats are expected to be converted into intertidal mudflat and open water, with higher rates of conversion taking place in California by 2110 (Thorne et al. 2018). It is expected that Humboldt Bay would exceed these values due to it having the highest rate of sea level rise in California (Montillet et al. 2018). Inundation and rising water levels would convert vegetated areas into areas of open water, with a consequent loss of wetland functions from the loss of vegetated wetlands. Climate change and associated sea level rise will also result in dieback of coastal habitats caused by rising groundwater tables and increased saltwater inundation from storm surges and exceptionally high tides (Sacatelli et al. 2020). In areas where slopes are not gradual or where there are other features blocking flow (e.g., bulkhead or surrounding developed landscape), wetland migration would be slowed or impeded. Sandy beaches and salt marshes in the Affected Environment are subject to erosion and the effects of climate change and sea level rise as vegetated tidal flats are converted to mudflats and lose the majority of their upland transitional habitats (Thorne et al. 2016), including ocean acidification and ocean warming. Salt marshes in Humboldt and Morro Bays are unlikely to keep pace if sea level rises 3 feet (0.9 meter) by the end of the century, which is predicted under a moderate sea level rise scenario (Thorne et al. 2018). Climate change may also affect coastal habitats through increases in instances and severity of droughts and range expansion of invasive species such as invasive cordgrass (*Spartina* spp.) along salt marshes of the West Coast, including the Affected Environment (Daehler and Strong 1996; Strong and Ayres 2016). Warmer temperatures will cause plants to flower earlier, will not provide needed periods of cold weather, and will likely result in declines in reproductive success of plant and pollinator species (Cassotta et al. 2019). Reptile and amphibian populations may experience shifts in distribution, range, reproductive ecology, and habitat availability. Increased temperatures could lead to changes in mating, nesting, reproductive, and foraging behaviors of species, including a change in the sex ratios in reptiles with temperature-dependent sex determination (Cassotta et al. 2019).

3.3.4.3.2 Impacts of the No Action Alternative on ESA-Listed Species

Ongoing activities may affect the species listed in Tables 3.3.4-6 and 3.3.4-7. IPFs described previously would also apply to ESA-listed species. Any future federal activities that could affect ESA-listed species would need to comply with ESA Section 7 to ensure that such activities do not jeopardize the continued species existence; similarly, ESA Section 10 would apply to future non-federal activities.

3.3.4.3.3 Cumulative Impacts of the No Action Alternative

Cumulative impacts on coastal habitat, fauna, and wetlands from ongoing activities may occur if onshore activity from these projects overlaps with the Affected Environment. Increasing onshore development activities may also affect coastal habitat and fauna. Other planned activities that may affect wetlands would primarily include increasing onshore and nearshore development (Appendix C). Planned activities may result in temporary or permanent landscape alteration and displacement and injury or mortality of individual plants and animals, but population-level effects would not be expected. Habitat and plant degradation and loss, as well as habitat conversion may also occur. These activities may permanently (e.g., fill placement) and temporarily (e.g., vegetation removal) affect wetland habitat, water quality, and hydrologic functions. It is further assumed that planned projects would remain subject to federal, state, and local regulations related to wetlands protection.

Accidental releases: Ongoing and planned activities may increase accidental releases. Section 3.2.2 discusses anticipated releases. Releases of fuels and oils nearshore or onshore may contaminate coastal habitat and wetlands and harm species. Accidental chemical releases with potential to sink or dissolve rapidly are predicted to dilute to non-toxic levels before they reach nearshore coastal habitat. Larger spills emanating from ocean vessels, though unlikely, could have larger impacts on coastal habitat, fauna, and wetlands by affecting water quality. While many wetlands filter out contaminants, any significant increase in contaminant loading could exceed the capacity of a wetland to perform its normal water quality functions. Onshore and nearshore, the use of heavy construction equipment could result in releases of fuels and oils, especially during refueling.

Because these impacts are expected to be distributed throughout the Affected Environment, temporary, and limited in volume, they are expected to be largely avoided or contained and abated. Compliance with applicable state and federal regulations related to oil spills and waste handling would minimize potential impacts. These regulations include the Resource Conservation and Recovery Act, Department of Transportation Hazardous Material regulations, and regulations requiring a spill prevention, control, and countermeasure plan for projects that may affect wetlands.

Impacts from accidental releases on wetlands would likely be limited because accidental releases would be small and localized, and compliance with state and federal regulations would avoid or minimize potential impacts on wetland quality or functions. However, depending on the location and magnitude of an accidental release onshore or nearshore, wetland impacts could be potentially greater. Similarly, although there is no evidence that the anticipated volumes and extents combined with cleanup measures would have measurable impacts on coastal habitat and fauna, impacts would depend on the location and magnitude of accidental release.

Cable installation and maintenance: Several existing submarine cables are present and others may be added (Appendix C). Installation activities, including use of HDD at entry and exit points, would result in temporary impacts and some long-term loss of habitat where permanent cable infrastructure is installed at the ground level. Maintenance activities for offshore transmission and telecommunication cables would infrequently disturb bottom sediments, fauna, and coastal habitats; these disturbances would be localized and limited to the areas of cable repair within the cable corridor. Refer to Section 3.3.2 for additional discussion.

EMFs: EMFs continuously emanate from telecommunication cables (existing and planned). However, EMF effects are reduced by cable shielding and burial to an appropriate depth. Because EMFs decrease rapidly with distance from the cable, cable burial significantly reduces the extent of impacts.

Land disturbance: Ongoing and planned activities in the Affected Environment may require clearing, excavating, trenching, fill, and grading, resulting in wetland loss or alteration and potential adverse effects on wetland habitat, water quality, and flood and storage capacity functions. Impacts could be temporary or permanent, with permanent impacts impairing some or all beneficial functions of wetlands.

Given that the Affected Environment includes suburban and rural landscapes, and ongoing and planned development activities would likely be sited in disturbed areas (e.g., along existing roadways and ROWs), BOEM anticipates wetland impacts would be minimal but would be dependent on project-specific details and locations of development activities.

Lighting: Vessel navigation and deck lighting contribute to existing and anticipated lighting impacts. Vessel light emissions are expected to continue, increasing with more marine transportation and vessel traffic. However, such lighting would be intermittent and have limited impacts on coastal habitat and fauna. Impacts would likely be isolated to the immediate vicinity of vessels.

Noise: Noise generated from ongoing activities would not likely produce sound levels in nearshore coastal areas that would be measurable from the Affected Environment. The intensity and extent of noise is difficult to generalize but coastal fauna impacts would be temporary and localized.

Anthropogenic underwater sounds come from many different sources including vessel traffic, seismic surveys, active sonar used for navigation of large vessels, and chart plotting. These low- and mid-frequency noises in oceanic waters (Henderson et al. 2008) dominate the ambient sound levels in frequencies below 200 Hz (Arveson and Vendittis 2000; Veirs et al. 2016). Construction noise occurs occasionally along populated areas in the Humboldt and Morro Bay lease areas and infrequently offshore. Noise from nearshore construction is expected to gradually increase in line with human population growth along the coast. The extent of the impact depends on the equipment used, noise levels, and local acoustic conditions. Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Construction noise intensity and extent are difficult to generalize, but these impacts on coastal fauna communities would be local and temporary.

Land disturbance: Ground-disturbing activities from ongoing activities could contribute to elevated levels of erosion and sedimentation but usually not to a degree that affects coastal fauna, assuming that industry-standard BMPs are implemented.

Some amount of habitat conversion may also result from planned port expansions, including those anticipated at Humboldt Bay (Appendix C). These include projects associated with offshore wind but are proceeding independently of any specific lease area. Trends in the Humboldt coast region indicate port activity will increase modestly and require some conversion of previously disturbed land. This conversion may result in permanent habitat loss for local populations of fauna.

Traffic: Traffic-related wildlife and wildlife habitat impacts would be limited because the onshore Affected Environment is highly developed. Any impacts from traffic are expected to be highly localized and short term and would not result in population-level effects on fauna.

3.3.4.3.4 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, coastal habitat, fauna, and wetlands would continue to be affected by existing environmental trends and impacts introduced by ongoing activities. BOEM expects ongoing activities to have continuing temporary, long-term, and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on coastal habitat and fauna primarily through onshore construction impacts, noise, traffic, and climate change. Land disturbance from onshore development would cause temporary and permanent loss of wetlands. Habitat removal from ongoing activities is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects on fauna in the Affected Environment. Permanent wetland impacts would likely occur, requiring compensatory mitigation because climate change is predicted to affect coastal habitat and fauna (Thorne et al. 2018).

Cumulative Impacts of the No Action Alternative. BOEM anticipates that the overall impacts associated with the No Action Alternative, when combined with all other planned activities, would likely be limited given that any activity would be required to comply with federal, state, and local regulations related to the protection of sensitive habitats and wetlands, and mitigation of impacts, and given the continued impacts of land disturbance and climate change.

3.3.4.4 Impacts of Alternative B – Development with No Mitigation Measures – Coastal Habitat, Fauna, and Wetlands

3.3.4.4.1 Impacts of One Representative Project in Each WEA

The development of one project in each WEA is expected to result in impacts similar to those described in Section 3.3.4.3.3, *Cumulative Impacts of the No Action Alternative*. Accordingly, the discussion below does not repeat previous analyses but describes where impacts may differ and reiterates the conclusions of those analyses.

BOEM expects that the onshore and nearshore facilities associated with offshore wind development in the Humboldt and Morro Bay lease areas would be designed to avoid wetlands and sensitive habitats to the extent feasible and would comply with all federal, state, and local regulations.

Accidental releases: One representative project in each WEA would increase the risk of accidental releases of fuels, oils, and other petroleum compounds, primarily during construction but also during operations and decommissioning. These potential accidental releases would be of low risk and small quantity and, combined with the cleanup measures in place, the duration of effects from accidental releases would be short to long term, and most impacts on species are expected to be avoided.

Applicants would be required to develop and implement spill prevention, control, and countermeasure plans to minimize water quality impacts (prepared in accordance with applicable NPDES and State Water Board regulations). All waste generated onshore would comply with applicable federal regulations, including the Resource Conservation and Recovery Act and the Department of Transportation Hazardous Material regulations. Therefore, BOEM anticipates a representative project in each WEA would result in short-term impacts on coastal habitat, fauna, and wetlands from releases from heavy equipment during construction and other cable installation activities.

Vessels serving all phases of offshore wind development can be sources of trash and debris. All vessels would be required to comply with laws and regulations to minimize releases. It is thus assumed any releases would be accidental, localized events of short duration in the vicinity of project activities, although nearshore activities are more likely to result in trash/debris that reaches coastal areas.

However, there does not appear to be evidence that the volumes, extents, and durations anticipated would have any measurable impact on coastal habitat, fauna, and wetlands.

Additionally, construction vessels would comply with USCG regulations and interim requirements of the Vessel Incidental Discharge Act (85 *FR* 67818). Vessel chemical releases are considered unlikely and would yield only short-term, localized impacts.

Cable installation and maintenance: HDD methods would likely be used to install offshore export cables under beaches and dunes and avoid affected sensitive, shallower, nearshore intertidal coastal habitat, wetlands, or seagrass beds and the coastal fauna that inhabit these areas. Trenchless installation would likely occur from a trenchless installation punch-out location offshore of the cable landing location. Either method would result in temporary disturbance to nearshore sediment. Most impacts on nearshore fauna are expected to be avoided; if impacts occur, they may result in the loss of a few individuals. Impacts on coastal habitat, fauna, and wetlands would be expected to be short term, with maintenance activities most likely involving small cable sections. BOEM expects most lessees would design their project to avoid sensitive coastal habitat. Most impacts on species are expected to be avoided; if impacts occur, they may result in the loss of a few individuals.

Electric and magnetic fields and cable heat: A representative project in each WEA would include offshore export cables, which along with existing submarine cables, can be sources of EMFs and cable heat in coastal habitat. Although little is known about potential impacts of EMFs on coastal resources, conservative calculations of magnetic-field and induced electric-field levels based on cable specifications commonly used for wind projects and peak and average load levels indicate that the fields produced by the project's cables would be below the detection thresholds for magnetosensitive and electrosensitive marine organisms. The maximum magnetic field expected for an offshore wind energy project's export cable EMF is about 165 milligauss, dropping to 40 milligauss 3.26 feet (1 meter) above the cable, a decrease in field strength of 76 percent (CSA and Exponent 2019). EMF strength diminishes rapidly with distance, and potentially impact-producing EMFs would likely extend less than 50 feet (15.2 meters) from each cable (Bilinski 2021). EMFs would be further minimized by shielding and by burying the offshore export cables to the target depth of 3 to 16 feet (0.9 to 5 meters). The duration of EMFs emitted is expected to be continuous over the life of the project but not have a measurable impact on species or habitat.

Lighting: One representative project in each WEA would include vessel lighting (during all development phases), as well as operational lighting, such as on onshore substations. Onshore lighting would be localized and would be expected to comply with local land use regulations that minimize light trespass/glare. Navigation lights during construction, operations, and decommissioning would be minimal and transitory.

Noise: Onshore and nearshore construction and O&M would generate noise potentially audible to fauna in coastal habitats from: nearshore drilling of piles and dredging, including rock placement; construction of onshore substations or buildings, and other port and terminal facilities; G&G surveys; vessel noise; and WTG assembly and other heavy lift terminal operations. Construction noise associated with WTGs and OSSs is not expected to reach the Affected Environment due to distance from shore. Onshore and nearshore noise would be localized and would be expected to comply with local land use regulations that minimize noise disturbance.

Onshore construction and O&M noise would likely be limited to daytime hours but could lead to the disturbance and displacement of mobile species. Such noise, along with any related physical changes, could render an area temporarily (during construction) or permanently (during O&M) unsuitable for fauna or result in masking effects on communication for fauna that remain in the area (Dooling et al. 2019). Because impacts from onshore construction noise would be short term and most likely concentrated during daytime and because most fauna are able to temporarily leave the area where noise is occurring, BOEM expects that no individual fitness or population-level impacts would occur. No lasting impacts on local breeding populations are anticipated.

Regular O&M of onshore facilities (once constructed) could generate localized continuous noise, but BOEM expects limited impacts when considered in the context of the other commercial and industrial noises in the Affected Environment with no measurable impact on coastal fauna.

G&G survey noise can disturb coastal fauna in the immediate vicinity of the investigation. High-resolution geophysical surveys include high-frequency sound sources from medium-penetration sub-bottom profilers (e.g., sparkers, boomers) and shallow-penetration, non-parametric sub-bottom profilers (e.g., Compressed High-Intensity Radiated Pulses) that generate less-intense sound waves than the seismic surveys used for oil and gas exploration that create high-intensity impulsive sound that penetrates deep into the seabed (Erbe and McPherson 2017). Impacts from vessel and equipment noise from these geophysical surveys of cable routes could disturb coastal fauna in the immediate vicinity of the investigation and cause temporary behavioral changes. The intensity and extent of the resulting noise impacts from G&G surveys are difficult to generalize but would likely be short term and localized.

Presence of structures: Installation of cable protection (dumped rocks, geotextile sand containers, and concrete mattresses) atop cables that can create uncommon hard-bottom habitat may be necessary for the representative project in each WEA. Where cables are buried deeply enough that protection is not used, presence of the cable would have no impact on coastal habitat. Although some of this would occur outside of the Affected Environment for coastal habitat, cable protection could remain permanently after cable installation. Most impacts on species are expected to be avoided, but the loss of a few individuals may result.

Land disturbance: Land disturbance associated with onshore construction could cause removal of vegetation, temporary disturbance to adjacent land uses (light, noise, and traffic), and disruption of shoreline access. A representative project in each WEA could include land disturbance from onshore construction associated with installation of export cables, landfalls, onshore substations and converter stations, and transmission facilities. The primary wetland impacts would be filling, excavation, rutting, compaction, mixing of topsoil and subsoil, and potential alteration due to clearing. Impacts on habitat from onshore construction activities are expected to be limited because such facilities would most likely be in existing developed areas, such as roads, parking lots, and utility ROWs.

Direct effects on sensitive environmental resources, such as wetlands, riparian areas, or other sensitive natural habitats, would be avoided to the maximum extent practicable by siting onshore project components in upland areas due to the requirements of federal, state, and local wetland permitting. These impacts would be temporary where onshore project components do not require permanent fill, as restoration would be conducted in accordance with applicable permit requirements. Following installation of interconnection cables in wetlands, topography would be restored and soils would be de-compacted to avoid long-term impacts. Permanent fill of a wetland would result in localized wetland loss. Other long-term impacts on wetlands would include clearing wetlands in temporary work areas. While these areas would be allowed to revert to ambient wetland conditions after construction, recovery could take decades or longer. Following construction, temporarily disturbed areas would be restored to pre-existing conditions and revegetated.

Where applicable, the onshore interconnection cables would be installed using trenchless technology (e.g., jack-and-bore, pipe jacking, HDD) beneath wetlands where crossing is necessary to minimize direct impacts on these resources. Entry/exit work areas would be in disturbed upland areas to further avoid impacts on wetlands.

Water quality in wetlands could be affected by sedimentation from nearby exposed soils. To prevent indirect impacts on wetlands and waterbodies, such as soil erosion and sedimentation from land-disturbing construction activities, applicants would need to comply with an approved soil erosion and sediment control plan, obtain coverage under an NPDES General Permit for Stormwater Discharges from Construction Activities, and prepare a stormwater pollution prevention plan (SWPPP) for the project. In accordance with these plans, BMPs—including, but not limited to, dust abatement and installation of silt fencing, filter socks, and inlet filters—would minimize or avoid potential effects. Additionally, once construction is completed, areas of temporary disturbance would be returned to preconstruction conditions, and at the onshore substations land would be appropriately graded, graveled, or revegetated to prevent future erosion.

The acreage of wetlands affected could vary widely depending on the proposed locations of onshore project components and the jurisdictional wetland definition(s) under consideration (Figure 3.3.4-5 and Figure 3.3.4-5). Therefore, wetland impacts could range from none to potentially permanent filling or clearing. Mitigation, as required under federal, state, or local wetland regulations, would likely include a combination of onsite restoration of wetlands temporarily affected during construction as well as wetland enhancement, wetland creation, or a mitigation banking credit purchase to offset permanent conversion or temporary loss of wetlands. Potential adverse impacts on wetlands from one representative project in each WEA would be both temporary and permanent and long and short term, depending on the siting of project components and the quality of the mitigation site(s) required to offset the temporary and permanent impacts.

Temporary construction impacts on coastal fauna would be limited (refer to the noise and traffic impacts), as most animals would avoid the noisy construction areas (Goodwin and Shriver 2010). As discussed previously, BOEM does not expect onshore construction noise to result in individual fitness or population-level impacts. Land disturbance that does occur, especially on shoreline parcels, could cause short-term erosion and sedimentation impacts in coastal habitat. Altering dune and beach habitat could increase erosion and sedimentation because dune habitat serves as a crucial buffer zone against flooding.

Traffic: Vehicle and vessel traffic impacts are anticipated to be similar to those of the No Action Alternative. Risks of impacts on wildlife from project-related vehicle traffic may increase along the portions of the onshore project area that do not currently experience consistent vehicular traffic (e.g., electric utility and pedestrian/bike lane ROWs). During construction, mechanized equipment traffic could disturb or displace local wildlife, but these impacts would be similar to those caused by human presence, land disturbance, and noise that already occur. Any vehicle-related impacts on wildlife are expected to be localized and limited to the duration of construction. Collisions between fauna and vehicles or construction equipment have the potential to cause mortality. It is expected that vehicle-related impacts on wildlife during routine O&M and decommissioning activities would be accidental and rare. Use of ports by one representative project in each WEA would increase during the construction and decommissioning stages of the project and would decrease during the O&M stage. Any impacts from traffic are expected to be highly localized and short term and would not result in any population-level effects on fauna.

3.3.4.4.2 Impacts of Five Representative Projects

The same impact types and mechanisms for one representative project in each WEA would apply to five representative projects. Impact potential would increase due to increases in vehicle and vessel traffic, extended periods of O&M, and potentially more onshore development from cable landing sites and maintenance. However, impacts from accidental releases, EMFs and cable heat, lighting, noise, vehicle and vessel traffic, and presence of structures are expected to remain minor and short term, as all five representative projects would implement measures to minimize impacts on water quality and because accidental chemical releases are considered unlikely and would yield only short-term, localized impacts.

Land disturbance impact levels would depend on the amount, function, impact type, and duration of the impact. It is reasonable to assume that five representative projects would not affect larger areas of coastal habitat and wetlands, as each project would likely use the same terminal facilities that were in place to serve one representative project. Potential adverse impacts on wetlands and coastal habitats from five representative projects would be both temporary and permanent and long and short term, depending on the siting of project components.

3.3.4.4.3 Impacts of Alternative B on ESA-Listed Species

The species discussed in Table 3.3.4-4 and 3.3.4-5 may be affected by Alternative B. The impacts described previously for all coastal habitat, wetlands, and fauna would also apply to ESA-listed species. Any future federal activities that could affect ESA-listed species would need to comply with ESA Section 7 to ensure that such activities do not jeopardize the continued species existence; similarly, ESA Section 10 would apply to future non-federal activities. Offshore wind development would include both federal and non-federal activities.

3.3.4.4.4 Cumulative Impacts of Alternative B

All phases of offshore wind projects in Affected Environment would contribute to primary IPFs of accidental releases, cable installation and maintenance, EMFs and cable heat, lighting, noise, traffic, presence of structures, and land disturbance. Temporary disturbance and permanent loss of coastal habitat and wetlands may occur as a result of constructing onshore and nearshore infrastructure such as onshore substations and export cables for offshore wind development.

Five representative projects would contribute to the combined accidental release impacts on wetlands from ongoing and planned activities including offshore wind. Impacts would likely be short term due to the low risk and localized nature of the most likely spills, the use of an Oil Spill Response Plan for projects, and regulatory requirements for the protection of wetlands. Five representative projects could contribute to the incremental land disturbance impacts from ongoing and planned activities including offshore wind. Impacts would likely be temporary to permanent, and compensatory mitigation would be required. However, wetland impacts could vary depending on the location and magnitude of an accidental release onshore or nearshore. BOEM would not expect normal O&M activities to involve further wetland alteration. Onshore cable routes and associated substation/converter station facilities and POIs generally have no maintenance needs unless a fault or failure occurs; therefore, O&M is not expected to have any notable effects on wetlands.

Cumulative impacts on coastal habitat and fauna would likely be expected if coastal habitat is anticipated to be lost or modified and fauna are anticipated to be disturbed or displaced by onshore construction. In general, the intensity of the impact would depend on the specific area of coastal habitat altered or removed. Impacts on species are expected to be avoided or mitigated; impacts on habitat may be short term, long term, or permanent and may include impacts on sensitive habitats including wetlands.

Impacts on habitat would not result in population-level effects on reliant species. Cumulative coastal habitat and wetland loss from ongoing and planned activities, including offshore wind, is expected but the intensity would depend on specific activities and their proximity to sensitive habitats and species. If construction of project components were staggered, coastal habitat and wetland effects could be reduced. Although impacts on sensitive habitats and wetlands would be avoided and minimized, compensatory mitigation would likely be necessary due to unavoidable permanent impacts; actual wetland impacts could vary widely depending on the locations of specific project components. In the context of reasonably foreseeable environmental trends, BOEM anticipates five representative projects would contribute an undetectable increment to cumulative accidental release impacts and a noticeable increment to cumulative land disturbance impacts on coastal habitat, fauna, and wetlands if greater impacts are incurred based on project-specific siting.

3.3.4.4.5 Conclusions

Impacts of Alternative B. Construction, installation, O&M, and decommissioning of Alternative B, whether one representative project in each WEA or five representative projects, would likely have impacts on coastal habitat and fauna, and wetlands, depending on the siting of project components and the quality of the mitigation site(s) required to offset the temporary and permanent impacts. The main significant risk to fauna would be from potential onshore removal of coastal habitat, which could lead to long-term impacts on fauna mortality and habitat, although BOEM anticipates this to be rare due to the ability of some fauna to avoid the site and because it is anticipated that onshore development would most likely be in existing developed areas, such as roads, parking lots, and utility ROWs.

Cumulative Impacts of Alternative B. BOEM anticipates cumulative impacts on coastal habitat, fauna, and wetlands in the Affected Environment. In the context of reasonably foreseeable environmental trends, incremental impacts on coastal habitat from offshore wind are unlikely to be detectable, whereas the incremental impacts on wetlands could be noticeable, depending on project component siting. Existing environmental trends and ongoing activities would continue, and coastal habitat and fauna would continue to be affected by ongoing and planned land disturbance and climate change.

3.3.4.5 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Coastal Habitat, Fauna, and Wetlands

Alternative C, the Proposed Action, includes mitigation measures such that the potential impacts described for Alternative B may be avoided or reduced. The analysis for this alternative is presented as the change in impacts from those discussed under Alternative B. Mitigation measures proposed under Alternative C are analyzed for a representative project in each WEA and five representative projects. Appendix E, *Mitigation*, identifies the mitigation measures that make up the Proposed Action. Table 3.3.4-9 summarizes mitigation measures relevant to coastal habitat, fauna, and wetlands. Additionally, any landside coastal improvements would require California Coastal Commission (CCC) approval.

Table 3.3.4-9. Summary of mitigation measures for coastal habitat and fauna

Measure ID	Measure Summary
MM-7	This measure encourages the lessee to follow the most current IMO guidelines for the reduction of underwater radiated noise, including propulsion noise, machinery noise, and dynamic positioning systems of any vessel associated with the project.
MM-10	This measure encourages reducing emissions and recommends replacing diesel fuel and marine fuel oil with alternative fuels such as natural gas, propane, or hydrogen to the extent that use of such alternative fuels is feasible.
MM-17	This measure requires the lessee to minimize lighting used to aid marine navigation during construction, operations, and decommissioning to the maximum extent practicable. This includes using any additional lighting only when necessary, and to shield and direct such lighting, when possible, to minimize use of high-intensity lighting, and reduce upward illumination and illumination of adjacent waters.
MM-21	This measure requires the lessee to avoid engineered stone or concrete mattresses in complex habitat, as practicable and/or feasible. The lessee should avoid the use of plastics/recycled polyesters/net material (i.e., rock-filled mesh bags, fronded mattresses) for scour protection.
MM-32	This measure encourages lessees to coordinate transmission infrastructure among projects by using, for example, shared intra- and interregional connections, meshed infrastructure, or parallel routing, which may minimize potential impacts from offshore export cables on coastal habitat.

Measure ID	Measure Summary
MM-33	This measures requires the lessee to conduct an inspection of interarray, interconnector, and export cables to determine cable location, burial depths, the state of the cable, and site conditions within a set time period. These surveys must also be conducted with additional events. The lessee must provide BSEE and BOEM with a cable monitoring report following each inspection with specific methods or a cable incident report in the event of entanglement with or accidents involving vessels.

3.3.4.5.1 Impacts of One Representative Project in Each WEA

Mitigation measures could potentially reduce impacts on coastal habitat, fauna, and wetlands compared to those under Alternative B for presence of structures only.

Accidental releases: Vessel chemical releases are considered unlikely and would yield only short-term, localized impacts. MM-10 recommends replacing diesel fuel and marine fuel oil with alternative fuels such as natural gas, propane, or hydrogen, which, depending on the fuel source, could reduce those short-term localized impacts from vessel chemical releases. However, MM-10 would not eliminate all impacts. Alternative C’s impacts would be the same as Alternative B.

Cable installation and maintenance: MM-33 proposes monitoring programs for interarray, interconnector, and export cables to gather data that could be used to evaluate and report monitoring efforts as well as any documented impacts or accidents involving vessels to BSEE or BOEM. However, MM-33 would not eliminate all impacts. Alternative C’s impacts would be the same as Alternative B.

EMFs and cable heat: MM-33 would require periodic post-installation cable monitoring. While this measure may identify areas where project HVAC or HVDC cables are exposed on the seabed, it is not anticipated to reduce the level of impact on coastal habitat and fauna compared to Alternative B. Geophysical survey efforts and vessel traffic associated with this measure could increase noise and traffic, thus, also increase impact risk to coastal habitat and fauna. However, this potential increase in risk is not anticipated to increase any impact rating, as the benefits gained through cable monitoring would outweigh the risks.

Lighting: MM-17 would require light impact reductions during all development phases. Onshore lighting would be localized and would be expected to comply with local land use regulations that minimize light trespass and glare. MM-17 is not anticipated to reduce the level of impact that light would have on coastal fauna compared to Alternative B. Navigation lights during construction, operations, and decommissioning would remain minimal and transitory.

Noise: MM-7 encourages the reduction of underwater noise from ship traffic. Given the noise from ship traffic would largely occur at a distance away from the shore, MM-7 is not anticipated to reduce the level of impact that light would have on coastal fauna compared to Alternative B.

Presence of structures: MM-21 requires the lessee to avoid engineered stone or concrete mattresses in complex habitat, as practicable and/or feasible, and to avoid using plastic materials for scour reduction. There are no other mitigation measures proposed to alter design elements. MM-21 is anticipated to reduce the level of impact that cable-protection structures would have on coastal fauna compared to Alternative B.

Land disturbance: There are no mitigation measures proposed to alter land disturbance. Direct effects on sensitive environmental resources, such as wetlands, riparian areas, or other sensitive natural habitats, would be avoided to the maximum extent practicable by siting onshore project components in upland areas due to the requirements of federal, state, and local wetland permitting. These impacts would be temporary where onshore project components do not require permanent fill, as restoration would be conducted in accordance with applicable permit requirements. The impacts of Alternative C would be the same as Alternative B and would depend on the siting of project components and the quality of the mitigation site(s) required to offset the temporary and permanent impacts.

Traffic: There are no mitigation measures proposed to alter vehicle or vessel traffic. The impacts for Alternative C would be the same as Alternative B.

3.3.4.5.2 Impacts of Five Representative Projects

The same impact types and mechanisms described for one representative project in each WEA also apply to five representative projects, with the addition of MM-32. MM-32 proposes coordination among operators to use shared transmission infrastructure where practical. This measure could reduce the overall amount of cable placed on the seafloor. Fewer landfalls and cable routes may reduce impacts on coastal habitat, fauna, and wetlands from cable installation and maintenance, as there may be less disturbance of beach, dune, and nearshore benthic habitats. Potential impacts on coastal habitat, fauna, and wetlands from cable installation and maintenance are reduced with MM-32.

Five representative projects would increase the impact potential, due to increases in vehicle and vessel traffic and an extended period of O&M. However, even with the proposed mitigation measures (Table 3.3.4-9), coastal habitat impact levels are not expected to differ substantially from those of Alternative B because direct effects on sensitive environmental resources, such as wetlands, riparian areas, or other sensitive natural habitats, would be avoided to the maximum extent practicable by siting onshore project components in upland areas and the requirement to compensate for any unavoidable impacts when permitting the onshore facilities. As such, impact levels for Alternative C are expected to remain the same as Alternative B for coastal habitat, fauna, and wetlands. Potential impacts on coastal habitat, fauna, and wetlands from one representative project in each WEA would be both temporary and permanent and long and short term depending on the siting of project components and the quality of the mitigation site(s) required to offset the temporary and permanent impacts when permitting onshore developments.

3.3.4.5.3 Impacts of Alternative C on ESA-Listed Species

The impacts described previously for coastal habitat, fauna, and wetlands would also apply to ESA-listed species that could be found in those habitats. Impacts for other IPFs would remain the same as described under Alternative B and future federal and non-federal activities would need to comply with

ESA Section 7 and 10, respectively. As a result, mitigation measures would result in negligible reductions in impacts for ESA-listed coastal habitat and fauna (Table 3.3.4-2).

Any future federal activities that could affect ESA-listed species would need to comply with ESA Section 7 to ensure that such activities do not jeopardize the continued species existence; similarly, ESA Section 10 would apply to future non-federal activities. Offshore wind development would include both federal and non-federal activities.

3.3.4.5.4 Cumulative Impacts of Alternative C

All phases of offshore wind development, even with mitigation measures, would still affect coastal habitat, fauna, and wetlands across the Affected Environment. Onshore habitat loss, including wetlands, is expected to be the same as described under Alternative B; it is anticipated that a small amount of habitat would be altered or removed, but with the possibility of larger areas altered or removed. In the context of reasonably foreseeable environmental trends, BOEM anticipates Alternative C would be unlikely to contribute a detectable increment to the cumulative impacts on coastal habitat and fauna but the incremental impacts on wetlands contributed by Alternative C could be noticeable, depending on project component siting relative to wetland locations and the quality of the mitigation site(s) required to offset the temporary and permanent impacts. Existing environmental trends and ongoing activities would continue, and coastal habitat, fauna, and wetlands would continue to be affected by land disturbance and climate change.

3.3.4.5.5 Conclusions

Impacts of Alternative C. Construction, installation, O&M, and decommissioning of Alternative C, whether for one representative project in each WEA or five representative projects, would likely have impacts on coastal habitat, fauna, and wetlands, depending on the IPF and the amount and quality of coastal habitat and wetlands altered or removed, the types of wetlands affected, and duration of impact. Mitigation measures under Alternative C could reduce impacts compared to Alternative B associated with the cable installation and maintenance, although the overall impacts on coastal habitat, fauna, and wetlands would be the same. The main significant risk to fauna from five representative projects would be from potential onshore removal of habitat, which could lead to long-term impacts on fauna mortality and habitat, although BOEM anticipates this to be rare due to the ability of some fauna to avoid the site and because it is anticipated that onshore development would most likely be in existing developed areas, such as roads, parking lots, and utility ROWs. For projects that would incur wetland impacts, the mitigation requirements set forth in the CWA Section 404(b)(1) guidelines of avoidance, minimization, and compensatory mitigation would likely reduce or eliminate project impacts on wetlands. Similarly, local and state policies require the avoidance or mitigation of impacts to sensitive coastal habitats.

Cumulative Impacts of Alternative C. BOEM anticipates that the cumulative impacts on coastal habitat, fauna, and wetlands in the Affected Environment, even with mitigation measures under Alternative C, would likely be the same as described under Alternative B for five representative projects. In context of reasonably foreseeable environmental trends, the incremental impacts on coastal habitat, fauna, and wetlands contributed by five representative projects could be noticeable, depending on project component sitting relative to wetland locations. Five representative projects would contribute to cumulative impacts primarily through the long-term impacts from onshore habitat loss related to onshore substations/converter stations, cables, and ship traffic. Existing environmental trends and ongoing activities would continue, and coastal habitat, fauna, and wetlands would continue to be affected by land disturbance unrelated to the five representative projects and climate change.

3.3 Biological Resources

3.3.5 Fishes, Invertebrates, and Essential Fish Habitat

This section discusses potential impacts on fishes, invertebrates, and EFH from the Proposed Action, alternatives, and ongoing and planned activities in the Affected Environment. Figure 3.3.5-1 shows the Affected Environment, which includes the northern and central areas of the California Current Large Marine Ecosystem (CCLME). Notwithstanding, the analysis in this draft PEIS focuses on fishes and invertebrates that would likely occur in the vicinity of the Humboldt and Morro Bay lease areas (Figure 3.3.5-1) and, thus, potentially be affected by future wind energy development.

3.3.5.1 Description of the Affected Environment and Baseline Conditions

Regional effects of climate change, such as ocean acidification, increasing sea temperatures, and changes in ocean circulation patterns, influence fishes, invertebrates, and EFH (McClure et al. 2023; Farr et al. 2021; Hare et al. 2012). Climate change impacts are likely to affect habitat suitability for and species distributions of fishes and invertebrates in the Affected Environment, including several EFHs.

The California Current Ecosystem Status Report for 2022–2023 summarizes recent trends in fish, invertebrate species, and climate drivers in the CCLME, including the Humboldt and Morro Bay WEAs (NOAA 2023). The CCLME, spanning from Baja California Sur to Puget Sound, experiences significant variability due to El Niño Southern Oscillation (ENSO) and other climate modes like the PDO and North Pacific Gyre Oscillation (Mantua and Hare 2002; Di Lorenzo et al. 2013; McClure et al. 2023). This variability affects productivity, forage fish dynamics, and habitat availability for top predators (Chavez et al. 2002; Di Lorenzo et al. 2013; Hazen et al. 2013; Lindegren et al. 2013). In 2022, positive basin-scale climate patterns suggested a favorable marine environment, but local dynamics and a major marine heatwave, the fourth largest on record, partially offset these benefits, showing a stronger coastal influence than in previous years (NOAA 2023).

3.3.5.1.1 Fishes

The CCLME ecosystem's oceanographic and ecological features naturally divide it into southern, central, and northern areas (NOAA 2023). The Affected Environment extends beyond the Humboldt and Morro Bay WEAs to encompass the movement range of most fish species in the northern and central CCLME. This area hosts diverse fish assemblages, categorized by life history and preferred habitat associations (e.g., pelagic, demersal, resident, highly migratory). The area includes deep water marine, estuarine, and diadromous species that use both freshwater and marine habitats during their life stages.

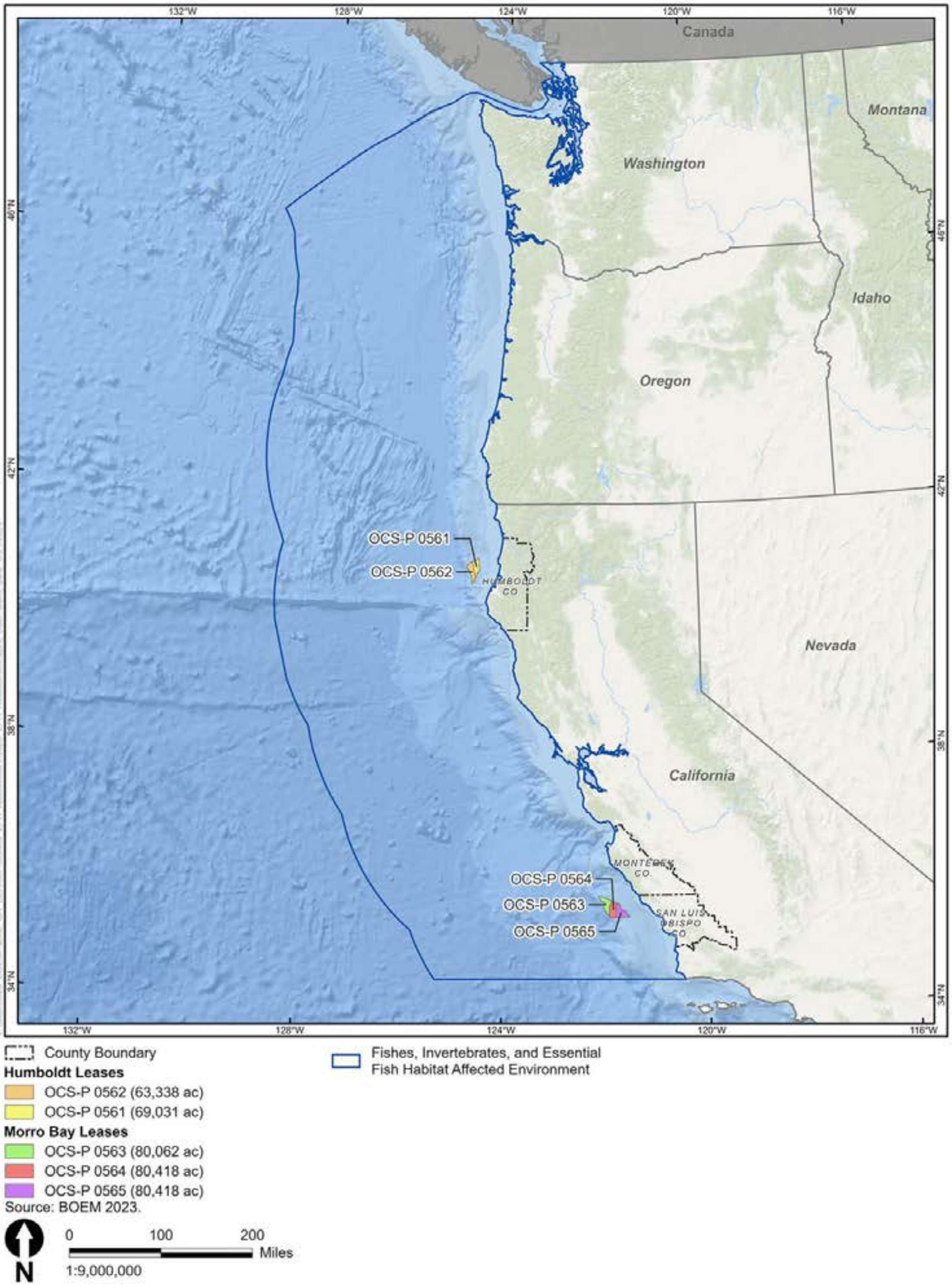

Figure 3.3.5-1. Fishes, invertebrates, and essential fish habitat Affected Environment

There are over 100 species of demersal and pelagic fishes that have the potential to occur in the Affected Environment. At the family level, demersal species, several of them resident species of the region, are represented by a diverse suite of taxa, including (but not limited to) cod fishes (Gadidae), flatfishes (Pleuronectidae), hakes (Merlucciidae), poachers (Agonidae), rockfishes and scorpionfishes (Scorpaenidae), sculpins, (Cottidae), greenlings (Hexagrammidae), sablefish (Anoplopomatidae), skates (Rajidae), and dogfishes (Squalidae). Pelagic family species include sardines (Clupeidae), anchovies (Engraulidae), mackerel, tuna, and bonito (Scombridae), smelt fishes (Osmeridae), and hake (Merlucciidae). Highly migratory species include pelagic species such as tunas, billfishes, marlins, and sailfish (Istiophoridae), broadbill swordfish (Xiphiidae), mackerel sharks (Lamnidae), thresher sharks (Alopiidae), and requiem sharks (Carcharhinidae).

ESA-listed fish species occur in both WEAs. There are six fish species federally listed as endangered or threatened under the ESA and one species listed under the California Endangered Species Act that may be affected by near-shore project activities (Table 3.3.5-1). The federally listed species are Chinook salmon *(Oncorhynchus tshawytscha)*, coho salmon *(Oncorhynchus kisutch)*, steelhead trout (*Oncorhynchus mykiss)*, Pacific smelt *(Thaleichthys pacificus)*, and green sturgeon *(Acipenser medirostris)* (NMFS 2023a). The California listed species is the longfin smelt (*Spirinchus thaleichthys*) (CDFW 2018). These species are described below. Interactions between ESA-listed species and offshore wind-related activities are most likely to occur near shore and not in the specific lease areas. However, vessel strikes are not identified as a threat in any of the species recovery plans.

Table 3.3.5-1. Federally listed fish species under the ESA potentially occurring in or interacting with project activities related to the lease areas

Common Name	Scientific Name	ESA Status
Chinook salmon	*Oncorhynchus tshawytscha*	Endangered (Sacramento River winter-run and Upper Columbia River spring-run) Threatened (Central Valley spring-run, California Coastal, Lower Columbia River, Snake River spring/summer, fall, Upper Willamette River, Puget Sound) ESA candidate (Oregon Coast)
Coho salmon	*Oncorhynchus kisutch*	Endangered (Central California Coast) Threatened (Southern Oregon/Northern California Coast, Lower Columbia River)
Steelhead trout	*Oncorhynchus mykiss*	Endangered (Southern California DPS) Threatened (Central and northern California, Oregon, Washington)
Eulachon/Pacific smelt	*Thaleichthys pacificus*	Threatened (Southern DPS)
Green sturgeon	*Acipenser medirostris*	Threatened (Southern DPS)
Longfin smelt	*Spirinchus thaleichthys*	California Endangered Species Act (CESA)–Threatened

Source: NMFS 2023a.

Chinook and coho salmon have life histories spanning both freshwater and marine habitats. Chinook salmon range from northern California to Washington, with distinct population segments (DPSs) linked to specific rivers (Myers et al. 1998; NMFS 2023c). Coho salmon range from central California to northern Washington, also with distinct populations tied to specific watersheds or river basins (NMFS 2023d). Population declines in both species have been attributed to overfishing, habitat loss, hydropower development, poor ocean conditions, and hatchery practices. Chinook salmon were listed as Threatened under the ESA in 1989 and reclassified as Endangered in 1994 (NMFS 2016). Coho salmon were listed as Threatened in 1999 and reclassified as Endangered in 2005 (NMFS 2023e). Conservation efforts focus on river habitat restoration and fishery regulations (NMFS 2016).

Steelhead trout are generally anadromous, but some individuals never leave freshwater river systems and are not included in ESA listings. Within the Affected Environment, there are 10 distinct steelhead trout population segments listed as Threatened; one as Endangered (NMFS 2023f). The Endangered southern California DPS was first listed under the ESA in 1997. This segment ranges from the Santa Maria River south to the Mexican border. The southern California steelhead shares a species recovery plan with the Threatened south-central California steelhead (ranging from Pajaro River in Monterey Bay to the Mexican border) (NMFS 2023g). Other Threatened steelhead populations range from northern California to Oregon and Washington.

The distribution of Eulachon (i.e., anadromous smelt in the family Osmeridae) overlaps with the Affected Environment. Eulachon spend 95 percent of their lifetime in the open ocean. Adults enter the lower parts of rivers annually to spawn (typically between December and June (NMFS 2023h). Juvenile eulachon can be found near the seabed at depths of 164 to 656 feet (50 to 200 meters). The southern DPS of eulachon relies on the Mad River near Eureka (California) and other coastal rivers and streams including Redwood Creek and the Klamath River (NMFS 2023h). The southern DPS was listed as Threatened under the ESA in 2010, but recent improvements in ocean conditions suggest the species may rebound in numbers in the near future (NMFS 2022).

Green sturgeon characteristics (anadromous, long-lived [approximately 70 years old], slow growing) make the species particularly vulnerable to impacts at various life stages. Green sturgeon migrate to freshwater rivers for spawning every 3 to 5 years and rely on estuarine habitats during their juvenile stages (NMFS 2023b). Juvenile green sturgeon typically inhabit brackish estuarine areas until maturing at age 15, when they migrate to the open ocean (NMFS 2023b). The Affected Environment includes green sturgeon critical habitat (71 FR 17757), which focuses on areas essential for their successful reproduction and juvenile development. Critical habitats for the Southern DPS of green sturgeon include the Sacramento, Feather, and Yuba Rivers (NMFS 2023b). Adult green sturgeon migrate seasonally along the Washington, Oregon, and California coasts during the summer and fall months. During the winter and spring months, non-spawning fishes migrate to Vancouver Island (NMFS 2023b). Green sturgeon that spawn in the Klamath and Eel Rivers in California belong to the Northern DPS and are not ESA-listed.

Longfin smelt was listed as threatened under the California Endangered Species Act in 2009 and occurs in the Affected Environment. This species is found along the Pacific Coast from Alaska to California and within California and uses a variety of habitats from nearshore waters to estuaries and lower portions of freshwater streams as they can tolerate a wide range of salinity (Garwood 2017). Historically they have been found in the San Francisco Estuary and the Sacramento/San Joaquin Delta, Humboldt Bay, and the estuaries of the Eel River and Klamath River (Garwood 2017; CDFW 2018).

3.3.5.1.2 Invertebrates

Invertebrate resources in this section range from planktonic zooplankton to megafauna with benthic, demersal, or planktonic life stages. For macrofaunal and meiofaunal invertebrates associated with benthic resources, refer to Section 3.3.2, *Benthic Resources*. Important invertebrates in the Affected Environment include mollusks (e.g., red abalone, *Haliotis rufescens*), market squid (*Doryteuthis opalescens*), shrimps (e.g., ocean pink shrimp, *Pandalus jordani*; spot prawn, *Pandalus platyceros*), echinoderms (e.g., purple sea urchin, *Strongylocentrotus purpuratus*), crustaceans (e.g., Dungeness crab, *Cancer magister*; krill, *Euphausia pacifica*), sea sponges, and other groups (e.g., annelids, bryozoans).

Table 3.3.5-2 details ESA-proposed or listed invertebrate species in the Affected Environment.

Table 3.3.5-2. Federally listed invertebrate species under the ESA potentially occurring in or interacting with project activities related to the lease areas

Common Name	Scientific Name	ESA Status
Sunflower sea star	*Pycnopodia helianthoides*	Proposed as threatened (Southern, Central, and northern California, Oregon, Washington).
Black abalone	*Haliotis cracherodii*	Endangered (Southern, Central, and northern California, Oregon, Washington).

Source: NMFS 2023i.

Invertebrates may be classified broadly into pelagic and demersal assemblages. Pelagic assemblages are composed of zooplankton, krill, squids, tunicates (pyrosomes), jellyfishes, and other invertebrates. Demersal invertebrate assemblages consist of infauna (e.g., annelid worms, crustaceans, snails and clams) and epifauna (e.g., crabs, shrimps, snails, and echinoderms).

For pelagic assemblages, zooplankton are ubiquitous. Zooplankton include heterotrophic plankton that range from small, microscopic organisms to large species, such as jellyfish. Kaplan et al. (2010) have summarized the planktonic communities in the region, noting that they are diverse and vary according to season and oceanographic conditions. Zooplankton dispersion patterns vary over a range of spatial and temporal scales (from feet/meters to thousands of miles/kilometers) and years/decades).

The California Current in the northern and central portions of the CCLME exhibits wind-driven coastal upwelling where deep, cold, and nutrient-rich water rises from beneath the surface, replacing coastal warm surface water that is pushed away by surface winds (Checkley and Barth 2009). The upwelled water fuels high phytoplankton production and subsequent high biomass of copepods (e.g., *Calanus pacificus, Metridia pacifica, Paracalanus parvus*), and euphausiids (krill). Upwelling occurs year-round along the central and northern California coast, and from April to September on the Oregon and Washington coasts. All pelagic invertebrates are sensitive to environmental variations (e.g., ocean temperature anomalies, changes in upwelling, low dissolved oxygen, ocean acidification) (Harvey et al. 2023). Section 3.3.2 discusses upwelling in detail.

Krill play a crucial role in the food web, linking primary production to higher trophic levels, making them vital prey in the Affected Environment (Harvey et al. 2023). Of the 24 krill species in the CCLME, *Euphausia pacifica* and *Thysanoessa spinifera* are significant in terms of biomass and importance to predators like fish, seabirds, and whales (Abraham and Sydeman 2006; Dufault et al. 2009; Dorman et al. 2023). *E. pacifica* is abundant offshore along the continental shelf break and slope, while *T. spinifera* is found primarily over the continental shelf (Dorman et al. 2015; Robertson and Bjorkstedt 2020). A 9-year survey estimates adult krill biomass on the central and northern California continental shelf at 1.75 to 2.0 million metric tons (Dorman et al. 2023). Most krill hotspots (76 percent) are associated with submarine canyons. The Pacific Fishery Management Council (PFMC) defines essential krill habitat as water from the shoreline to 6,000 feet (1,829 meters), covering the entire continental shelf/slope of Washington, Oregon, and California (PFMC 2008; Santora et al. 2012, 2018).

Market squid has multifaceted ecological interactions, primarily preying on zooplankton and small fishes, and simultaneously providing a significant food source for a wide array of marine organisms, including larger fishes, seabirds, and marine mammals (Zeidberg et al. 2006). The species is short lived (6 to 9 months) and spawns typically in sandy bottom habitats on the continental shelf (Navarro et al. 2018).

Demersal assemblages include red sea urchins (*Mesocentrotus franciscanus*), California two-spot octopus (*Octopus bimaculatus*), California mussels (*Mytilus californianus*), and rock crabs (*Cancer productus, Metacarcinus anthonyi, Romaleon antennarium*) in hard-bottom areas. Soft-bottom areas are inhabited by ocean pink shrimp, ridgeback prawn (*Sicyonia ingentis*), and Dungeness crab. Dungeness crabs play a key role in marine communities by influencing the distribution and abundance of other infaunal species (Sulkin 1984; Rasmuson 2013). Their life cycle includes a planktonic larval stage affected by coastal currents and CCLME upwelling, determining the spatial distribution and recruitment success of juveniles and adults (Shanks and Roegner 2007). Dungeness crabs inhabit estuarine and nearshore environments with soft-bottom substrates and are thus unlikely to be found in the lease areas 20 or more miles offshore (Jamieson et al. 1989; Rasmuson 2013).

3.3.5.1.3 Importance of Sound to Fish and Invertebrates

Compared to marine mammals, scientists have only begun to study and understand the importance of sound to marine fishes and invertebrate species. Yet there are sufficient data so far to conclude that underwater sound is vitally important to their basic life functions, such as finding a mate, deterring a predator, or defending territory (Popper and Hawkins 2018, 2019). Thus, these lower taxonomic groups must be able to detect components of marine soundscapes. This detectability could be adversely affected by the addition of noise from anthropogenic activity including offshore wind development. Appendix H, *Background on Underwater Sound*, provides an in-depth discussion of the importance of sound to fishes and invertebrates, hearing anatomy, and thresholds for non-auditory injury and behavioral disturbance.

3.3.5.1.4 *Essential Fish Habitat*

EFH is defined as waters and substrate necessary for fish to spawn, breed, feed, or grow to maturity (16 USC 1802(10)). The EFH final rule (67 FR 2343, January 17, 2002) defines an adverse effect as "any impact reducing EFH quality or quantity." Adverse effects include direct or indirect physical, chemical, or biological changes to waters or substrate, and harm to benthic organisms, prey species, and their habitats. Actions reducing prey availability, either through direct harm or habitat impact, are considered adverse effects. Adverse effects can result from actions within or outside EFH, including site-specific or habitat-wide impacts and individual, cumulative, or synergistic consequences.

This section provides a qualitative assessment of the impacts of each alternative on EFH, which has been designated under the Magnuson-Fishery Conservation and Management Act of 1976 (later renamed the Magnuson-Stevens Fishery Conservation and Management Act [MSA]) as "essential" for the conservation of federally managed fish and invertebrate species. More detailed information regarding the impact on species listed under the MSA is being developed in the EFH Biological Assessment (BA) and under the ESA discussion in the Programmatic BA, which are being prepared to support EFH and Section 7 consultation with NMFS.

The MSA requires fishery management councils to do the following.

- Describe and identify EFH for managed species (and their prey) in their respective regions.
- Specify actions to conserve and enhance EFH.
- Minimize the adverse effects of fishing on EFH.

The MSA requires federal agencies to consult on activities that may negatively affect EFH identified in FMPs. In the Humboldt and Morro Bay WEAs, PFMC manages fishery species and EFH.

Table 3.3.5-3 summarizes pertinent regional FMPs and managed species.

Table 3.3.5-3. Fishery Management Plans and species in the Affected Environment

Pacific Fishery Management Council				Tri-State Dungeness Crab
Pacific Coast Groundfish FMP	**West Coast Fisheries for Highly Migratory Species FMP**	**Coastal Pelagic Species FMP**	**Pacific Coast Salmon FMP**	**Oregon Dungeness Crab FMP**
Big skate (*Raja binoculata*)	North Pacific albacore (*Thunnus alalunga*)	Pacific sardine (*Sardinops sagax*)	Chinook or king salmon (*Oncorhynchus tshawytscha*)	Dungeness crab (*Cancer magister*)
Leopard shark (*Triakis semifasciata*)	Yellowfin tuna (*Thunnus albacares*)	Pacific mackerel (*Scomber japonicus*)	Coho or silver salmon (*Oncorhynchus kisutch*)	--

Pacific Fishery Management Council				Tri-State Dungeness Crab
Pacific Coast Groundfish FMP	West Coast Fisheries for Highly Migratory Species FMP	Coastal Pelagic Species FMP	Pacific Coast Salmon FMP	Oregon Dungeness Crab FMP
Longnose skate *(Raja rhina)*	Bigeye tuna (*Thunnus obesus*)	Jack mackerel (*Trachurus symmetricus*)	--	--
Spiny dogfish (*Squalus suckleyi*)	Skipjack tuna (*Katsuwonus pelamis*)	Northern anchovy (*Engraulis mordax*)	--	--
Cabezon (*Scorpaenichthys marmoratus*)	Pacific bluefin tuna *(Thunnus orientalis)*	Market squid (*Doryteuthis opalescens*)	--	--
Kelp greenling (*Hexagrammos decagrammus*)	Common thresher shark *(Alopias vulpinus)*	Krill (Euphausiacea)[1]	--	--
Lingcod (*Ophiodon elongatus*)	Shortfin mako or bonito shark *(Isurus oxyrinchus)*	--	--	--
Pacific cod (*Gadus macrocephalus*)	Blue shark (*Prionace glauca*)	--	--	--
Pacific whiting; hake (*Merluccius productus*)	Striped marlin (*Tetrapturus audax*)	--	--	--
Sablefish (*Anoplopoma fimbria*)	Swordfish (*Xiphias gladius*)	--	--	--
Rockfish (Scorpaenidae spp.)[1]	Dorado or dolphinfish *(Coryphaena hippurus)*	--	--	--
Arrowtooth flounder; turbot *(Atheresthes stomias)*	--	--	--	--
Butter sole (*Isopsetta isolepis*)	--	--	--	--
Curlfin sole (*Pleuronichthys decurrens*)	--	--	--	--
Dover sole (*Microstomus pacificus*)	--	--	--	--
English sole (*Parophrys vetulus*)	--	--	--	--
Flathead sole (*Hippoglossoides elassodon*)	--	--	--	--
Pacific sanddab (*Citharichthys sordidus*)	--	--	--	--
Petrale sole (*Eopsetta jordani*)	--	--	--	--
Rex sole (*Glyptocephalus zachirus*)	--	--	--	--

Pacific Fishery Management Council				Tri-State Dungeness Crab
Pacific Coast Groundfish FMP	**West Coast Fisheries for Highly Migratory Species FMP**	**Coastal Pelagic Species FMP**	**Pacific Coast Salmon FMP**	**Oregon Dungeness Crab FMP**
Rock sole (*Lepidopsetta bilineata*)	--	--	--	--
Sand sole (*Psettichthys melanostictus*)	--	--	--	--
Starry flounder (*Platichthys stellatus*)	--	--	--	--

[1] Prohibited harvest species but included in the FMP.
[2] The category "rockfish" includes all genera and species of the family Scorpaenidae, that occur in the Washington, Oregon, and California area. The Scorpaenidae genera are *Sebastes*, *Scorpaena*, *Sebastolobus*, and *Scorpaenodes*.
Sources: PFMC 2023, 1998, 2007, 2022; ODFW 2022.

The EFH for groundfish, highly migratory species, and coastal pelagic species FMPs extend along the entire west coast in depths less than 11,483 feet (3,500 meters) and at seamounts deeper than 11,483 feet (3,500 meters). Central and northern portions of the CCLME provide EFH for the following species.

- 160 groundfish species (e.g., Pacific cod [*Gadus macrocephalus*], Pacific whiting [*Merluccius productus*], sablefish [*Anoplopoma fimbriai*], rockfish [*Scorpaenidae* spp.], arrowtooth flounder, [*Atheresthes stomias*]).
- Coastal pelagic fishes (e.g., Pacific sardine [*Sardinops sagax*], Pacific mackerel [*Scomber japonicus*], northern anchovy [*Engraulis mordax*], market squid [*Doryteuthis opalescens*], krill [*Euphausiacea*]).
- Highly migratory species (e.g., North Pacific albacore [*Thunnus alalunga*], yellowfin tuna [*Thunnus albacares*], common thresher shark [*Alopias vulpinus*], shortfin mako [*Isurus oxyrinchus*], swordfish [*Xiphias gladius*]) at all life stages [NMFS 2023i].

The geographic extent of EFH for Pacific salmon includes all marine waters within the EEZ north of Point Conception, California. Habitat types or areas within EFH—identified as having important ecological functions and being sensitive to human-induced environmental degradation—are rare and can be affected negatively by development activities are considered Habitat Areas of Particular Concern (HAPCs). Designated HAPCs in the Affected Environment include estuaries, kelp, seagrass, and rocky reefs (Figure 3.3.5-2). Estuary HAPCs also include those estuary-influenced offshore areas of continuously diluted seawater (Cowardin et al. 1979; PFMC 2022). Kelp stands provide nurseries, feeding grounds, and shelter to a variety of groundfish species and their prey (Ebeling et al. 1980; Feder et al. 1974). The canopy kelp HAPCs include those waters, substrate, and other biogenic habitat associated with canopy-forming kelp species (Macrocystis pyrifera and Nereocystis luetkeana) (PFMC 2022).

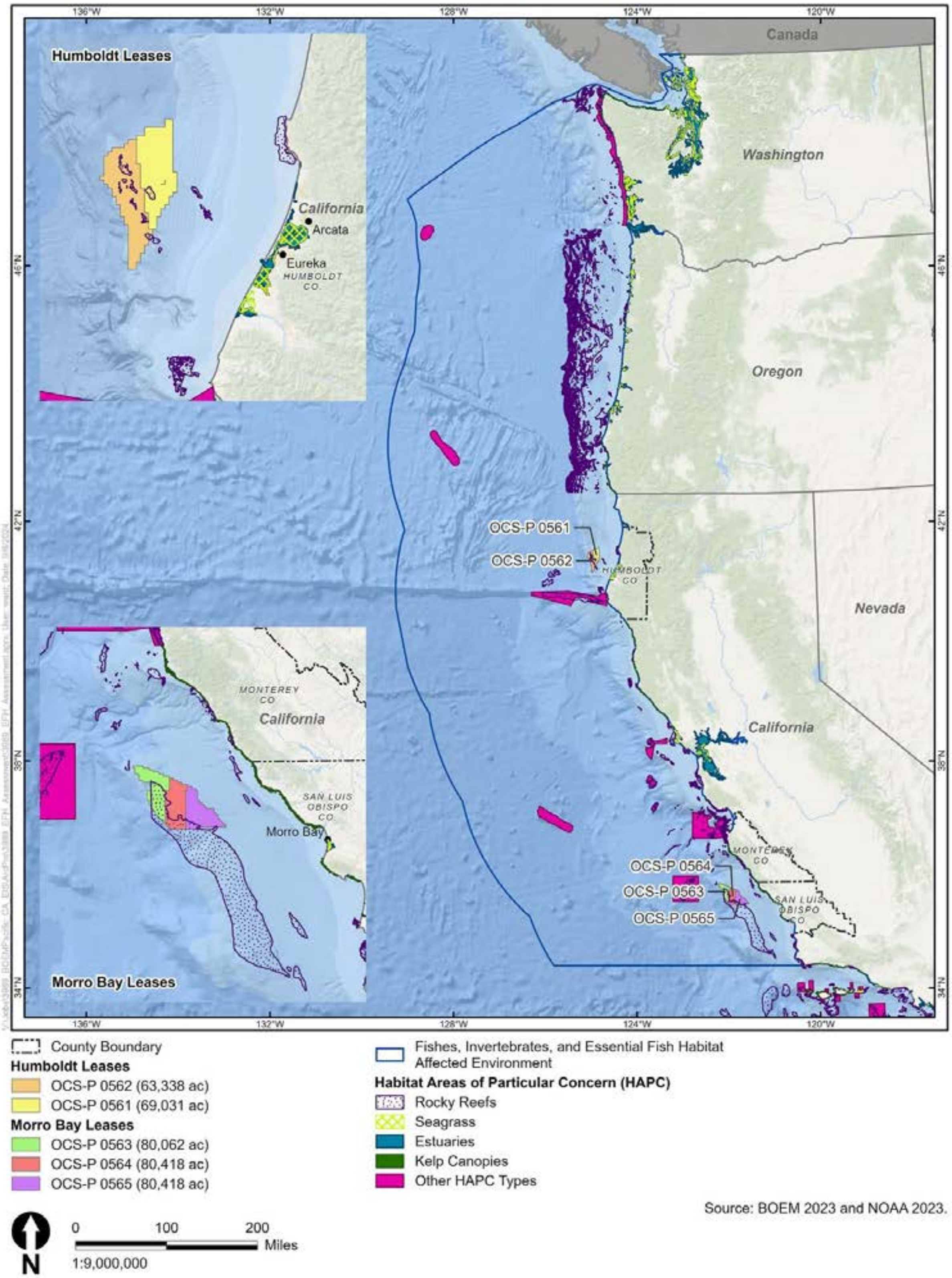

Figure 3.3.5-2. HAPCs in the Affected Environment

Seagrass species such as eelgrass species (Zostera spp.), widgeongrass (Ruppia maritima), and surfgrass (Phyllospadix spp.) are found year-round- in the lower intertidal and subtidal areas. Eelgrass is found on soft-bottom substrates in intertidal and shallow subtidal areas of estuaries; surfgrass is found on hard-bottom substrates typically along the open coast. Seagrass beds have important ecological functions because they are among the areas of highest primary productivity in the world (Herke and Rogers 1993; Hoss and Thayer 1993). Seagrass HAPCs include those waters, substrate, and other biogenic features associated with the noted eelgrass species (PFMC 2022). Rocky reef habitats are generally categorized as either nearshore or offshore in reference to the proximity of the habitat to the coastline. Rocky habitat may be composed of bedrock, boulders, or smaller rocks, such as cobble and gravel. Hard substrates are among the most important habitats for groundfish (PFMC 2022).

In addition to designated estuaries, kelp, seagrass, and rocky reefs, other areas of interest with designated HAPCs in the Affected Environment include all waters and sea bottom in Washington State waters from the 3-nm (5.6-kilometer) boundary of the territorial sea shoreward to the mean higher high water level; the Daisy Bank/Nelson Island, Thompson Seamount, President Jackson Seamount off Oregon; and all seamounts in California including Gumdrop Seamount, Pioneer Seamount, Guide Seamount, Taney Seamount, Davidson Seamount, San Juan Seamount, and Mendocino Ridge; Cordell Bank; and Monterey Canyon in California. HAPCs in the Humboldt and Morro Bay lease areas include rocky reefs. Additionally, the Davidson Seamount is identified as an HAPC and is near the Morro Bay lease areas (Figure 3.3.5-2).

3.3.5.2 Impact Background for Fishes, Invertebrates, and Essential Fish Habitat

Accidental releases, anchoring, cable installation and maintenance, discharge/intakes, EMFs and cable heat, land disturbance, gear utilization, lighting, noise, port utilization, and presence of structures are contributing IPFs to fishes, invertebrates, and EFH. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.3.5-4. Refer to Section 3.1.2, *Impact Terminology*, for beneficial impact definitions.

Table 3.3.5-4. Issues and indicators to assess impacts on fishes, invertebrates, and essential fish habitat

Issue	Impact Indicator
Underwater noise and vibration	Fishes: Extent, frequency, and duration of noise above established effects thresholds, and other quantifiable effects as noted in Section 2.5 (Tables 1–4) in the COP Modeling Guidelines.[1] Invertebrates: Qualitative estimate of potential disturbance, injury, or mortality on invertebrates based on extent, frequency, and duration of noise or vibration.
Crushing, deposition, and entrainment	Estimated extent of potential disturbance, injury, and mortality-level effects on fish and invertebrates (including eggs and larvae) from crushing or burial by construction equipment and materials placement, entrainment by construction equipment, and burial from suspended sediment deposition.

Issue	Impact Indicator
Seabed profile and water column alteration	Short-term and long-term effects on water column and benthic habitats by habitat displacement by monopiles and anchors, habitat modification by placement of scour protection and concrete mattresses, short-term alteration of soft-bottom benthic habitat function, and long-term alteration of complex benthic habitat function.
Water quality impacts	Duration and intensity of suspended sediment impacts. Qualitative analysis of impacts from accidental spills and releases of trash and debris.
Artificial light	Extent and duration of artificial light effects.
Power transmission	Exposure above ambient EMF levels based on extent, duration, and proximity of contact with or exposure to infrastructure; species sensitivity.[2]
Entanglement risk from floating mooring lines and cables	Qualitative estimate of potential entanglement risk.
Invasive Species	Qualitative estimate of sources of invasive species, introduced habitat, and propagation or expansion of invasive species.

[1] https://www.boem.gov/renewable-energy/boemoffshorewindpiledrivingsoundmodelingguidance.
[2] EMF sensitivity varies widely; no effect threshold guidance has been established. The minimum EMF levels needed to produce behavioral responses observed in available research are one or more orders of magnitude larger than the anticipated EMF effects likely to result from the Humboldt and Morro Bay projects. Electrosensitive fishes can detect low-frequency bioelectric fields at weak levels but are unable to detect higher frequency fields >20 Hertz (Hz) (Bedore and Kajiura 2013).

3.3.5.3 Impacts of Alternative A – No Action – Fishes, Invertebrates, and Essential Fish Habitat

When analyzing the impacts of the No Action Alternative on fishes, invertebrates, and EFH, BOEM considered the impacts of ongoing activities on baseline conditions for these resources. The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative on existing baseline trends, plus other planned activities (Appendix C, *Planned Activities Scenario)*.

3.3.5.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for fishes, invertebrates, and EFH would continue to follow regional trends as described in the CCLME Status Report provided by NOAA (Harvey et al. 2023) and respond to IPFs introduced by other ongoing activities. Ongoing activities in the Affected Environment that can affect fishes, invertebrates, and EFH are generally associated with commercial harvesting and fishing activities, fisheries bycatch, water quality degradation and pollution, effects on benthic habitat via dredging (e.g., for navigation, port development, marine minerals extraction) and bottom trawling, accidental fuel leaks or spills, and climate change. The rate and continuation of these activities is uncertain, but their effects on fishes, invertebrates, and EFH would be detectable from changes in various metrics including changes in species migrations and distributions, habitat structure, species abundance, diversity, and composition.

Seafloor habitat is routinely disturbed through anchoring, submarine cable installation, dredging (e.g., navigation, marine minerals extraction, hydrokinetic energy projects, military purposes, dredge disposal), and commercial fishing use of bottom trawls and dredge fishing methods. Abandoned or lost fishing gear remains in the aquatic environment for extended time periods, often entangling or trapping mobile invertebrate and fish species.

Water quality impacts from ongoing onshore and offshore activities affect nearshore habitats. Although many of the California oil and gas platforms are outside of the Affected Environment, four are within the bounds. Accidental spills can occur from platforms, pipeline loss, or marine shipping. Invasive species and marine disease can be accidentally introduced through the discharge of ballast water and bilge water from marine vessels. The resulting impacts on invertebrates and fishes depend on many factors but can be widespread and permanent, especially if the invasive species becomes established and outcompetes native species.

Entrainment and impingement of fishes and invertebrates could occur from ongoing operation of power plants cooled by ocean water (e.g., Diablo Canyon, San Onofre, Moss Landing). For example, the Diablo Canyon Power Plant draws 1.74 million gallons of ocean water per minute for cooling purposes and subsequently discharges heated water (approximately 20°F [-7°C] above ambient ocean temperature) directly into the ocean at Diablo Cove (Tenera 1997).

The sensitivity of invertebrates to IPFs depends largely upon their motility. Some mobile invertebrates can migrate long distances and encounter a wide range of stressors over broad geographical scales (e.g., market squid). Their mobility and broad range of habitat requirements may also indicate that limited disturbance may not have measurable effects on their populations. This would apply to fishes, where populations are composed largely of long-range migratory species; it would be expected that their mobility and broad ranges would preclude many temporary and short-term impacts associated with ongoing offshore impacts throughout the Affected Environment. Invertebrates with more restricted geographical ranges or life stages and/or sessile invertebrates can be sensitive to such stressors.

Global climate change has the potential to affect distribution and abundance of invertebrates and their food sources. These effects manifest primarily through increased water temperatures but also through changes to ocean currents and acidification. Fishes and invertebrate migration patterns can be influenced by warmer waters, as can the frequency or magnitude of disease (Hare et al. 2016). Ocean acidification driven by climate change is contributing to reduced growth and, in some cases, decline of invertebrate species with calcareous shells. Increased freshwater input into nearshore estuarine habitats can result in water quality changes and subsequent effects on invertebrate species (Hare et al. 2016). In general, rocky and mud bottom, intertidal, special areas of conservation, kelp, coral, and sponge habitats were considered the most vulnerable habitats to climate change in marine ecosystems (Farr et al. 2021). Estuarine and riverine habitat types were found to be moderately to highly vulnerable to stressors resulting from climate change. Continued climate change impacts on marine life and habitats could lead to dramatic changes and decline (Farr et al. 2021).

3.3.5.3.2 Impacts of Alternative A – No Action on ESA-Listed Species

ESA-listed species may be particularly vulnerable to ongoing activities such as port utilization, commercial fisheries, and climate change. Overfishing, loss of estuarine habitat, hydropower development, poor hatchery practices, and poor ocean conditions are primary reasons for population declines for ESA-listed species.

Climate change and changing ocean conditions along the Pacific Coast are a threat to all ESA-listed species in the Affected Environment. Given that estuaries are one of the most vulnerable habitats to climate change (Farr et al. 2021), impacts on estuary-dependent ESA-listed species could hinder recovery of Chinook salmon, coho salmon, steelhead trout, Pacific smelt, longfin smelt, and green sturgeon populations. However, recent improvements in freshwater and estuarine habitat conditions suggest some ESA-listed species may rebound in numbers in the near future (NMFS 2022).

3.3.5.3.3 Cumulative Impacts of the No Action Alternative

Impacts from planned activities would be similar to those from ongoing activities and are expected to include temporary and permanent impacts on fishes, invertebrates, and EFH from disturbance, injury, mortality, habitat degradation, and habitat conversion. While these impacts would have localized effects on fishes, invertebrates, and EFH, population-level effects would not be expected. Planned activities include port expansions, other renewable energy projects (PacWave South), military use, shipping and marine transportation, fisheries and fisheries management, scientific surveys and buoys, installation of undersea transmission lines and telecommunications cables, and fall 2024/early 2025 designation of the Chumash Heritage National Marine Sanctuary. New oil and gas drilling is not anticipated off California due to state and federal moratoriums; however, decommissioning of three platforms in federal waters in the Affected Environment is planned in the next 10 years (Argonne 2023). Other cumulative impacts include changes in species distribution due to climate change (i.e., increased sea temperatures, changes in ocean circulation patterns).

Accidental releases: Accidental releases from vessels usually consist of fuels, lubricating oils, and other petroleum compounds that tend to float in seawater. Increased vessel activity can increase the risk of accidental releases from current levels as part of commercial shipping and fishing operations. Accidental releases would be expected to occur at or near the ocean surface in association with vessel operations; they are unlikely to contact benthic species and habitats in offshore waters but could affect pelagic species. Larger spills emanating from ocean vessels, though unlikely, could have larger impacts if they occur. Releases in shallow waters may cause habitat contamination from releases (e.g., adsorption of spilled hydrocarbons to suspended sediments, and subsequent sinking). Cleanup activities could cause harm to sensitive habitats and species. The Humboldt WEA is entirely within a military operating area, which may increase the risk of accidental releases during at-sea training exercises and operations. Designation of the Chumash Heritage National Marine Sanctuary would enhance the protections within portions of the Affected Environment.

Anchoring: Vessel anchoring related to ongoing, commercial, and recreational activities would continue to cause temporary and permanent impacts. These impacts would occur in the immediate area where anchors and chains meet the seafloor. Impacts on fishes, invertebrates, and EFH would be greatest for sensitive EFH (e.g., seagrasses, rocky reefs, seamounts) and sessile or slow-moving species (e.g., sedentary fishes and invertebrates). Impacts resulting from anchoring or bottom contact would include increased turbidity levels and potential for contact causing mortality of demersal species and, possibly, degradation of sensitive habitats. All impacts would be localized, and turbidity would be temporary; therefore, impacts from anchor contact are expected to be short term. Degradation of sensitive habitats such as certain types of hard-bottom or seagrasses could result in long-term to permanent impacts in habitats. Anchoring would be restricted within sensitive habitats in the Chumash Heritage National Marine Sanctuary, resulting in reduced bottom disturbance and turbidity in the sanctuary. The footprint of each anchoring would be relatively small and of short duration but would contribute to cumulative impact on the fish and invertebrate community and the EFH of managed species.

Cable installation and maintenance: The process of cable installation can cause localized short-term impacts by disturbing the seafloor and temporarily increasing suspended sediment, which would cause sediment redeposition and burial impacts. Generally, disturbances would be local and limited to cable corridors. Cable installation and maintenance would involve ground disturbance (grapnel runs) through jetting, jet plowing, or mechanical dredging equipment. Such activities have the potential to disturb, displace, and injure fishes and invertebrates and result in temporary to long-term habitat alterations, depending on the benthic habitat type. The intensity of impacts depends on the time (season) and place (habitat type) where the activities occur.

Dredging would most likely occur in sand wave areas where typical jet plowing is insufficient to meet cable burial target depths. Sand waves that are dredged would likely be redeposited in areas containing similar sediments. A sand wave may not recover to the same height and width as pre-disturbance. However, the habitat function would largely recover post-disturbance, although full recovery of faunal assemblage may require several years (Boyd et al. 2005). Therefore, seabed profile alterations, while locally intense, would have regional-scale cumulative impacts on fishes, invertebrates, and EFH.

Assuming the extent of such impacts is proportional to the length of cable installed, such impacts from the planned projects would not be extensive.

Discharges/intakes: Maritime activity, including recreation and shipping, would likely increase in the foreseeable future resulting in an increase in discharges and intakes. Permitted offshore discharges would include uncontaminated bilge water, ballast, gray water, and treated liquid wastes. However, vessels would be required to comply with regulatory requirements related to the prevention and control of discharges. Designation of the Chumash Heritage National Marine Sanctuary would enhance the protections in portions of the Affected Environment with regulations on discharges (NOAA 2023).

Fish and invertebrate entrainment and impingement could occur at intakes like that of power plants or during dredging during cable installation. Impacts from cable installation typically would be limited to cable centerlines and would be short term, while power plant water intake would be long term. Studies have shown that up to 120,000 northern anchovy (*Engraulis mordax*) adults per year were entrained. However, nearshore species such as sculpins, kelpfish, blackeye goby (*Rhinogobiops nicholsii*), and monkeyface prickleback (*Cebidichthys violaceus*) showed relatively high larval loss (California Central Coast RWQCB 2000). Once entrained, larval mortality was assumed to be 100 percent. Injuries or mortality of individuals would occur, and impacts would be long term, but this impact would be localized. Impacts on fishes, invertebrates, and EFH from entrainment and impingement at intakes are expected to be long term.

EMFs and cable heat: EMFs emanate continuously from installed electrical power transmission cables and telecommunications and communication cables. Additional sources of EMFs in offshore environments include ICCP systems, which supply a controlled amount of DC current to submerged surfaces (e.g., vessels, offshore oil and gas structures and equipment). To date, no studies have been conducted examining the effects of EMFs from ICCP on marine organisms, but research is anticipated. Buried submarine cables can warm the surrounding sediment in contact with the cables up to tens of centimeters, but impacts on bottom-dwelling organisms are expected to be insignificant (Taormina et al. 2018) and would be limited to a small area around the cable. Kavet et al. (2016) showed that that EMFs would likely not interfere with movement or migration of marine species. Cumulative impacts are not anticipated.

Gear utilization: Gear utilization refers to fisheries monitoring survey gear, site characterization equipment, and commercial fishing gear (e.g., trawl, trap, hook and line, crab pot, seine, diving, video sled, and troll). Multiple fishing grounds are in the Affected Environment where survey gear utilization can cause impacts. These include Monterey Bay, Bodega Bay, Fort Bragg Grounds, Eureka and Trinidad grounds; the Continental Shelf, Heceta, and Stonewall Bank complexes; and the Columbia River Mouth. Some of these gear types would encounter benthic species and habitats, which can disrupt the habitat and cause mortality by crushing if under the gear. Surveys could include trawl surveys (affecting fishes and squid) and gillnet surveys (affecting green sturgeon). Trawl and gillnet surveys for fisheries monitoring would likely result in direct impacts on fishes, invertebrates, and EFH and could result in injury and mortality, reduced fecundity, and delayed or aborted spawning migrations (Moser and Ross 1995; Collins et al. 2000). Trawling in sensitive habitats could have detrimental impacts especially for slow-growing species. Amendment 28 to the Pacific Coast Groundfish FMP went into effect in January 2020 and included reopening historic fishing ground; closing smaller areas that totaled 13,000 square miles (33,670 square kilometers) to protect a variety of features including canyons, seamounts, and methane seeps; and closures of waters deeper than 11,500 feet (3,500 meters) to fisheries with bottom-contacting gear, such as trawls to offer further protections for offshore habitat with seamounts to the boundary of the California EEZ (Georgian 2020; NMFS 2023j). Trawl surveys conducted as part of fisheries monitoring would be limited to small sampling nets, short tow times, and slow tow speeds. Other gear would add short-term sound inputs, which may temporarily disturb fishes and invertebrates, as well as affect EFH. Impacts from fisheries monitoring surveys are expected to be of short duration (e.g., approximately 20 minutes) and a relatively low scale of spatial impact.

Impacts related to commercial and recreational gear loss would be localized but can affect fishes and motile and sessile invertebrate assemblages and other marine vertebrates (e.g., marine mammals, sea turtles) through entanglement. Fouled gear would result in highly localized, periodic, short-term impacts on fishes, invertebrates, and the EFH of managed species. Fisheries monitoring and commercial fishing would realize cumulative impacts.

Invasive species: Invasive species can disrupt the ecosystem and overall health of fishes and invertebrates by altering habitats, competing for essential food or habitat resources, adding new predators, interbreeding with closely related native species potentially threatening their survival, and introducing new diseases or parasites to native species (CDFW 2024). Sources of invasive species include ballast water discharge, hull fouling, aquaculture, accidental releases, marine debris, shore-based discharges, and climate-driven range changes or dispersion (NOAA Fisheries n.d.a., Pederson 2005).

For instance, in California the European green crab (*Carcinus maenas*), Atlantic oyster drill (*Urosalpinx cinerea),* and Japanese bubble snail (*Haminoea japonica*) disrupt marine habitats by preying on a variety of benthic organisms, such as bivalves, small crustaceans, eggs and larvae, and juvenile fishes. This predation can lead to changes in the structure and composition of benthic communities. Several species of tunicates and encrusting bryozoans can form dense colonies on submerged hard surfaces, outcompeting native species and altering habitats by smothering native marine organisms leading to a reduction in biodiversity and altered structure of local benthic communities. Asian kelp (*Undaria pinnatifida*) has become an invasive species in California where it competes with native kelp and alters the structure and function of kelp ecosystems.

Sources of invasive species are not expected to change significantly with planned activities. Impacts from invasive species would be detectable and measurable, long term and potentially widespread. Effects would decrease biodiversity but would likely be recoverable and unlikely to affect population viability of any one species.

Lighting: Light emitted from anthropogenic sources such as offshore oil and gas platforms and vessels in the Affected Environment and can attract fishes and invertebrates, potentially affecting distributions in very localized areas. Anthropogenic light could disrupt natural cycles (e.g., spawning), possibly leading to short-term impacts. Artificial lighting may disrupt the diel migration of some prey species, including zooplankton. More fishes were seen at lit oil and gas platforms versus unlit platforms; however, their numbers declined at the surface at night, indicating that there may be nocturnal avoidance behavior in some species (Barker and Cowan 2018). However, there is little downward-focused lighting; only a small fraction of emitted light enters the water and lighting impacts from offshore platforms are localized and spatially restricted compared to other planned activities (e.g., fisheries, military operations). Cumulative light impacts on fishes, invertebrates, and EFH would be short term, limited to highly localized attraction, and may include some potential disruption of spawning cycles and prey distribution.

Noise: Anthropogenic noises associated with current and planned activities include G&G surveys, military activities, underwater detonations, vessel traffic impact and vibratory pile driving, cable laying and trenching, platform decommissioning, and drilling.

Noise (drilling): Drilling noise can occur from oil and gas well activities, as well as sea-to-shore power and telecommunications cable connections. New oil and gas drilling is not anticipated off California due to state and federal moratoriums. Some existing wells or platforms could require drilling for maintenance or for plugging an abandonment. The extent and duration of potential drilling scenarios for oil and gas would be minimal. Given the physical qualities of drilling noise (Appendix H), injury and auditory impairment are unlikely, but fishes and invertebrates could experience behavioral disturbance or masking close to these activities. No research has specifically looked at responses to these noise sources, but impacts are likely to be similar, though less intense, than those observed with vessel noise, since these activities are not as widespread or frequent as vessel transits.

Noise (G&G surveys): Well analysis and G&G research activities use seismic surveys with airguns, which are expected to be infrequent and localized. These surveys may cause temporary or permanent hearing impairment in some fishes but are unlikely to cause serious injury except at very close range. The effects are generally transitory, causing startle responses and changes in schooling behavior (Popper 2003; Hastings 2008; Popper and Hastings 2009a,b; Slabbekoorn et al. 2010; Popper and Hawkins 2011).

Fishes with specialized hearing abilities may exhibit behavioral responses to distant seismic surveys (McCauley 1994). G&G surveys using high-resolution geophysical (HRG) sources near the Morro Bay WEA could lead to short-term behavioral disturbances, avoidance, or stress in fishes and invertebrates. Only a few HRG sources emit sounds within the hearing range of most fishes and invertebrates.

Boomers, sparkers, hull-mounted sub-bottom profilers, and bubble guns have source levels close to the injury threshold for pressure-sensitive fish, but non-auditory injury is unlikely unless the fish is within a few meters of the source (Crocker and Fratantonio 2016; Popper et al. 2014). Behavioral impacts could occur within several hundred feet or meters from the source (Crocker and Fratantonio 2016). Most HRG sources are typically “on” for short periods with silence in between, making behavioral effects intermittent and temporary.

Overall, impacts from G&G surveys, including seismic surveys, would be most likely avoided. If impacts were to occur, they may result in the loss of a few individuals but would not affect regional or population levels.

Noise (impact and vibratory pile driving): Ongoing pile-driving activities would be associated with coastal and inshore construction, including bridges, ports, sea-to-shore cable connections, and other infrastructure. Additionally, sea-to-shore cable connections may include installation of temporary steel casing pipes (goal posts) and/or steel sheet piles (cofferdams) and this activity usually occurs within a few miles or kilometers from shore. Piles, if driven and not drilled, would be driven using a combination of vibratory and impact driving methods. The coupling of the driven pile with the seabed generates stress waves and vibrations, and while related, stress waves and vibrations are different physical concepts of particle motion related to the transfer of energy between the pile and seabed; and particle motion in this context is different than particle motion discussed in hearing for fishes. Stress waves are the initial disturbances that propagate through materials due to external forces, and vibrations are the resultant oscillatory motions. The propagation and intensity of stress waves and vibrations resulting from pile driving depends on sediment properties, pile-driving method and energy, pile type and size, and geological features. While fish and invertebrates would be able to perceive the resulting vibration from pile driving, impacts would be expected to occur in combination with the noise produced by pile driving. Should they occur, impacts from impact and vibratory pile driving may result in the loss of a few individuals but there would be no regional or population-level impacts.

Noise (trenching and cable laying): Given the physical qualities of noise associated with trenching and cable-laying (Appendix H), minimal impacts on finfish and invertebrates are expected.

Noise (underwater detonations): UXO on the seabed may be encountered during ongoing and planned activities. If encountered, the UXO may be left alone, shifted, or removed by low-order deflagration or explosive detonation. If explosive removal is used, the underwater explosion generates a shock wave characterized by extreme changes in pressure, both positive and negative. In fishes, barotrauma occurs when there is a rapid contraction and overextension of the swim bladder, which can occur when a fishes is close to a detonation. Pacific mackerel exposed to explosives in situ at distances ranging 102 to 2,648 feet (31 to 807 meters) and examined potential damage to auditory tissues (Smith et al. 2022) and non-auditory tissues (Jenkins et al. 2022) showed increases in mortality observed at distances up to 515 feet (157 meters) from the explosion, and other non-auditory injuries (e.g., damage to swim bladder and kidneys) occurred up to 1,093 feet (333 meters) from the source at received Lpk of 226 dB re 1 µPa (Jenkins et al. 2022). At greater distances and lower received Lpk levels (220 dB re 1 µPa), there was evidence of hair cell damage, suggesting that hearing would likely be impaired at this distance, although no hearing tests were conducted (Smith et al. 2022). Larval forms of fishes with closed swim bladders are also likely to experience injury or mortality at close distances, as demonstrated in a field study by Govoni et al. (2008). Fishes and invertebrates that lack swim bladders are more resistant to underwater blasts (Goertner et al. 1994) because it is typically the rapid expansion and contraction of gas-filled spaces that result in the greatest physiological injury. Modeling work by Goertner (1978) predicted that the range at which effects could occur in a non-swim bladder fish was 100 times smaller than that of a fish with a swim bladder. Keevin and Hempen (1997) report on several studies in which various invertebrate species were exposed to charges of different sizes. Overall, despite some studies lacking adequate controls and sample sizes, they conclude that invertebrates are resilient to pressure-related damage from underwater explosions. UXO detonations are expected to occur infrequently but may have severe effects within several hundred feet/meters for fishes with swim bladders, but this would likely only affect a few individuals or a few fish schools. Given the extremely short duration of explosions, most impacts on species are expected to be avoided. However, given the large ranges for non-auditory injury, the risk for mortality, and the severity of consequences to an exposed individual, unmitigated UXO detonation would have potential for impacts.

Ongoing activities occurring along the California coast also include the use of “seal bombs,” which are used by fishers as deterrents in fisheries. During peak periods, seal bombs were a prevalent noise source off Southern California; detectable at the Channel Islands and Monterey Bay National Marine Sanctuary. These have the potential to cause auditory and non-auditory injury in fishes, invertebrates, and the EFH of managed species and can result in temporary threshold shift (TTS) and behavioral disturbance for the animals. Impacts of seal bombs on fishes and invertebrates and their habitat would be like those described for UXO detonations, but whereas UXO detonations would be infrequent, seal bombs would occur more frequently. Seal bombs could result in mortality events and impacts on fishes and invertebrates would be detectable and measurable, of medium intensity and long term, but would not have population level effect on fishes and invertebrate species.

Noise (vessel): Due to the physical nature of vessel noise, it is unlikely to cause barotrauma or auditory damage in fishes, but could lead to behavioral changes, increased stress, or masking (Vabø et al. 2002; Handegard et al. 2003; De Robertis and Handegard 2013; Nedelec et al. 2017). Overall, impacts of vessel noise on fishes, invertebrates, and eggs and larvae are expected to be short term and if they occur, there would be no regional or population-level impacts.

Noise (decommissioning): Underwater explosives and mechanical cutting are two potential methods that could be used for decommissioning oil and gas platforms. Cutting generates relatively low sound levels, but if explosives must be used, impacts would be similar to those expected from UXO detonations described above.

Port utilization: Multiple California ports are independently investing in expanding and modifying port facilities to accommodate increasing demand (CalSTA 2023). In addition to port expansion activities, maintenance dredging would occur within each of the California ports to ensure the safety of navigation is also routinely conducted and would potentially increase with any port expansions. For example, dredging of the Humboldt Bay navigation channels and entrance occurs annually (USEPA and USACE 2020).

Increased sound, turbidity, and sediment deposition from port expansion activities and maintenance dredging could have localized, short-term impacts especially on eggs and larvae. Although the degree of impacts on EFH would likely be undetectable outside the immediate vicinity of the ports, cumulative impacts on EFH for certain species, life stages, or both may lead to impacts on fishes and invertebrates beyond the vicinity of the port (e.g., EFH for salmon in estuaries and rivers near ports).

Presence of structures: Adding structures to the seascape can impact fishes and invertebrates and their associated EFHs though direct displacement and possible mortality of slow-moving and benthic invertebrate species. Artificial structures modify and influence the movement patterns of mobile species and dispersal stages of sessile marine species. However, there are critical knowledge gaps as to how these structures influence marine organisms (McLean et al. 2022).

Oil and gas platforms in the Affected Environment can act as reef habitats, attracting migratory (e.g., tunas, pelagic sharks) and coastal pelagic fishes, as well as structure-associated demersal species (e.g., rockfishes). Artificial reef habitat can provide refuge, enhance larval settlement, increase prey availability, increase reproductive output, and serve as nursery grounds (Claisse et al. 2014; Love et al. 2019; Haberlin et al. 2022). New hard-bottom substrate in a predominantly soft-bottom environment can increase local biodiversity (Degraer et al. 2020). This indicates that marine structures can generate beneficial impacts on local ecosystems even though some adverse impacts, such as the loss of soft-bottom habitat and introduction of invasive species, may occur. These beneficial impacts can be short term to permanent on some fish species. Initial recruitment to these hard substrates can increase the abundance of certain fishes and epifaunal invertebrate species (Claisse et al. 2014; Smith et al. 2016; Snodgrass et al. 2020); leading to the development of diverse demersal fishes and invertebrate assemblages. However, such high initial diversity levels may decline over time as early colonizers are replaced by successional communities (Degraer et al. 2018). Further, colonization by non-Indigenous biota (e.g., invasive or nuisance species) may alter localized benthic or epipelagic communities (Glasby et al. 2007).

Considering this information, cumulative impacts of the presence of structures on fishes, invertebrates, and EFH could occur, but some impacts may be beneficial for some species. All impacts would persist as long as the structures remain but would cease when structures are decommissioned.

3.3.5.3.4 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, fishes, invertebrates, and EFH would continue to be affected by existing environmental conditions and ongoing activities. Ongoing activities would have temporary and permanent impacts (i.e., disturbance, displacement, injury, mortality, habitat degradation, habitat conversion) primarily through climate change, commercial fishing activities, dredging, anthropogenic noise, new cable installation, invasive species, port expansion, and the presence of structures.

Cumulative impacts of the No Action Alternative. Ongoing plus planned activities would have temporary and permanent impacts (i.e., disturbance, displacement, injury, mortality, habitat degradation, habitat conversion) primarily through commercial fishing activities, dredging, anthropogenic noise, new cable installation, port expansion, and the presence of structures.

3.3.5.4 Impacts of Alternative B – Development with No Mitigation Measures – Fishes, Invertebrates, and Essential Fish

ESA Section 7 consultation with NMFS would be conducted in association with each COP-level NEPA review. It is assumed that the Letter of Authorization would include mitigation requirements that would reduce impacts.

3.3.5.4.1 Impacts of One Representative Project in Each WEA

Accidental releases: The risk of any accidental release would be increased primarily during construction or decommissioning but may also occur during O&M. From 2000 to 2009, the average spill size for vessels other than tanker ships and tanker barges was 88 gallons (333 liters) (USCG 2011). Should a spill from a vessel occur, BOEM anticipates that the volume would be similar. Accidental releases can also come from WTGs. According to BOEM modeling (Bejarano et al. 2013), an accidental release of 128,000 gallons (484,533 liters) including all oil types from WTGs is likely to occur no more often than once per 1,000 years, and a release of 2,000 gallons (7,571 liters) or less of diesel fuel is likely to occur every 5 to 20 years. The probability of an accidental discharge or spill occurring simultaneously from multiple WTGs is extremely low. An oil-weathering model used by NOAA predicted that a diesel fuel spill of 105,000 gallons (397,468 liters) would dissipate rapidly, and depending on the ambient conditions, would reach a concentration of 0.05 percent between 0.5 and 2.5 days (Tetra Tech Inc. 2015). BOEM assumes all vessels associated with representative projects would be required to comply with USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize accidental release effects on fishes, invertebrates, and their respective EFHs (BOEM 2012). For further consideration of accidental releases, refer to Section 3.2.2, *Water Quality*.

Vessels may generate waste, including increased discharges of bilge and ballast water, sanitary and domestic wastes, and trash and debris. In the event accidental releases occur, impacts on fishes, invertebrates, and EFH would likely be localized and temporary because of the limited extent and duration of a release.

Anchoring: Anchoring would have both short- and long-term impacts on fishes, invertebrates, and EFH and may occur during all project phases. Impacts would be greatest for any HAPCs (i.e., rocky reefs) that may underlie lease areas and the species that rely on rocky reef habitats (e.g., rockfishes). The use of DP vessels would preclude the use of vessel anchors, but anchor placement for mooring systems would directly affect benthic fishes, invertebrates, and EFH. These impacts would include increased turbidity levels, and seafloor contact would cause mortality of benthic species and, possibly, degradation of sensitive habitats. All turbidity impacts would be localized and temporary. Therefore, impacts on fishes and invertebrates from anchors are expected to be short term. Degradation of EFH and HAPCs could be long term to permanent as anchor scars have shown to be persistent. The footprint of each anchor would be relatively small, although any benthic habitat under each anchor would be permanently lost. Adjacent soft-bottom habitat affected by sediment movement and turbidity from anchor installation would likely recover within several years.

Impacts on HAPCs would depend on the area of HAPC resources affected in each of the lease areas. Some lease areas have substantial rocky reef HAPC habitat (Figure 3.3.5-2); therefore, impacts on EFH and HAPCs would vary between the lease areas. HAPC impacts would be greatest for OCS-P 0562 and OCS-P 0563, and less severe for the remaining three lease areas.

Cable installation and maintenance: Interarray cables and mooring lines would be suspended in the water column, while export cables would have a typical burial depth of 3 to 10 feet (1 to 3 meters), although cables may not be buried along the full cable route. All cables, if sited to avoid HAPCs, may have short-term impacts. Impacts on benthic invertebrate populations and communities are expected to be temporary and localized to the cable corridor. However, recovery of these benthic invertebrate assemblages would be expected to occur within months after cable installation. If avoidance of HAPCs is not possible, cable-related activities could result in longer-term and more severe impacts on these habitats and the biotic communities that rely on them. Although array cables and mooring lines have no loose ends and are sufficiently taut so that no looping can occur, the risk of animal entanglement in anthropogenic debris caught in floating mooring lines and subsea cables persists (Taormina et al. 2018; Copping et al. 2020). These floating cables and lines could act as FADs and cause changes to existing fish communities (Kramer et al. 2015; Snodgrass et al. 2020). Portions of the array cables may require burial or other protections. Impacts on managed species from cable installation and maintenance would be expected if sensitive habitats could not be avoided.

Discharges/intakes: One representative project would increase discharges, entrainment, and impingement, particularly during construction and decommissioning. If HVDC converter OSSs with open-loop cooling systems are used, plankton would be entrained by the intake of seawater for cooling. If intake velocity is low, most strong-swimming juvenile fishes and smaller adults would be able to escape entrainment or impingement. However, drifting plankton would not be able to escape entrainment except for a few fast-swimming larvae of certain taxonomic groups. The most effective way to cool these HVDC systems is by pumping in seawater through a heat exchanger to cool the deionized water within the system (Middleton and Barnhart 2022). The discharge pipe for the cooling systems is generally situated at a depth that will allow for immediate thermal absorption of the discharge within the surrounding water column. CWA Section 316(b) requires that NPDES permits to ensure the location, design, construction, and capacity of cooling water intake structures reflect the best technology available to minimize adverse environmental impacts (Middleton and Barnhart 2022). Those organisms entrained may be stressed or killed, primarily through changes in water temperature during the route from cooling intake structure to discharge structure and mechanical damage (turbulence in pumps and condensers). As Reine and Clarke (1998) have demonstrated, the rate of egg and larval survival to adulthood for many marine fishes and invertebrate species is naturally extremely low. Impacts from water intakes/discharges would be staggered over time and localized. Based on the limited area of intake and intake volumes associated with one representative project, entrainment and impingement of fishes and invertebrates and the EFH of managed species would be mostly confined to the immediate area of OSS intakes.

EMFs and cable heat: One representative project would require a network of cables to transmit power from WTGs to onshore infrastructure. EMF and cable heat effects would begin once cables begin transmitting power. EMFs emanate continuously from installed electrical power transmission cables. The impact of EMFs on benthic habitats, fishes, and invertebrates is an emerging field of study. Thus, there is uncertainty regarding the nature and magnitude of effects on all potential receptors (Hogan et al. 2023). Generally, three major factors determine levels of magnetic and induced electric fields: (1) the amount of electrical current being generated or carried by the cable, (2) the design of the generator and cable, and (3) the distance of organisms from the generator or cable (Taormina et al. 2018).

Array cables would float between individual WTGs and connect to OSSs, while export cables would connect the OSS to the electric grid. Both HVAC and HVDC technologies could be considered for offshore energy export systems; each cable would carry a voltage of up to 525 kV (HVDC) or 420 kV (HVAC). Cables would be dynamic between the OSS and the seabed but would transition to a static cable for the remaining length to the shore. Burial may not be required along the full cable route depending on the seabed conditions, or other factors that are taken into consideration during the cable burial risk assessment. Where the export cable would require burial, a target depth range of 3 to 10 feet (1 to 3 meters) is proposed, which will help dampen EMFs.

Energized cables have not been documented as causing biologically notable impacts on fishes, invertebrates, and the EFH of managed species (CSA Ocean Sciences Inc. and Exponent 2019; Thomsen et al. 2015). However, behavioral impacts have been documented for benthic species (skates and lobster) near operating DC cables (Hutchison et al. 2018). EMF impacts from such cables are localized and would only affect fishes and invertebrates located within 3.3 feet (1 meter) of the cable (Love et al.

2016). Love et al. 2016 found that EMF levels dropped off precipitously with distance from the cable and returned close to background EMF levels within 3.3 feet (1 meter) to the cable. Potential responses to EMFs by elasmobranchs include interference with navigation, predator/prey interactions, avoidance or attraction behaviors, and physiological and developmental effects but the effect and severity would be different between species and only to animals proximal to the cable (Hutchison et al. 2018; Taormina et al. 2018; Normandeau et al. 2011).

Sensitivity ranges, likely encounter rates, and the varying potential effects based on fish and invertebrate life stages and population-level effects are not well known (Hogan et al. 2023). Harsanyi et al. (2022) found that direct exposure to EMFs, like that produced by offshore wind export cables, during European lobster egg development led to significantly smaller larval parameters and higher occurrence of larval deformities that could affect larval mortality, recruitment, and dispersal. This study also notes that egg and larvae sensitivity to anthropogenic EMFs is species specific. Additional studies are needed to understand impacts to early life stages from EMFs. ICCP systems can also produce EMFs; however, no studies have been conducted examining ICCP's potential EMF effects on fishes or invertebrates; further research is anticipated. Based on the available literature, no measurable impacts on pelagic teleost (bony) fish species would be expected; impacts on demersal fishes, elasmobranchs, motile invertebrate species, and the EFH of managed species could occur.

Gear utilization: Lost gear, moved by currents, could disturb, injure, or kill bottom-dwelling fishes and invertebrate species, as well as impact EFH. A common method for retrieving lost equipment is using grapnel lines, which are dragged along the bottom until the lost gear is retrieved. After the line catches the lost equipment, it will drag all the components along the seafloor until recovery, resulting in additional EFH impacts. The geographic distribution, temporal spacing, and fast recovery (Brooks et al. 2006; Dernie et al. 2003) of these short-term impacts on sandy bottoms (Lindholm et al. 2004) would likely preclude long-term impacts on EFH. Much of the offshore area is closed to trawling, which benefits fishes, benthic invertebrates, and EFH (Georgian 2020; NOAA Fisheries 2023).

Anticipated fisheries monitoring would harvest fishes and macroinvertebrates and could include trawl surveys (impacting fishes and squid). Trawl and gillnet surveys would likely result in direct impacts on fishes, invertebrates, EFH, and ESA-listed species (injury and mortality, reduced fecundity, and delayed or aborted spawning migrations [Moser and Ross 1995; Collins et al. 2000]). Trawl surveys conducted as part of fisheries monitoring would be limited to areas open for trawl surveys, small sampling nets, short tow times, and slow tow speeds, which would reduce the risk of capture. Impacts on fishes and invertebrates would be intermittent at any one location but could be more severe if, in a rare circumstance, a mortality of an ESA-listed species were to occur during associated fish-monitoring activities.

Invasive species: Invasive species can alter the habitat structure, food sources, and overall health of fishes and invertebrates (CDFW 2024). Invasive species can be accidentally released, especially during ballast and bilge water discharges and within the fouling communities of ship hulls. Once established in the region, invasive species have been found to quickly colonize available hard surfaces on offshore oil and gas infrastructure in southern California (Viola et al. 2018; Page et al. 2019). The potential for introducing an invasive species through ballast water releases or biofouling from construction activities is quite small and only related to the vessels utilized to potentially import components of some of the WTG systems. These vessels are required to adhere to existing state and federal regulations related to ballast and bilge water discharge, including USCG regulations (33 CFR 151.2025) and USEPA NPDES Vessel General Permit standards, both of which aim to prevent the release of ballast waters contaminated with an invasive species. Once WTGs are operational, timing of maintenance can be important in helping to limit the spread of any invasive species, especially those attached to the offshore infrastructure. Viola et al. (2018) found that scheduled maintenance of oil platforms in central and southern California that occurred after the reproductive period of *Watersipora* allowed enough time for native species to recolonize the bare surfaces disturbed during maintenance.

The introduction of an invasive species related to the construction activity of one representative project is expected to be extremely rare. However, should an invasive species be introduced, impacts on fishes, invertebrates, and EFH would occur.

Lighting: Lighting during construction would be intermittent and temporary. Lighting would be added on WTGs and OSSs and impacts from light would be greatest during the operational phase. Each structure would be lit in accordance with USCG, FAA, and BOEM requirements including placement of lighting as high as possible, avoidance of direct lighting, and methods to minimize indirect lighting of the water surface once the wind facility is in operation (BOEM 2021). As such, only a small fraction of emitted light would enter the water.

Noise: Activities in all phases of project development could cause underwater noise, potentially affecting fishes and invertebrates through auditory injury and/or behavioral disturbance. Noise from decommissioning, given what information is available, would be comparable to the noise sources and impacts expected during construction. Subsections below summarize sources and potential impacts.

Noise (drilling): Drilling may be required to support anchoring as well as for connecting offshore cables at onshore landings (HDD). A description of the source characteristics of drilling noise is provided in Appendix H, but generally drilling is non-impulsive source with SPL source levels ranging from 145 to 162 dB re 1 µPa m depending on the drill type (Erbe and McPherson 2017; Huang et al. 2023). These measured drilling activities fall below acoustic thresholds established for fishes and invertebrates auditory and behavioral responses (Appendix H). Drilling would have small potential impacts on fishes and invertebrates, given the depth of pile drilling and short duration of potential HDD. Because drilling noise is not expected to exceed fish and invertebrate auditory or behavioral thresholds, any impacts would be so small that they would not be expected to be measurable or detectable.

Noise (impact and vibratory piling): Sea-to-shore export cable connection and TLP anchoring could each require impact and vibratory pile driving. The sea-to-shore export cable connection may include installation of temporary steel casing pipes (goal posts) and/or steel sheet piles (cofferdams) to accommodate the conduit used for pulling the cable from the seabed through to the shore after HDD. This activity usually occurs within a few kilometers from shore, would involve relatively small piles driven using a combination of vibratory and impact driving methods, and completed in a relatively short duration (Appendix H). Ranges (distances) to thresholds have not been predicted for the HDD piling associated with the sea-to-shore connection; however, permanent threshold shift (PTS) acoustic threshold ranges for fishes and invertebrates are expected to be considerably large (> 3,281 feet [1,000 meters]). However, due to the 24-hour exposure time required to meet PTS thresholds (Appendix H), and the short duration of piling, PTS would not be expected. Finfish and motile invertebrates (squid and crabs) could be disturbed enough to temporarily vacate the immediate area; however, the effects would be limited to short term, temporary behavioral disturbances.

For impact and vibratory pile driving of the TLP anchor piles, no measurements are available but ranges to thresholds can be estimated by the pile size using NMFS Multi-Species Calculator Tool as described in Appendix H. Ranges to the non-auditory injury thresholds for fish may extend out to 32,808.4 feet (10,000 meters) for impact and vibratory pile driving. However, it is worth noting that there are no currently accepted thresholds for fish for non-impulsive sound sources, so this estimate is based on thresholds for impulsive sources. As described in Appendix H, source levels for vibratory pile driving are lower than those for impact pile driving. The range to the behavioral disturbance threshold for all fish for impact and vibratory pile driving may extend out to 152,283.1 feet (46,415.9 meters).

The range to the non-auditory injury threshold is based on an SEL threshold, which requires animals to be present within the ensonified area for a given period to accumulate enough sound energy to elicit injury. For mobile species, it is unlikely they will remain within this area long enough for injuries to be realized. Species that are less mobile, however, may not be able to avoid exposure. Especially given the predicted range, the risk of injury for fishes and invertebrates cannot be discounted. However, the NMFS Multi-Species Calculator Tool does not account for local bathymetric and oceanographic features that would influence underwater sound propagation, both of which are unknown for this programmatic assessment. Site-specific information used in a project-specific model would likely alter the predicted threshold ranges for fishes and invertebrates, but this will not be conducted until future project-specific consultations are initiated. Impact and vibratory pile driving would increase the risk of injury; impacts may be long term but would not result in population-level effects.

Noise (G&G surveys): For G&G surveys, only HRG survey equipment and geotechnical survey equipment would be used; no airguns would be used for offshore wind surveys under Alternative B. Given the source characteristics for HRG sources and geotechnical sampling equipment (Appendix H), impacts of G&G surveys would be of small spatial extent and short duration of exposure.

Noise (trenching, cable laying, and dredging): Activities for one representative project are not expected to increase the amount of trenching, cable laying, and dredging such that impacts on fish and invertebrate species would be more severe.

Noise (underwater detonations): Non-explosive methods may be employed to lift and move UXO that may be encountered, but deflagration or removal by explosive detonation may also be needed. Underwater explosions of this type generate high pressure levels that could cause non-auditory injury to fishes and invertebrates. UXO detonation is anticipated to be infrequent, localized, and temporary.

However, given the large ranges for non-auditory injury, the risk for mortality, and the severity of consequences to an exposed individual, UXO detonation has potential for impacts.

Noise (vessel): Vessel noise is not expected to result in substantial impacts. Research indicates the effects of vessel noise, including dynamic positioning vessel noise, would not cause mortality or injuries in adult fishes (Hawkins et al. 2014) given the low source levels and non-impulsive nature of the source. The potential for exposures above physiological injury thresholds is extremely unlikely for any fishes or invertebrate species. Behavioral disturbances caused by noise would only be expected within a few meters of the vessel and would dissipate once the vessel has moved away. In addition, fish and invertebrate species are thought to be more sensitive to particle motion than sound pressure (Popper and Hawkins 2018; Mickle and Higgs 2022). Therefore, impacts of vessel noise on fishes, invertebrates, and eggs and larvae, if they occur, may result in the loss of a few individuals, but there would be no regional or population-level impacts.

Noise (WTG operations): Efforts to measure operational noise have largely focused on fixed-bottom WTGs (Farr et al. 2021), though a recent study characterized operational noise from floating WTGs in Scotland (Risch et al. 2023). In summary, operational sounds from floating WTGs were concentrated in the frequencies below 200 Hz and seem to change with blade rotational speed and mooring structures (Risch et al. 2023; Maxwell et al. 2022). At semisubmersible foundations, sounds ranged between 50 and 80 Hz and 25 and 75 Hz on spar-buoys (Risch et al. 2023). At similar distances from the source, these measured received levels are like those from fixed turbines (Risch et al. 2023). Incremental wind speed increases led to differing increases of operational sound. At a wind speed of 50 feet per second (15 meters per second) operational noise levels were found to be about 3 dB higher at the semisubmersible foundations (148.8 decibels referenced to a pressure of 1 microPascal [dB re 1 µPa]) as compared to spar-buoys (145.4 dB re 1 µPa) (Risch et al. 2023). The operational noise from floating WTGs of the size proposed has yet to be determined, but for the purposes of this analysis, noise impacts are assumed to be similar to those associated with bottom-founded WTGs.

Elliott et al. (2019) compared offshore wind operations from the Block Island Wind Farm to audiograms of several fish species including Atlantic salmon (*Salmo salar*), plaice, dab (*Limanda limanda*), and Atlantic cod (*Gadus morhua*). The report showed that at 164 feet (50 meters) from an operating WTG, particle acceleration levels were below the levels that these fish species can detect, meaning that it would not be audible at this distance. Operational noise is unlikely to be audible to fishes beyond those that travel in close vicinity (i.e., within 164 feet [50 meters]) to the pile (e.g., for foraging opportunities), and even if it is audible, it would not be expected to affect biologically relevant behaviors such as feeding or mating. Assuming a source level of 149 dB re 1 µPa m (Risch et al. 2023), the SPL 150 dB re 1 µPa behavioral disturbance threshold likely would not be exceeded. However, this source level is based on smaller turbines than the maximum WTG size proposed (Appendix A, *Representative Project Design Envelope for Floating Offshore Wind Energy*) so actual sound levels may be higher. Operational sounds from the gearboxes and the vibration of the turbine structures are considered unlikely to affect most species (Farr et al. 2021; Haberlin et al. 2022). Use of different technologies like direct-drive turbines rather than gearboxes like those used on WTGs measured in Europe would substantially reduce noise produced regardless of turbine size (Stöber and Thomsen 2021).

Walsh et al. (2017) studied the underwater noise from installation and operation of a wave energy converter. Their study estimated a back-calculated SPL source level of 155 dB re 1 µPa/Hz for the 10 Hz to 32 kHz frequency band, which was only estimated to be detectable above background noise within approximately 656 feet (200 meters) (Walsh et al. 2017). Copping et al. (2020) studied the impacts of different Marine Renewable Energy systems. The study found overlap between sound generated by Marine Renewable Energy systems and offshore WTGs and found no evidence to date to suggest that operational noise from Marine Renewable Energy devices harms marine life but noted the need for more data to characterize noise produced from additional types and designs of WTG and wave energy converter.

Heaving movements of ropes, chains, and WTG platforms can also cause noise. Currently, there is no information on such sources, even from comparable oil and gas structures. Available sound source information is summarized in Appendix H. It is expected that noise produced from flotation and mooring structures would not produce sounds sufficient to risk non-auditory injury in fishes and invertebrates because of the discrete nature of the noise events and these species would likely not accumulate sound energy long enough to experience injury; however, behavioral disturbance could occur. Synthetic mooring lines could reduce source levels, but uncertainty remains regarding chain and structure noise for offshore floating wind.

Some impacts from WTG operation on fishes, invertebrates, and EFH of managed species would likely occur but, despite the unknowns, population-level effects are not anticipated.

Port utilization: Port utilization would affect fishes, invertebrates, and EFH in nearshore environments. Potential ports would depend on which leases are developed. Vessel traffic would increase during construction but decrease during operations. During the operations, WTG and OSS substructures, mooring lines, and anchors would be inspected at regular intervals to check their condition and determine if maintenance is needed. BOEM anticipates impacts on fishes, invertebrates, and EFH from port utilization would be short term.

Presence of structures: The addition of up to 200 floating WTGs and six OSSs in each lease area would result in direct displacement and possible mortality of some slow-moving and benthic invertebrate species. The addition of new hard-bottom substrate in a predominantly soft-bottom environment would enhance local biodiversity (Degraer et al. 2020). This indicates that marine structures would generate some beneficial impacts on local ecosystems even though some impacts, such as the loss of soft-bottom habitat, may be adverse. Soft bottom is the dominant habitat type in the Affected Environment; the species that rely on this habitat are not likely to experience population-level impacts. Additionally, some fish species would be susceptible to secondary entanglement on mooring lines and interarray cables from ghost fishing gear and other debris (Maxwell et al. 2022). Other impacts would include attraction to these artificial substrates by both fishes and invertebrates. FADs found in association with structures can provide localized, short-term to permanent beneficial impacts on some fish species because of increased prey species availability. There are still research gaps on the impacts of floating offshore wind structures, their potential to act as artificial reefs, FADs, and their long-term cumulative impacts on fishes and benthic communities (Haberlin et al. 2022; Maxwell et al. 2022).

Additionally, the presence of structures could result in hydrodynamic effects, but impacts on fishes communities and ecological and oceanographic processes are not well understood (Claisse et al. 2014; Integral 2021; Haberlin et al. 2022; Raghukumar et al. 2023). Hydrodynamic impacts from the presence of one representative project in each WEA could result in impacts on fishes and invertebrates that forage on planktonic species and other fish species by changing prey distribution or concentrations. Recent modeling was done in full build-out and is discussed in Section 3.3.5.4.2, *Impacts of Five Representative Projects*.

Impacts on rocky reef HAPCs and the species reliant upon such habitat beneath lease areas would depend on the number of WTGs and the placement of anchorages, mooring lines, and cables. Long-term impacts on can be avoided if sensitive habitats are avoided. Additionally, the presence of structures could have beneficial impacts.

3.3.5.4.2 Impacts of Five Representative Projects

The same IPFs described for one representative project would apply to five representative projects. The larger amount of offshore development would result in a greater potential for impacts in several areas described below. Impacts from accidental releases, lighting, and port utilization are not expected to increase in severity.

Anchoring: Anchoring impacts would occur throughout each lease area. Impacts would be both short term for vessels and long term from mooring systems, resulting in permanent impacts on some EFH from mooring line anchors.

Cable installation: Impacts from cable installation and maintenance for five projects could increase in severity depending on cable routes, installation methodology, and affected habitats; five projects would increase the potential for impacts due to more export cables. The primary activities that would cause disturbance would be related to the preparation of the cable routing (pre-lay grapnel run) and installation of the export cable routing connecting the WEA to the onshore POI. If cables from these activities are routed through HAPCs, potential displacement of fishes and motile invertebrates could occur but impacts on sensitive resources should be avoided. There would be mortality of benthic invertebrate infauna within the respective corridors, and sediment deposition/burial impacting sensitive life stages of finfish and invertebrates, as well as potential impacts on EFH depending on the cable route.

Discharges/intakes: Potential impacts on fish and invertebrate larvae through the discharge and intakes to surrounding sea water would require permits through the USEPA NPDES (Middleton and Barnhart 2022). Fish and invertebrate larvae entrained may be stressed or killed. Section 316(b) of the Clean Water Act requires NPDES permits to ensure that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available to minimize adverse environmental impacts from impingement and entrainment of aquatic organisms. Impacts of entrainment and impingement on finfish and invertebrates at OSS HVDC converter intakes would be limited to the immediate area of the OSSs and to intake volumes. If the intake velocity is low, it should allow most strong-swimming juvenile fishes and smaller adults to escape entrainment or impingement. However, drifting plankton would not be able to escape entrainment except for a few fast-swimming larvae of certain taxonomic groups. Those organisms entrained would be killed or extremely stressed, primarily through changes in water temperature during the route from cooling intake structure to discharge structure and mechanical damage (turbulence in pumps and condensers). Placement of the intake pipe opening depth and velocity of the pump system can mitigate effects on finfish and invertebrate species (Middleton and Barnhart 2022). Because of the limited area scope and intake volumes, long-term impacts from entrainment and impingement of fishes, invertebrate, invertebrates, and managed species associated with OSS structure presence would be mostly confined to the immediate area of the OSS intake. As Reine and Clarke (1998) have demonstrated, the rate of egg and larval survival to adulthood for many marine fish and invertebrate species is naturally extremely low, and the adverse effects would be diluted over the large geographical extent of the Affected Environment. Impacts from EMFs and cable heat would remain localized, affecting animals only while they are in relative proximity to an EMF source.

Gear utilization: Impacts from gear utilization would likely remain and could increase in severity for pelagic and demersal finfish and motile invertebrate species because of increased areas of impact or, if in a rare circumstance, mortality of an ESA-listed species were to occur during associated fish-monitoring activities.

Invasive species: The introduction of invasive species could increase, but the risk of introduction would still be considered rare. Once construction of the WEA is completed this risk would reduce or almost be eliminated because the number of vessels needed to support WEA operations would decrease, greatly reducing the vector element vessels provide for invasive species introduction. If invasive species were introduced into the offshore and coastal environment, impacts would be detectable, measurable, long term, and potentially widespread.

Noise: Five representative projects would increase noise impacts. While the area of effect would be limited to a relatively small area around the noise-producing activity, the full build of each WEA would result in a long-term increase in noise levels for individuals in the project areas.

Presence of structures: Five representative projects would increase impacts on sensitive habitats but not on soft-bottom habitats. The increased number of structures would create an artificial reef effect and fish aggregating effect, whereby more sessile and benthic organisms would likely colonize some of the bottom founded structures (anchors) over time (e.g., sponges, algae, mussels, shellfish, sea anemones), and pelagic fish species would be attracted to the floating structures. Higher densities of invertebrate colonizers and fish species would provide a food source for predatory species in both cases, resulting in beneficial impacts for some species. The addition of scour and cable protection for five representative projects would have similar effects.

Hydrodynamic impacts are expected to increase for five representative projects but still would not result in population-level effects. Most knowledge on the impacts from floating infrastructure is based on modeling exercises, including a study off the California coast (Integral 2021). In a modeling study comparing upwelling effects from 877 WTGs off Morro Bay, Diablo Canyon, and Humboldt Bay, a 5 percent reduction in lee wind speeds was estimated to result in an approximately 10 to 15 percent decrease in upwelling volume nutrient supply to the coastal zone near Morro Bay (Integral 2021; Raghukumar et al. 2023). After this study, the Diablo Canyon WEA was removed from further consideration. The Integral (2021) and Raghukumar et al. (2023) studies found a small but consistent pattern of reduction in upwelling and an approximate 5 percent reduction in wind speeds in the presence of WTGs for Humboldt Bay as well. The studies stated that no conclusions on ecosystem impacts or phytoplankton productivity can be drawn from the modeled physical changes; however, future studies on changes of the phytoplankton productivity are needed. Regardless, these effects would be long term that may be detectable through inference from long-term oceanographic data collection but are not expected to result in population-level effects on fishes and invertebrate populations or the EFH of the managed species.

3.3.5.4.3 Impacts of Alternative B on ESA-Listed Species

ESA-listed species in the Affected Environment are Chinook salmon, coho salmon, steelhead trout, Pacific smelt, longfin smelt, green sturgeon and black abalone. These species may be found in the Humboldt and Morro Bay WEAs during construction, O&M, and decommissioning. However, interactions between ESA-listed species and project activities are most likely to occur near shore versus the lease areas, which are more than 20 miles offshore. ESA-listed species could be present in the WEAs during migratory movements, although interaction between ESA-listed species and project vessels is unlikely. Furthermore, vessel strikes are not identified as a threat in any of the species recovery plans (NMFS 2023b, c, d, e, f, g, h). General impacts of one or five representative projects on fishes are described in the previous subsections for Alternative B and apply to ESA-listed species. The primary IPFs from one or five representative projects that could affect ESA-listed species are upwelling, entrainment, entanglement from anchoring systems (green sturgeon), vessel and potential pile driving and WTG operational noise (green sturgeon), and port utilization (Chinook salmon, coho salmon, steelhead trout, Pacific smelt, longfin smelt, green sturgeon, and black abalone) near rivers and estuaries. Project development could result in local diminishment and enhancement in upwelling on either side of the developed area (Integral 2021). However, there would be little net change in upwelling regionally, when integrated over a larger area that fully encompasses the WEAs. Since the exact location of the export cable route, or POI landing are not known at the programmatic level, the full extent of impacts to ESA listed species cannot be determined.

Estuaries and rivers are crucial habitats for ESA-listed species. ESA-listed species occupying these habitats near the ports or cable transmission points of interconnection may experience an increase in vessel traffic, noise, and habitat disturbance. Depending on the number of projects developed and which ports and points of interconnection are used, potentially affected rivers and estuaries include Humboldt Bay Estuary, South Bay, Eel River, Arcata Bay, and Mad River near the Port of Humboldt; Morro Bay Estuary, Chorro Creek, and Los Osos Creek near Morro Bay; San Luis Obispo Creek and Pismo Creek Estuary near the Port of San Luis; and the Santa Clara River near Port Hueneme. Once a COP for a specific project is complete, an assessment and review would be completed through the Section 7 ESA consultation process, which will identify the level of impacts and mitigation measures to eliminate or greatly reduce impacts and adverse effects to ESA species. No population-level impacts are expected.

3.3.5.4.4 Cumulative Impacts of Alternative B

The construction, O&M, and decommissioning for planned activities across the Affected Environment would contribute to the primary IPFs. Cumulatively, Alternative B would contribute to impacts because there are HAPCs in all five lease areas. The number of added structures and the artificial reef effect would add a beneficial impact. Designation of the Chumash Heritage National Marine Sanctuary would benefit fishes, invertebrates, and EFH by prohibiting discharge of sewage or graywater within the sanctuary boundaries, thereby improving water quality south of the Morro Bay WEA. Impacts resulting from discharge/intake could be more severe depending on the design and location of OSSs. Sound impacts would be greatest during construction and would return to near baseline levels during operations. The use of seal bombs within the coastal environment could be a consistent source of impacts. Overall, impacts could be reduced if construction of all five representative projects were staggered. However, impacts on HAPCs (i.e., hard bottoms, kelp, and seagrass) would likely be permanent.

3.3.5.4.5 Conclusions

Impacts of Alternative B: Impacts would be greatest in lease areas with the greatest concentration of HAPCs, especially if such areas could not be avoided. Invasive species impacts are expected to be rare but, if introduced, could affect sensitive species. Other relevant IPFs include accidental releases, anchoring, discharges/intakes, EMFs and cable heat, gear utilization, noise, and presence of structures. Beneficial impacts could be expected for some species that could colonize newly added hard surfaces (WTGs, OSSs, cable protection, etc.). The occurrence or severity of impacts could be influenced by the frequency of disturbance, seasonal scheduling of construction activities, and the use of bottom-tending fishing gear.

Cumulative impacts of Alternative B. For the reasons summarized above, construction, O&M, and decommissioning of offshore wind projects would contribute to cumulative impacts on fishes, invertebrates, and EFH in the Affected Environment, though some species would experience beneficial impacts from the added presence of structures.

3.3.5.5 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Fishes, Invertebrates, and Essential Fish Habitat

Alternative C, the Proposed Action, is the prospective adoption of mitigation measures intended to avoid or reduce Alternative B's potential impacts on fishes, invertebrates, and EFH. Accordingly, the analysis considers the change in impacts relative to Alternative B. Appendix E, *Mitigation*, identifies the mitigation measures that would be included in the Proposed Action. Table 3.3.5-5 summarizes relevant mitigation measures.

Table 3.3.5-5. Summary of mitigation measures for fishes, invertebrates, and EFH

Measure ID	Measure Summary
MM-3	Vessels and facilities must have adequate equipment available and be prepared to address entanglements, consistent with current guidelines and local marine stranding centers.
MM-6	This measure requires that where post-construction surveys show significant changes in berm height, the lessee must develop and implement a Berm Remediation Plan to restore created berms to match adjacent natural bathymetric contours (isobaths), as technically and/or economically practical or feasible.
MM-7	This measure requires that, to the extent reasonable and practicable, lessees follow the most current IMO guidelines for the reduction of underwater-radiated noise, including propulsion noise, machinery noise and dynamic positioning systems of any vessel associated with the project.
MM-8	This measure requires NMFS-approved qualified third-party PSOs on vessels during project activities, training for crew members on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. This measure also includes PSO visibility requirements and data-collection requirements.
MM-19	This measure requires lessees to submit an Anchoring Plan that identifies and maps locations of interest including hardbottom, sensitive habitats, potential shipwrecks, potential hazards, and existing and planned infrastructure. The plan will require all vessels deploying anchors to use, whenever feasible and safe, mid-line anchor buoys to reduce the amount of anchor chain or line that touches the seafloor.
MM-20	This measure requires lessees to submit a Sensitive Marine Species Characterization and Monitoring Plan for biological species and habitats in the water column or on the seafloor that may be affected by a project's activities. Species and habitats that are particularly sensitive to impacts will be identified and avoided and will require monitoring, allowing for the identification of adverse effects and evaluation of mitigation efforts. Consolidated seafloor sediments are equivalent to sensitive habitats and species and shall be avoided from direct and indirect impacts unless data exist to demonstrate no harm to sensitive species and habitats.
MM-21	This measure proposes that the lessee must prepare a Scour and Cable Protection Plan that includes descriptions and specifications for all scour and cable protection materials. All materials used for scour and cable protection measures should consist of natural or engineered stone that provides three-dimensional complexity in height and in interstitial spaces, as practicable and feasible. These methods would also ensure that the lessee avoid the use of engineered stone or concrete mattresses in complex habitat, use tapered or sloped edges for trawled areas, use materials that do not inhibit epibenthic growth, avoid use of plastics or recycled polyesters or net material, and submit the plan for review and approval.
MM-27	This measure recommends static cable-design elements, including burial below the seabed where feasible, avoidance of methods that raise the profile of the seabed, and removal of large marine objects and decommissioning instrumentation and/or anchors as soon as practicable and within required regulations and permits. This measure should reduce possible damage to fishing gear. Future mitigations may include gear identification and or lost survey gear monitoring and reporting.
MM-32	This measure encourages lessees to coordinate transmission infrastructure among projects by using, for example, shared intra- and interregional connections, meshed infrastructure, or parallel routing, which may minimize potential impacts from offshore export cables.

Measure ID	Measure Summary
MM-33	This measure requires monitoring of cables periodically after installation to determine cable location, burial depths, and site conditions to determine if burial conditions have changed and whether remedial action or additional mitigation measures are warranted.
MM-34	This measure recommends operators use standard underwater cables that have electrical shielding to control the intensity of EMFs.
MM-36	This measure requires the lessee to develop an Oceanographic Monitoring Plan. Monitoring reports will be used to determine the need for adjustments to the monitoring approach, consideration of new monitoring technologies, and/or changes to the frequency of monitoring. Components of the plan include coordination with relevant regulatory agencies and neighboring lessees; monitoring strategies for all phases of a project; comparisons with available model outputs; technologies; and appropriate physical and biochemical measurements.
MM-37	This measure encourages lessees to incorporate technologies for detecting tagged fish in their projects to monitor the effect of increases in habitat use and residency around WTG foundations and share monitoring results or propose new or additional mitigation measures and/or monitoring methods, if appropriate.
MM-38	This measure requires disengaging dredge pumps when dragheads are not in use for activities requiring the use of a trailing suction hopper dredge offshore to prevent impingement or entrainment of sea turtle species.
MM-40	Lessees are encouraged to coordinate monitoring and survey efforts of long-term scientific surveys (e.g., NMFS surveys) across lease areas to standardize approaches, understand potential impacts on resources at a regional scale, and maximize efficiencies in monitoring and survey efforts.

3.3.5.5.1 Impacts of One Representative Project in Each WEA

Implementation of proposed mitigation measures could reduce impacts relative to Alternative B. MM-19 and MM-20 would be most effective in mitigating and minimizing potential impacts on fishes, invertebrates, and EFH resources by avoidance.

The only IPFs addressed in the following analysis are those where mitigation measures outlined in Appendix E apply to the specific resource. If an individual IPF is not discussed, the impact determinations outlined under Alternative B still apply.

Anchoring: MM-19 and MM-20 would mitigate the impacts associated with placing anchors, equipment, or installation of facilities (e.g., buoys, export cable installation, WTG or OSS installation and interarray cable installation) or decommissioning. MM-19 would require detailed anchoring plans outlining the avoidance of sensitive benthic habitats and require implementation of measures to minimize sediment disturbance resulting in avoidance of impact on the species that rely on the sensitive habitats and a minimization of turbidity impacts on fishes and invertebrates. MM-20 would require lessees to reduce or avoid impacts on important environmental resources such as sensitive habitats and species to the extent feasible. Implementing these measures would likely reduce the impacts on sensitive benthic resources and the associated fish and invertebrate species. Even with mitigation measures, the spatial extent of any anchor impact and anchor chain sweeps could be large and of long duration, but the measures would minimize the potential anchoring impacts on sensitive benthic habitats, such as HAPCs.

Impacts would still vary depending on the lease area and corresponding extent of sensitive habitat present. The severity of impacts on sensitive benthic habitats would be reduced at OCS-P 0562, OCS-P 0563, and OCS-P 0564, depending on the efficacy of avoidance.

Cable installation and maintenance: Potential impacts on fishes, invertebrates, and EFH from cable installation and maintenance would likely decrease under Alternative C. MM-19 and MM-20 would mitigate the potential for affecting sensitive habitats, which would require the focused assessment and avoidance of the sensitive habitat within the export cable corridors and anchors. MM-21 would require a Scour and Cable Protection Plan to include descriptions of materials to be used for cable protection and that such materials reflect pre-existing conditions as much as possible. MM-38 would reduce impacts on fish and invertebrates through disengaging dredge pumps when not active.

MM-6 proposes that any bathymetric significant changes in berm height after the post-installation survey would be restored as technically and/or economically practical or feasible. The lessee must develop and implement a Berm Remediation Plan to restore created berms to match adjacent natural bathymetric contours. MM-33 would require the lessee to conduct post-installation cable monitoring of array and export cables in set intervals after commissioning, as well as within 180 days of a storm event to ensure proper burial depth and cable integrity. The adoption of mitigation measures analyzed above would reduce the occurrence/severity of impacts in certain areas.

EMFs and cable heat: MM-27 would require all static cables be buried below the seabed where technically feasible and avoid installation techniques that raise the profile of the seabed to a minimum of 3 feet (0.9 meter) below the seabed where feasible. Such burial, along with cable insulation and sheathing, would reduce EMFs. MM-33 would require periodic cable inspection to ensure proper cable burial depth and integrity. Unburied export cables may inadvertently subject organisms to higher EMFs or cause avoidance behaviors; MM-33 would minimize these risks. MM-31 would require that lessees use standard underwater cables that have electrical shielding to control the intensity of EMFs, which may reduce impacts from floating array cables. These measures would reduce impacts on bottom-dwelling finfish, motile invertebrates, and pelagic finfish.

Gear utilization and port utilization: Although developed primarily for ESA-listed species, these measures may afford some reduction of impacts on fish, invertebrates, and EFH. Refer to Section 3.3.5.5.3, *Impacts of Alternative C on ESA-Listed Species,* for analysis of these measures.

Noise: MM-7 includes a reduction of underwater-radiated noise to the extent reasonable and practicable, which would reduce impacts from noise on fishes, invertebrates, and EFH. The requirement for PSO and crew monitoring during project activities (MM-8) would indirectly reduce fishes' overall exposure to sound sources.

Presence of structures: MM-36 would require the development of an Oceanographic Monitoring Plan. While monitoring would not directly reduce hydrodynamic effects of wind farms on fishes and invertebrates, the information gathered could be evaluated for efficacy and potentially lead to changes in or additions to existing mitigation measures. MM-37 would incorporate technologies for detecting tagged fishes to monitor the effect of increases in habitat use and residency around WTG foundations potentially leading to the development of new or additional mitigation measures. MM-3 would reduce impacts from entanglement of fish by having vessels and facilities with adequate equipment available and being prepared to address entanglements. These mitigation measures would not directly reduce impacts on sensitive habitats and species.

3.3.5.5.2 Impacts of Five Representative Projects

Five representative projects would cause the same types of impacts as for one representative project in each WEA, but with increased intensity and potential for impacts. However, Alternative C's mitigation measures would scale up accordingly. Moreover, projects would not only be spaced geographically (several hundred miles/kilometers between Humboldt and Morro Bay WEAs), but also temporally. In addition, use of shared transmission infrastructure and parallel routing between adjacent projects, as stated in MM-30, would result in fewer benthic impacts from anchoring, cable installation, EMF and heat, and noise. Mitigation measures would decrease overall benthic habitat disturbance and associated impacts on fishes, invertebrates, and EFH. However, total avoidance of HAPC impacts is not likely as HAPCs are in each WEA.

MM-36 would require the development of an Oceanographic Monitoring Plan; MM-40 encourages lessees to coordinate monitoring and survey efforts across lease areas to standardize approaches, understand potential impacts on resources at a regional scale, and maximize efficiencies in monitoring and survey efforts. While monitoring would not directly reduce impacts on fishes, invertebrates, or EFH, the information gathered could be evaluated for efficacy and potentially lead to changes in or additions to existing mitigation measures.

3.3.5.5.3 Impacts of Alternative C on ESA-Listed Species

Five ESA-listed species may be present in the Affected Environment but impacts on ESA-listed species are most likely to occur in habitats near shore (e.g., estuaries, bays, river mouths) and not in the offshore lease areas. Mitigation measures identified for fishes, invertebrates, and EFH (Table 3.3.5-5) would reduce impacts on ESA-listed species.

Gear utilization: MM-19 (Anchoring Plan) could result in future mitigations that could include gear identification and/or lost survey gear monitoring and reporting to potentially reduce the risk of entanglement. MM-3 would reduce impacts from entanglement of fish (sturgeon) by having vessels and facilities with adequate equipment available and being prepared to address entanglements. While the risk of entanglement would be functionally lower, mortality and injury cannot be eliminated without full evaluation of individual survey plans.

Port utilization: MM-8 would require vessel crew training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements; PSO monitoring and reporting protected species; PSO visual coverage requirements during use of noise-producing equipment and vessel transiting; PSO low-visibility monitoring requirements; and PSO data-collection requirements. While vessel strikes are not identified as a threat to green sturgeon in their recovery plan (NMFS 2023b), increased vessel traffic would elevate the risk of a vessel strike injuring or killing green sturgeon. This mitigation measure would provide additional protection for Chinook salmon, coho salmon, steelhead trout, and Pacific smelt, especially near rivers and estuaries.

Shared infrastructure (MM-32) and monitoring of areas surrounding project components and activities (MM-20, MM-8, MM-37, and MM-40) could reduce impacts on ESA-listed species occupying and migrating between estuaries, bays, and rivers in the Affected Environment. The described mitigation measures could reduce impacts and risk of injury, mortality, and habitat disturbance while increasing knowledge of the presence of ESA-listed species in the Affected Environment.

3.3.5.5.4 Cumulative Impacts of Alternative C

Cumulatively, Alternative C would likely have impacts due to HAPCs being in all five lease areas; however, mitigation measures would be adopted that would reduce the impacts on benthic habitat, sensitive habitats, ESA-listed species, and EFH. There would be a beneficial impact due to the added new structures resulting in FAD and artificial reef effects. Designation of the Chumash Heritage National Marine Sanctuary would also provide benefits to fishes, invertebrates, and EFH.

3.3.5.5.5 Conclusions

Impacts of Alternative C. Mitigation measures would avoid or reduce the severity of impacts on fishes, invertebrates, and EFH across most IPFs. Mitigation would not affect anticipated beneficial impacts associated with newly added hard surfaces.

Cumulative Impacts of Alternative C. Alternative C's incremental contributions to cumulative impacts on fishes, invertebrates, and EFH (particularly HAPCs) would be reduced but would remain noticeable. Beneficial impacts would still be anticipated from the designation of the Chumash Heritage National Marine Sanctuary and the addition of hard surfaces.

3.3 Biological Resources

3.3.6 Marine Mammals

This section discusses potential marine mammal impacts from the Proposed Action, alternatives, and ongoing and planned activities in the Affected Environment (Figure 3.3.6-1). Marine mammals occurring within the California lease areas and future export cable corridors have large geographic ranges, including the CCLME and regions that migratory marine mammal species frequent on a seasonal basis (i.e., Gulf of Alaska Large Marine Ecosystem [LME], Gulf of California LME). However, this analysis focuses on the marine mammals that are likely to occur in California coastal and OCS waters, including the five California lease areas and surrounding areas where impacts are most likely to occur (such as sea-to-shore connections and vessel transit routes).

3.3.6.1 Description of the Affected Environment and Baseline Conditions

Thirty-two marine mammal species are known to occur or could occur in California coastal and OCS waters (Table 3.3.6-1). This includes 8 mysticete whales (baleen whales), 17 odontocete whales and dolphins (toothed whales, dolphins, and porpoises), 6 pinnipeds (i.e., sea lions, seals), and 1 fissiped (sea otter) species.

Marine mammals use the Affected Environment for migrating, foraging, resting, reproduction, and rearing young. Some species are highly migratory, traveling long distances between foraging and calving areas, whereas others do not undergo any migration. Species occurrence patterns are not uniform because some species are pelagic and occur farther offshore, some are coastal and are found nearshore, while others occur in both near and offshore areas.

Prey abundance and availability generally determine seasonal migration and local movement patterns; these factors are themselves dependent on oceanographic properties and processes. Therefore, prey-related impacts must also be considered when assessing impacts on marine mammals. Refer to Section 3.3.5, *Fishes, Invertebrates, and Essential Fish Habitat*.

Figure 3.3.6-1. Marine mammals Affected Environment

Table 3.3.6-1. Marine mammal species and NMFS and USFWS management stocks that may occur in the Affected Environment

Common Name	Scientific Name	MMPA Stock	Listing Status[1]	Best Population (Abundance) Estimate (Nest)[2]	Population Trend[3]	Potential Biological Removal (PBR) Level[4]	Total Annual Human- Caused Mortality or Serious Injury[5]	Critical Habitat in Affected Environment	Humboldt WEA		Morro Bay WEA	
			ESA/MMPA						Relative Occurrence[6]	Seasonality[7]	Relative Occurrence[6]	Seasonality[7]
Mysticetes												
Blue whale	*Balaenoptera musculus*	ENP	E/D	1,898	Unknown	4.1	18.6	No	Uncommon	Summer, fall	Regular	Summer, fall
Bryde's whale	*Balaenoptera edeni*	Eastern Tropical Pacific	None/N	Unknown	Unknown	Unknown	N/A	No	Rare	--	Rare	--
Fin whale	*Balaenoptera physalus*	California/Oregon/ Washington	E/D	11,065	7.5% Increase	80	43.4	No	Regular	Year-round	Regular	Year-round
Gray whale	*Eschrichtius robustus*	ENP	None/N	26,960	Increasing	801	131	No	Regular	Winter, spring	Regular	Winter, spring
	Eschrichtius robustus	WNP	E/D	290	Increasing	0.12	Unknown	No	Rare	--	Rare	--
Humpback whale	*Megaptera novaeangliae*	Central American/Southern Mexico – California-Oregon-Washington	E/D	1,496	1.6% Increase	3.5	14.9	Yes	Regular	Summer, fall	Regular	Summer, fall
	Megaptera novaeangliae	Mainland Mexico – California-Oregon-Washington	T/D	3,477	8.2% Increase	43	22	Yes	Regular	Summer/fall	Regular	Summer/fall
Minke whale	*Balaenoptera acutorostrata*	California/Oregon/ Washington	None/N	915	No apparent trend	4.1	0.19	No	Regular	Year-round	Regular	Year-round
North Pacific right whale	*Eubalaena japonica*	ENP	E/D	31[8]	Unknown	0.05	N/A	Yes	Rare	--	Rare	--
Sei whale	*Balaenoptera borealis*	ENP	E/D	864	Unknown	1.25	0	No	Rare	--	Rare	--
Odontocetes												
Baird's beaked whale	*Berardius bairdii*	California/Oregon/ Washington	None/D	1,363	Stable-growing	8.9	0.2	No	Regular	Summer, fall	Regular	Summer, fall
Bottlenose dolphin	*Tursiops truncatus*	California Coastal	None/N	453	Stable-growing	2.7	2	No	None (range limit)	--	Common	Year-round
		California/Oregon/ Washington Offshore	None/N	3,477	No apparent trend	19.7	0.82	No	Uncommon	Winter, spring	Regular	Winter, spring
Common dolphin, long-beaked	*Delphinus delphis bairdii*	California	None/N	83,379	Increasing	668	29.7	No	Rare	--	Regular	Year-round
Common dolphin, short-beaked	*Delphinus delphis delphis*	California/Oregon/ Washington	None/N	1,056,308	Increasing	8,889	30.5	No	Rare	--	Common	Year-round
Cuvier's beaked whale	*Ziphius cavirostris*	California/Oregon/ Washington	None/N	5,454	3% Increase	42	0.1	No	Uncommon	Year-round	Uncommon	Year-round

Common Name	Scientific Name	MMPA Stock	Listing Status[1]	Best Population (Abundance) Estimate (Nest)[2]	Population Trend[3]	Potential Biological Removal (PBR) Level[4]	Total Annual Human- Caused Mortality or Serious Injury[5]	Critical Habitat in Affected Environment	Humboldt WEA		Morro Bay WEA	
			ESA/MMPA						Relative Occurrence[6]	Seasonality[7]	Relative Occurrence[6]	Seasonality[7]
Dall's porpoise	*Phocoenoides dalli dalli*	California/Oregon/ Washington	None/N	16,498	Stable	99	0.66	No	Regular	Winter	Regular	Winter
Dwarf sperm whale	*Kogia sima*	California/Oregon/ Washington	None/N	Unknown	Unknown	Unknown	0	No	Rare	--	Rare	--
Harbor porpoise	*Phocoena phocoena*	Morro Bay	None/N	4,191	Increasing	65	0	No	None (range limit)	--	Common	Year-round
		Monterey Bay	None/N	3,760	Decreasing	35	0.2	No	None (range limit)	--	Common	Year-round
		San Francisco-Russian River	None/N	7,777	Decreasing	73	0.4	No	Uncommon	Year-round	None (range limit)	--
		Northern California/Southern Oregon	None/N	15,303	Stable	306	0	No	Common	Year-round	None (range limit)	--
Killer whale	*Orcinus orca*	ENPOffshore	None/N	300	Stable	2.8	0	No	Regular	Year-round	Regular	Year-round
		ENPSouthern Resident	E/D	73	1% Decline	0.13	0	Yes	Rare	--	None (range limit)	--
Killer whale	*Orcinus Orca*	West Coast Transient	None/N	349	Unknown	3.5	0.4	No	Regular	Year-round	Regular	Year-round
Mesoplodon beaked whales[9]	*Mesoplodon* spp.	California/Oregon/ Washington	None/N	3,044	Unknown	20	0.1	No	Uncommon	Year-round	Uncommon	Year-round
Northern right whale dolphin	*Lissodelphis borealis*	California/Oregon/ Washington	None/N	29,285	Unknown	163	6.6	No	Regular	Winter	Regular	Winter
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	California/Oregon/ Washington, Northern and Southern	None/N	34,999	Unknown	279	7	No	Regular	Winter	Regular	Winter
Pygmy sperm whale	*Kogia breviceps*	California/Oregon/ Washington	None/N	4,111	Unknown	19.2	0	No	Rare	--	Rare	--
Risso's dolphin	*Grampus griseus*	California/Oregon/ Washington	None/N	6,336	Unknown	46	3.7	No	Regular	Winter	Regular	Winter
Short-finned pilot whale	*Globicephala macrorhynchus*	California/Oregon/ Washington	None/N	836	Unknown	4.5	1.2	No	Rare	--	Rare	--
Sperm whale	*Physeter macrocephalus*	California/Oregon/ Washington	E/D	2,606	Unknown	4.0	0.52	No	Regular	Apr–Jun; Aug–Nov	Regular	Apr–Jun; Aug–Nov
Striped dolphin	*Stenella coeruleoalba*	California/Oregon/ Washington	None/N	29,988	Unknown	225	4	No	Regular	Unknown	Regular	Unknown
Pinnipeds												
California sea lion	*Zalophus californianus*	United States	None/N	257,606	Increasing	14,001	321	No	Uncommon	Non-breeding	Common	Year-round
Guadalupe fur seal	*Arctocephalus townsendi*	Mexico	T/D	34,187	5.9% Increasing	1,602	3.8	No	Rare	--	Uncommon	Year-round

Common Name	Scientific Name	MMPA Stock	Listing Status[1]	Best Population (Abundance) Estimate (Nest)[2]	Population Trend[3]	Potential Biological Removal (PBR) Level[4]	Total Annual Human- Caused Mortality or Serious Injury[5]	Critical Habitat in Affected Environment	Humboldt WEA		Morro Bay WEA	
			ESA/MMPA						Relative Occurrence[6]	Seasonality[7]	Relative Occurrence[6]	Seasonality[7]
Harbor seal	*Phoca vitulina richardsii*	California	None/N	30,968	Decreasing	1,641	43	No	Common	Year-round	Common	Year-round
Northern elephant seal	*Mirounga angustirostris*	California Breeding	None/N	187,386	3.1% Increasing	5,122	13.7	No	Regular	Summer (molt); Winter (breeding)	Regular	Summer (molt); Winter (breeding)
Northern fur seal	*Callorhinus ursinus*	California	None/N	14,050	Increasing	451	1.8	No	Regular	Unknown	Regular	Unknown
Steller sea lion	*Eumetopias jubatus*	Eastern	None/N	77,149[10]	Increasing	2,178	93.2	No	Regular	Non-breeding	Rare	--
		Western	E/D	52,932[10]	Increasing	299	267	Yes	Rare	Non-breeding	Rare	--
Fissipeds												
Southern sea otter	*Enhydra lutris nereis*	California	T/D	2,962[11]	0.12% Increasing[11]	12	1	No	None (range limit)	--	Regular	Year-round

D = depleted (strategic); E = endangered; ENP = Eastern North Pacific; ESA = Endangered Species Act; MMPA = Marine Mammal Protection Act; N = non-strategic; N/A = not applicable; T = threatened; WNP = Western North Pacific.

[1] Denotes the highest federal regulatory classification (16 USC 1531 et seq. and 16 USC 1361 et seq.). A strategic stock is defined as any marine mammal stock:

a. For which the level of direct human-caused mortality exceeds the PBR level;
b. That is declining and likely to be listed as threatened under the ESA; or
c. That is listed as threatened or endangered under the ESA or as depleted under the MMPA.

[2] Unless otherwise noted, best available population (abundance) estimates (Nest) are from the most recent NMFS or U.S. Fish and Wildlife Service (USFWS, in the case of the southern sea otter) stock assessment reports available for each species (Carretta et al. 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024; USFWS 2021; Young et al. 2024).

[3] Increasing = beneficial trend, not quantified; Decreasing = adverse trend, not quantified; Unknown = there are insufficient data to determine a statistically significant population trend (Carretta et al. 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024; USFWS 2021; Young et al. 2024).

[4] The PBR level is defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population.

[5] The total annual estimated average human-caused mortality and serious injury (M/SI), if known, is the sum of detected mortalities/serious injuries resulting from incidental fisheries interactions and vessel collisions within the U.S. Exclusive Economic Zone (EEZ). The value (number of individuals per year) represents a minimum estimate of human-caused mortality/serious injury only (Carretta et al. 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023; USFWS 2021).

[6] Relative occurrence is defined as:

Common: occurring consistently in moderate to large numbers.
Regular: occurring in low to moderate numbers on a regular basis or seasonally.
Uncommon: occurring in low numbers or on an irregular basis.
Rare: limited records exist for some years.

[7] Seasonal occurrence, when available, was derived from abundance estimates using density models (Roberts et al. 2016, 2023) and NMFS/USFWS Stock Assessment Reports (Carretta et al. 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023; USFWS 2021). Seasons are depicted as follows: spring (March–May); summer (June–August); fall (September–November); winter (December–February).

[8] The most recent population estimate for the North Pacific right whale is more than 12 years old. As per NMFS' 2016 guidelines for preparing stock assessment reports, abundance estimates greater than 8 years old should be considered unknown. However, considering the extremely low abundance for this stock and low calf production, Young et al. (2024) determined that the current population size is not likely to be significantly different than this estimate presented.

[9] Estimated abundance is for *Mesoplodon* spp. (Blainville's beaked whale [*M. densirostris*], Perrin's beaked whale [*M. perrini*], Lesser beaked whale [*M. peruvianus*], Stejneger's beaked whale [*M. stejnegeri*], Gingko-toothed beaked whale [*M. gingkodens*], and Hubbs' beaked whale [*M. carlhubbsi*]) (Carretta et al. 2018).

[10] The best abundance estimates for the eastern and western stocks of Steller sea lion are a combination of pup count and non-pup count estimates from the most recent stock assessment reports (Carretta et al. 2020, 2022).

[11] Because southern sea otters are under jurisdiction of USFWS and not NMFS, the minimum abundance estimate and range-wide population trend are derived from USFWS (2021). However, Hatfield et al. (2019) reveal localized positive and negative 5-year population trends throughout the southern sea otter's geographic range.

The CCLME is the best descriptor of baseline oceanographic conditions that influence marine mammal distribution and use of the Affected Environment. The CCLME extends from Baja California, Mexico, to British Columbia, Canada. While the CCLME is an integrated ecosystem, it can be categorized as three subregions: the northern CCLME that encompasses the Humboldt lease areas, the central CCLME that encompasses the Morro Bay lease areas, and the southern CCLME that encompasses the ports of Los Angeles and Long Beach. Unique conditions in each subregion result in differences in temperature, nutrient influx, and primary productivity, which drive marine mammal habitat use and distribution in the larger CCLME. Other factors influencing marine mammal distribution, habitat, and population fitness are ongoing climate change, port activities, and fisheries (Marine Insight 2023; Berman-Kowalewski et al. 2010; Rockwood et al. 2017, 2018, 2021; Keen et al. 2019; Redfern et al. 2020).

As listed in Table 3.3.6-1, this Draft PEIS assesses 32 species comprising 41 stocks of marine mammals[1] that may occur in California coastal and OCS waters and thus could be affected by wind energy development (Carretta et al. 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023; USFWS 2021). Rare marine mammal species will reliably fall into the general assessment categories of mysticete, odontocete, and pinnipeds; low-, med-, high-frequency cetaceans and pinniped hearing groups; and/or ESA-listed versus non-ESA-listed marine mammal groups. Therefore, while effects would differ somewhat by species and even by individual, it is reasonable to assume that rare species in any of those categories would incur the same impact level as the groups with which they are being associated.

3.3.6.1.1 Threatened and Endangered Marine Mammals

The ESA (16 USC 1531 et seq.) provides for the listing of species as threatened or endangered based on criteria that include loss of range or habitat, overutilization, disease or predation, inadequacy of regulatory mechanisms, and other natural or anthropogenic factors that affect a species' continued existence.

Ten marine mammal species comprising 11 stocks or DPSs, that are known to potentially occur in the Affected Environment are currently classified as endangered or threatened.

Endangered:

- Blue whale (*Balaenoptera musculus*)
- Fin whale (*Balaenoptera physalus*)
- Gray whale (*Eschrichtius robustus)* – Western North Pacific (WNP) stock
- Humpback whale (*Megaptera novaeangliae*) – Central America DPS

[1] Although beaked whales are rarely sighted in the region, advances in acoustic monitoring (e.g., using echolocation pulse features) have improved the ability to detect and identify some of these species (McDonald et al. 2009; Zimmer et al. 2008). Recent studies have detected some beaked whale species in and around the California WEAs (Simonis et al. 2020); however, due to limited identification information, beaked whales are considered and assessed as a beaked whale species complex comprising the California/Oregon/Washington stocks of Baird's beaked whale, Cuvier's beaked whale, and Mesoplodon species of beaked whales.

- Killer whale (*Orcinus orca*) – Eastern North Pacific (ENP) Southern Resident stock
- North Pacific right whale (*Eubalaena japonica)*
- Sei whale (*Balaenoptera borealis*)
- Sperm whale (*Physeter macrocephalus*)

Threatened:

- Guadalupe fur seal (*Arctocephalus townsendi*)
- Humpback whale (*Megaptera novaeangliae*) – Mexico DPS
- Southern sea otter (*Enhydra lutris nereis*)

Blue whales migrate to the California coast in spring due to high prey (krill) availability. While their distribution is uneven (Calambokidis et al. 2015), they tend to be prevalent between southern and central California during summer and early fall, including within major shipping lanes off Los Angeles and San Francisco. By winter, most migrate to far distant breeding grounds, but some stay year-round. Persistent high densities of blue whales are found at several Southern California hot spots (Bailey et al. 2009). These high-density areas largely overlap with feeding areas, with nine such biologically important areas (BIAs) identified along the California coast (Calambokidis et al. 2015, 2024).

Fin whales are found year-round off the entire coast of California with some seasonal shifts in habitat use. Although wider migration between summer foraging and winter breeding grounds may occur, these movements are not as pronounced as they are for other baleen whale species (Carretta et al. 2023; Falcone et al. 2022). Residency patterns, particularly in the southern CCLME, are linked to complex bathymetric features that increase prey abundance (Scales et al. 2017; Carretta et al. 2023). Given their preference for nearshore areas, fin whale habitat in the southern CCLME overlaps with areas of high human use. Fin whale abundance increases over shelf waters in the northern and central CCLME in summer; the species is regularly found farther offshore than blue or humpback whales (Falcone et al. 2022; Derville et al. 2022).

Gray whales are distributed along the eastern and western margins of the North Pacific Ocean. They have extensive migrations between their Arctic feeding grounds and their warmer water breeding and calving grounds. This species tends to be more associated with coastal waters compared to other large whale species. Genetic studies have suggested differentiation between two populations: the WNP population and the ENP population (Carretta et al. 2023). WNP gray whales primarily inhabit waters off the coast of Asia, particularly near Russia. ENP gray whales summer in the Chukchi, Beaufort, and northwestern Bering Seas. Once thought to be geographically isolated, studies have confirmed that individuals from the WNP gray whales migrate into eastern waters, including coastal areas of Canada, the United States, and Mexico (Weller et al. 2012; Mate et al. 2015).

Humpback whales typically spend late spring through fall feeding in cooler upwelled waters of the California Current that supports an abundance of krill and small schooling fish. Humpbacks are common during this period between Monterey Bay and the Cordell Bank National Marine Sanctuary, although they can be more widespread depending on food sources (Carretta et al. 2023). During late fall and early winter, humpbacks typically migrate towards Mexico and Central America; however, they can still be sighted and acoustically detected offshore California during the winter (Carretta et al. 2023). Seven feeding BIAs are identified for humpback whales along the West Coast, five off California (Calambokidis et al. 2015; Harrison et al. 2023).

The killer whale is found worldwide in all major oceans. In the Pacific, three recognized ecotypes exist: “resident,” “Bigg’s” (formerly referred to as “transient”), and “offshore,” distinguished by characteristics such as morphology, behavior, and genetics. Killer whales found in the Affected Environment belong to the ENP Southern Resident stock, ENP Offshore stock, and West Coast Transient stock.

The North Pacific right whale, once widely distributed in the North Pacific, is now one of the most endangered whale species globally. This species experienced a significant decline in population due to whaling and was almost driven to extinction. There have been individual sightings of North Pacific right whale off the coast of California in recent years. In 2022, one individual was sighted off Año Nuevo Island; in 2023, another was sighted near Monterey Bay (Muto et al. 2021).

Sei whales are typically distributed in deep waters on the shelf edge, though they may enter shallower OCS waters, depending on ocean patterns and prey availability (Hain et al. 1985; Hayes et al. 2022). Sei whales are considered rare off the California coast (Carretta et al. 2024).

Sperm whales occur year-round off California, primarily in deep waters, with highest abundances from April through mid-June and from the end of August through mid-November (Carretta et al. 2023).

The southern sea otter, the Affected Environment’s only marine fissiped, is a resident of coastal and nearshore habitats from central to Southern California, including coastal islands (USFWS 2021). Its diet consists of more than 70 species of benthic invertebrates that are captured during shallow dives. Breeding (and subsequent pupping) occurs year-round, with peak breeding season occurring from May to June (USFWS 2021).

The Guadalupe fur seal population is centered on Guadalupe Island, a volcanic island west of Baja California. Sightings and haul outs are documented from Mexico to Canada (McCue et al. 2021). Distribution in California waters extend as far north as the Farrallon Islands. Between 2015 and 2021, an unusual mortality event for Guadalupe and northern fur seals was declared when 715 Guadalupe fur seals were stranded in California, Oregon, and Washington. The mortality was attributed to malnutrition resulting from warm oceanographic conditions produced by the “warm water blob” (Di Lorenzo and Mantua 2016), El Niño, and several ocean heatwaves (NMFS 2022a).

The Affected Environment includes designated critical habitat for several ESA-listed species. Humpback whale critical habitat runs along the entire coast of California. The Southern Resident killer whale stock also has designated critical habitat along the coast to Point Sur.[2] There is critical habitat for Steller sea

[2] Members of this Southern Resident stock of killer whales are rare outside of the nearshore and inshore waters of the Salish Sea; due to recent information about movements of this stock, the critical habitat was expanded to

lion rookeries off San Francisco and Humboldt; however, Steller sea lions expected in California waters are from the Eastern DPS, which is no longer listed as endangered or threatened. NOAA Fisheries is currently reviewing existing Steller sea lion critical habitat to consider any new and pertinent sources of information since the 1993 designation, including the delisting of the Eastern DPS.

3.3.6.1.2 Non-Endangered Marine Mammals

Marine mammals are protected and managed under the MMPA (16 USC 1361 et seq.), which is implemented by NOAA for all marine mammals that occur within the Affected Environment. The sole exception is the southern sea otter, which USFWS manages.

Mysticete whale species that are not endangered or threatened and occur in California coastal and OCS waters include the ENP stock of gray whale (*Eschrichtius robustus*) (including the Pacific Coast feeding group) and minke whale (*Balaenoptera acutorostrata*). One of the six feeding area BIAs identified for gray whales is in California (off Point St. George), where feeding primarily occurs between June and November (Calambokidis et al. 2015; Harrison et al. 2023). The remaining feeding BIAs are off Oregon and Washington. There are three migration BIAs identified for the gray whale that correspond to seasonal, directional migration phases. Although the migration corridor is primarily within 6.2 miles (10 kilometers) from shore, the BIA buffer extends out to 29 miles (47 kilometers) along the entire California coast (Calambokidis et al. 2015). No BIAs have been identified for minke whales.

The following odontocete whales and dolphin species and their associated stocks may occur in California coastal and OCS waters: beaked whale species, common bottlenose dolphin (*Tursiops truncatus*), long- and short-beaked common dolphin (*Delphinus delphis*), Dall's porpoise (*Phocoenoides dalli dalli*), harbor porpoise (*Phocoena phocoena*), killer whale – ENP Offshore stock (*Orcinus orca*), Northern right-whale dolphin (*Lissodelphis borealis*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Risso's dolphin (*Grampus griseus*), and striped dolphin (*Stenella coeruleoalba*).

The following pinniped species are not endangered or threatened and are expected to occur in California coastal and OCS waters: California sea lion (*Zalophus californianus*), harbor seal (*Phoca vitulina richardsii*), northern elephant seal (*Mirounga angustirostris*), northern fur seal (*Callorhinus ursinus*), and the Eastern U.S. stock of Steller sea lion (*Eumetopias jubatus*).

3.3.6.1.3 The Importance of Sound to Marine Mammals

Marine mammals rely heavily on acoustic cues for extracting information from their environment. Sound travels faster and farther in water (~1500 m/s) than it does in air (~350 m/s), making this a reliable mode of information transfer across large distances and in dark environments where visual cues are limited. Acoustic communication is used in a variety of contexts, such as attracting mates, communicating to young, or conveying other relevant information (Bradbury and Vehrencamp 2011). Marine mammals can also glean information about their environment by listening to acoustic cues, like

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include coastal waters from 20 to 656 feet (6 to 200 meters) outside of their primary distribution area. Southern Resident killer whales are still expected to be rare in the California WEAs and surrounding waters.

ambient sounds from a reef, the sound of an approaching storm, or a call from a nearby predator. Marine mammal hearing sensitivity and subsequent risk of underwater noise impacts varies based on species hearing anatomy, so marine mammals are grouped into five different hearing groups to better account for susceptibility to noise effects. Appendix H, *Background on Underwater Sound*, provides an in-depth discussion of the importance of sound to marine mammals, hearing anatomy, and thresholds for non-auditory injury, auditory injury, and behavioral disturbance.

3.3.6.2 Impact Background for Marine Mammals

Accidental releases, anchoring, cable installation and maintenance, discharges/intakes, EMFs and cable heat, gear utilization, invasive species, lighting, noise, port utilization, presence of structures, and traffic are contributing IPFs to impacts on marine mammals. Table 3.3.6-2 further identifies specific issues and indicators relevant to assessing impacts on marine mammals. Not every IPF necessarily contributes to the issues identified in Table 3.3.6-2. Refer to Section 3.1, *Impact Analysis Terms and Definitions*, for descriptions of beneficial impacts.

Table 3.3.6-2. Issues and indicators to assess impacts on marine mammals

Issue	Impact Indicator
Seabed and water column alteration	The impacts on individual marine mammals and their habitat, if any, would be at the lowest levels of detection and barely measurable, with no perceptible consequences to individuals or the population.
Long-term habitat alteration and hydrodynamic effects	Impacts on individual marine mammals and their habitat would be detectable and measurable; however, they would be of low intensity, short term, and localized. Impacts on individuals and their habitat would not lead to population-level effects.
Underwater noise from construction, operations, and decommissioning	Impacts on individual marine mammals and their habitat would be detectable and measurable; they would be of medium intensity, can be short term or long term, and can be localized or extensive. Impacts on individuals and their habitat could have population-level effects, but the population can sufficiently recover from the impacts or enough habitat remains functional to maintain the viability of the species both locally and throughout their range.
Vessel collision	Impacts on individual marine mammals and their habitat would be detectable and measurable; they would be of severe intensity, can be long lasting or permanent, and would be extensive. Impacts on individuals and their habitat would have severe population-level effects and compromise the viability of the species.
Water quality impacts	Quantitative estimate of intensity and duration of suspended sediment effects. Qualitative analysis of impacts from potential discharges (fuel spills, trash, and debris) relative to baseline.
Artificial light	Intensity, frequency, and duration of impacts relative to baseline conditions.
Power transmission	Theoretical extent of detectable EMF effects.
Prey impacts	Impacts on individual marine mammals and their prey would be detectable and measurable; however, they would be of low intensity, short term, and localized. Impacts on individuals and their habitat would not lead to population-level effects.
Entanglement risk from gear/wind equipment to the list of issues	Impacts on individual marine mammals would be detectable and measurable; they would be of medium intensity, can be short term or long term, and can be localized or extensive. Impacts on individuals would not lead to population-level effects.

Issue	Impact Indicator
Invasive Species	Qualitative estimate of sources of invasive species, introduced habitat, and propagation or expansion of invasive species.

3.3.6.3 Impacts of Alternative A – No Action – Marine Mammals

When analyzing the impacts of Alternative A, No Action Alternative on marine mammals, BOEM considered the impacts of ongoing activities on the baseline conditions for marine mammals.

The cumulative impacts of Alternative A, No Action Alternative consider the impacts on existing baseline trends, including other planned activities, which are described in Appendix C, *Planned Activities Scenario*.

3.3.6.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for marine mammals described in Section 3.3.6.1, *Description of the Affected Environment and Baseline Conditions*, would continue to follow regional trends and respond to project-related IPFs introduced by ongoing activities. Current resource conditions, trends, and impacts from ongoing activities under the No Action Alternative serve as the baseline against which the direct and indirect impacts of all action alternatives are evaluated.

Ongoing activities within the Affected Environment that contribute to impacts on marine mammals include undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; dredging and port improvement projects; marine minerals use and ocean dredged material disposal; military use; marine transportation; scientific research; fisheries use, management, and monitoring surveys; oil and gas activities; onshore development activities; and global climate change. These activities are relevant to the following IPFs.

- Accidental releases, which can have physiological effects on marine mammals.
- Anchoring, which can disturb benthic habitats and affect water quality.
- Discharges/intakes, which can result in prey entrainment (e.g., the Diablo Canyon Power Plant once-through cooling system).
- EMFs, which can result in behavioral changes in marine mammals.
- Cable installation/maintenance and port utilization, which can disturb benthic habitats and affect water quality.
- Gear utilization, which can result in an increased entanglement risk.
- Introduction of invasive species, which can result in changes in prey availability.
- Land disturbance, which can result in habitat degradation.
- Lighting, which can affect aggregations of prey.
- Noise, which can have physiological and behavioral effects on marine mammals.

- Presence of structures (including the mooring structures), which can result in behavioral changes in marine mammals and effects on prey availability.
- Traffic from vessels, which can result in behavioral changes in marine mammals and increased risk of collisions with vessels.

The IPFs can affect individuals over broad geographic and temporal scales, with effects on individuals ranging from sublethal to lethal. The main known anthropogenic contributors to mortality for marine mammals are collisions with vessels (ship strikes) and entanglement with fishing gear, including fisheries bycatch.

Global climate change is an ongoing risk for marine mammal species through increasing temperatures and ocean acidity, changes to ocean circulation patterns, sea levels, and precipitation patterns; more frequent and more intense storms, and more freshwater runoff, erosion, and sediment deposition. These have the potential to reduce long-term foraging and reproductive success, increase individual mortality and disease occurrence, and affect the distribution and abundance of prey resources (Love et al. 2013; Santora et al. 2020; Gulland et al. 2022; USEPA 2022; NASA 2023).

The CCLME's seasonal upwelling (Section 3.3.2, *Benthic Resources*) is influenced by wind and current changes, affecting species distribution and health. Climate change impacts ocean conditions, affecting the CCLME's biological components. For instance, a 2013–2014 warm water anomaly off California, "The Blob,", caused low chlorophyl levels and range shifts in several marine species (Bond et al. 2015; Di Lorenzo and Mantua 2016). Concurrently, Cassin's auklet experienced high starvation mortality, and several unusual mortality events were reported for Alaska and British Columbia large whales, California sea lions, and Guadalupe/Northern fur seals (NMFS 2023a). In 2019, a West Coast gray whale unusual mortality event was declared due to emaciation, with the species' abundance continuing to decline (NMFS 2023b). This decline is linked to prey distribution shifts due to climate change–induced ocean conditions in the whales' summer feeding grounds (Moore et al. 2022).

In June 2024, NOAA announced the final rule granting the Makah Tribe a waiver from the take prohibitions in the MMPA. Under this final rule, the existing quota established by the International Whaling Commission in 1997 for ENP gray whale hunting remains unchanged. The rule allows the Makah Tribe to utilize their quota with a limit of 2 to 3 whales annually in U.S. waters (maximum of 25 individuals within a 10-year period) (NOAA Fisheries 2024b).

Climate change–induced storm severity or frequency increases can elevate energetic costs on marine mammals, especially for young life stages, reducing fitness (Evans and Bjørge 2013; Wingfield 2013). Warming-related habitat/ecology changes have prompted northward shifts in some prey species, with some marine mammals adjusting their behavior and distribution (Carretta et al. 2015-2023). Such climate change-induced distribution changes can have enduring biological and economic impacts (Brodie et al. 2022; Liu et al. 2023). Brodie et al. (2022) showed a loss of migratory and coastal pelagic species biomass in Southern California, an increase in Northern California, and groundfish losses along California's entire coastline due to climate-driven oceanographic changes. Liu et al. (2023) predicted a likely shift to deeper waters and biomass decrease in some commercially important fish species along the West Coast. These shifts, though shown for commercial fish, indicate a fundamental food chain change affecting marine mammals.

Altered ocean conditions may increase marine mammals' exposure to injury or mortality sources, including entanglement risk (Santora et al. 2020; Ingman et al. 2021), vessel strikes, and disease frequency (Burek et al. 2008; Burge et al. 2014). Ocean acidification could negatively impact zooplankton and other prey (PMEL 2020). Climate change and coastal development could modify habitats over time, making some areas unsuitable for certain species and their prey, and others more suitable. These factors, individually and combined, can affect survivorship and fecundity across broad geographical and temporal scales. They could lead to increased energetic costs from altered migration routes, reduced suitable breeding and foraging habitats, decreased fitness, and increased exposure to anthropogenic injury or mortality sources. Thus, global climate change could have long-term, substantial consequences on marine mammals.

3.3.6.3.2 Impacts of Alternative A – No Action on ESA-Listed Species

Three ESA-listed marine mammal species are expected to occur regularly in the Humboldt WEA: fin whale, humpback whale, and sperm whale; five ESA-listed marine mammal species are expected to occur regularly in the Morro Bay WEA: blue whale, fin whale, humpback whale, sperm whale, and southern sea otter.

Alternative A impacts would be the same for ESA-listed and non-ESA-listed mysticetes, odontocetes, pinnipeds, and fissipeds. Impacts that have the potential for mortality would disproportionately affect ESA-listed species due to their smaller, less resilient population sizes; however, the disproportionate effects would not be sufficient to result in impacts that are significantly greater than impacts on non-ESA species. None of the impacts on ESA-listed species are expected to result in unrecoverable population changes.

3.3.6.3.3 Cumulative Impacts of the No Action Alternative

Planned activities that may affect marine mammals include new submarine cables and pipelines, tidal energy projects, oil and gas activities, dredging and port improvement, marine minerals extraction, military use (i.e., sonar, munitions training), marine transportation, research initiatives, and new structures (such as artificial reefs) on the U.S. Continental Shelf.[3] These activities could result in displacement, injury, or mortality of individual marine mammals.

Some planned projects could result in beneficial effects, such as designation of the Chumash Heritage National Marine Sanctuary, whose new regulations would limit some impacts on marine mammals.

BOEM expects ongoing and planned activities to affect marine mammals through the following IPFs.

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[3] Refer to BOEM's Environmental Assessment for more discussion of the site assessment activities associated with the Brookings and Coos Bay WEAs: https://www.boem.gov/renewable-energy/state-activities/oregon-wind-energy-areas.

Accidental releases: Oil spills can expose marine mammals to aquatic contaminants and inhalation of fumes, potentially resulting in mortality or sublethal effects (including but not limited to adrenal, hematologic, and liver effects; lung disease, poor body condition, fur fouling, and skin lesions (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008; Riordan et al. 2023; Smith et al. 2017; Sullivan et al. 2019; Takeshita et al. 2017). Sea otters and fur seals are most at risk from oil-spill–related fur fouling as these animals rely on their fur for insulation and buoyancy (Gales et al. 1991).

Pollutants, including contaminants like PCBs, DDT, and DDE, can accumulate in marine mammals through the food chain or ingestion of garbage, causing long-term impacts (effects on reproduction, survivorship, and health [Pierce et al. 2008; Jepson et al. 2016; Hall et al. 2018; Murphy et al. 2018]). However, the population-level effects are unknown and research on many species is lacking. Moderate contaminant levels have been found in pilot whale blubber (Taruski et al. 1975; Muir et al. 1988; Weisbrod et al. 2009). Inshore and coastal populations in contaminated regions are more at risk due to higher exposure levels. For instance, PCBs and pesticides have been found in stranded pinnipeds in California (Kajiwara et al. 2001). Navy-trained dolphins in San Diego Bay showed reproductive declines with higher PCB levels (Reddy et al. 2001). California sea otters exhibited higher PCB levels, potentially increasing disease susceptibility (Jessup et al. 2010). PCB contamination hot spots include San Francisco Bay, the Southern California Bight, the Palos Verdes Shelf, and Santa Monica Bay.

Oil and gas activities have a higher potential for large volume spills but low incidence of occurrence. Two significant oil spill incidents off Santa Barbara, one in 1969 and one in 2015, resulted in marine mammal mortality (among other effects). Based on data between 2015 and 2020, there have been 12 reportable spills in California waters (https://calspillwatch.wildlife.ca.gov/Spill-Archive).

Vessels can release trash and debris that can harm marine mammals. Worldwide, approximately 50 percent of marine mammal species have been documented ingesting marine litter (Werner et al. 2016). The global stranding data indicate potential debris-induced mortality rates of 0 to 22 percent. Mortality has been documented in cases of debris interactions, as well as blockage of the digestive tract, disease, entanglement, injury, and malnutrition (Baulch and Perry 2014). However, it is difficult to link physiological effects on individuals to population-level impacts (Browne et al. 2015).

The potential for large oil spills would be the primary contributor to cumulative impacts on marine mammals and their habitat.

Anchoring: Vessel anchoring related to ongoing commercial, recreational, and military uses would continue to cause temporary seafloor impacts where anchors and chains meet the seafloor.

Anchoring-induced bottom disturbance and associated turbidity would be localized and temporary. While data on whales' avoidance of localized turbidity plumes are unavailable, Todd et al. (2015)(2015) suggest that marine mammal frequent presence in turbid waters makes turbidity impacts unlikely. Any behavioral responses to elevated turbidity, such as avoidance or foraging behavior changes, would be temporary with short-term impacts. Increased turbidity could affect prey distribution for marine mammals in both offshore and inshore environments. Studies indicate that fish are likely to react acutely only when suspended solid concentrations reach thousands of mg/L (Wilber and Clark 2001).

Sedimentation effects from resettled materials would be temporary and localized, reverting to previous levels once the disturbing activity ends. Given the limited extent of anchoring in ongoing and planned activities within the affected environment, effects on marine mammal prey resources are expected to be minimal and not perceptible.

Seabed alterations would be restricted in the Chumash Heritage National Marine Sanctuary, reducing bottom disturbance/turbidity locally. However, vessel anchoring would not be prohibited, so temporary effects may still occur.

Cumulative impacts from anchoring on mysticetes, odontocetes, pinnipeds, fissipeds, and their habitat would be at the lowest levels of detection and barely measurable, with no perceptible consequences to individuals or the population.

Cable installation and maintenance: Seabed disturbance and temporary increases in sediment suspension can occur when installing, maintaining, or decommissioning telecommunications cables, pipelines, and power cables. Suspended sediment impacts would vary in extent and intensity depending on project- and site-specific conditions. In general, plumes generated during trenching of offshore areas would be limited to directly above the seabed and not extend into the water column. Suspended sediments due to jet plowing are expected to remain localized to the area of disturbance and settle quickly to the seafloor.

Sediment transport modeling for Atlantic OCS activities (Tetra Tech 2022) was used as a proxy for this assessment. The modeling indicated that sediment displacement would be low, with suspended concentrations of less than 500 mg/L remaining for a short period of time (4 hours or less), and typically dissipating to background levels in relative proximity to the disturbance. Suspended sediment concentrations would be limited in extent to within a few feet vertically and a few hundred feet horizontally during trenching. All sediment plumes are expected to settle out of the water column entirely within 24 hours after the completion of jetting operations. Jet plow use in cable installation would, therefore, result in short-term and localized heightened turbidity. Jet plow trenching in areas of shallow waters could cause plumes to nearly reach the surface of the water.

Elevated turbidity could cause marine mammal behavioral responses, including avoiding the turbidity zone or changed foraging behavior. This includes the foraging success of sea otters. Further, nearshore cable installation may also disturb resting sea otters and pinnipeds. However, it is expected that such responses by marine mammals would be temporary, and impacts, if any, would be short term.

Cumulative impacts from cable installation and maintenance on mysticetes and odontocetes and their habitat, if any, would be at the lowest levels of detection and barely measurable, with no perceptible consequences to individuals or the population. For pinnipeds and fissipeds and their habitat, impacts would be detectable and measurable but would be short term and localized and would not lead to population-level effects.

Discharges/intakes: Permitted vessel actions, wastewater discharge, and nuclear power plant cooling comprise ongoing and planned discharges and intakes in the Affected Environment. Vessels may discharge uncontaminated bilge water, ballast, gray water, and treated liquid wastes. Certain discharges would be restricted or prohibited in the Chumash Heritage National Marine Sanctuary, once fully designated in late 2024/early 2025. Such restrictions would benefit marine mammals, but likely only within the proposed sanctuary and thus not significantly altering the collective effects of other ongoing activities.

The Diablo Canyon Power Plant uses a once-through cooling system, drawing up to 2.5 billion gallons (9.5 billion liters) of ocean water daily for steam condensation, then discharging it back into the ocean at a regulated temperature not exceeding 22°F (11°C) above ambient conditions. Radioactive water within the nuclear reactor is isolated, ensuring the discharged water is not radioactive (PG&E 2023).

Potential effects of intake and discharge include altered microclimates around outfalls, changed hydrodynamics near intakes/discharges, prey entrainment, and attraction to intakes if prey aggregate around intake screens. Direct entrainment of marine mammals is unlikely due to intake safety screens. Marine mammals are likely to avoid or tolerate the warm discharged water, minimizing direct effects. However, high-volume discharges have impacted kelp forests and larval prey (Tenera 1997). The potential impact area is limited, and individuals are expected to forage nearby with minimal effect on overall prey availability and foraging efficacy.

No cumulative impacts are anticipated for mysticetes, odontocetes, pinnipeds, and fissipeds and their habitat. Impacts on individual marine mammals and their habitat, if any, would be at the lowest levels of detection and barely measurable, with no perceptible consequences to individuals or the population.

EMFs and cable heat: Power transmission cables in offshore environments use either AC or DC and would be transmitted through both floating (dynamic) and buried (static) cables. All cables are insulated, and, compared to static cables, dynamic cables have additional sheathing over insulation materials, adding additional layers of armoring. As voltage moves the electricity through wires, it produces an induced magnetic field and electrical field, and generates heat sufficient to increase the temperature of the surrounding sediments and potentially the water column in immediate proximity to the cable. These effects would be most intense at locations where the cables are suspended or are not buried.

EMFs are generated by several sources in the Affected Environment, including natural processes, existing and planned submarine telecommunication and fiber optic cables, and ICCP systems. Notably, fiber-optic communications cables with optical repeaters do not produce EMF effects. ICCP systems can also produce EMFs by supplying a controlled amount of DC current to submerged surfaces (e.g., vessels, offshore oil and gas structures and equipment) using mixed metal oxide anodes and zinc reference electrodes. To date no studies have been conducted examining ICCP's potential EMF effects on marine mammals, though effects are expected to be minimal; further research is anticipated.

Studies have documented electric or magnetic sensitivity up to 0.05 microTesla (0.5 milligauss) for Earth's magnetic field for fin whale, humpback whale, sperm whale, bottlenose dolphin, common dolphin, long-fin pilot whale, Atlantic white-sided dolphin, striped dolphin (*Stenella coeruleoalba*), Atlantic spotted dolphin (*S. frontalis*), Risso's dolphin, and harbor porpoise (Normandeau et al. 2011).

However, evidence used to make the determinations was only observed behaviorally/physiologically for bottlenose dolphins, and the remaining species were concluded based on theory or anatomical details.

Electrical telecommunications cables induce a weak EMF on the order of 1 to 6.3 microvolts per meter (0.033 to 0.21 milligauss) within 3.3 feet (1 meter) of the cable path (Gill et al. 2005). Transmission cables using HVAC emit 10 times less magnetic field than HVDC (Taormina et al. 2018); therefore, EMF impacts from HVAC cables would have less effects on marine mammals than HVDC cables (Hutchison et al. 2018).

Heat transfer into surrounding sediment for buried high-voltage cables and the water column for exposed high-voltage cables is possible (Middleton and Barnhart 2023; Emeana et al. 2016). Although HVDC cables transmit more electricity than HVAC cables, AC cables tend to have higher transmission losses in the form of heat energy compared to equivalent sized HVDC cables (Middleton and Barnhart 2023; Taormina et al. 2018). However, heat transfer from buried submarine high-voltage cables is not expected to extend to any appreciable distance into the water column due to the high heat capacity of water, the use of thermal shielding, the cable's burial depth, and additional cable protection such as scour protection or concrete mattresses for cables unable to achieve adequate burial depth.

No cumulative impacts from power cable EMFs and heat would be expected for mysticetes, odontocetes, pinnipeds, and fissipeds and their habitat. The impacts on individual marine mammals and their habitat, if any, would be at the lowest levels of detection and barely measurable, with no perceptible consequences to individuals or the population.

Gear utilization: Gear utilization refers to biological and fisheries monitoring survey gear (i.e., trawl, trap/pot, gillnet) and site-characterization survey gear (i.e., acoustic, geological, and geophysical equipment deployments, metocean buoys). Interactions with site-characterization survey gear would be improbable and do not pose a realistic entanglement risk to marine mammals and, therefore, are not considered further.

Biological and fisheries monitoring gear could affect marine mammals by entrapment or entanglement. Each year, NMFS conducts several large-scale scientific surveys along the U.S. West Coast to monitor and assess the populations of fishery stocks, marine mammal stocks, and threatened and endangered species, as well as their habitats, in the CCLME. Gear entanglement is a concern for marine mammals in the Affected Environment. Large whales are more prone to entanglement in stationary lines associated with trap/pot gear, including ventless trap surveys. Such entanglement is a leading cause of mortality in large whale species like humpback and gray whales along the West Coast (Saez et al. 2021; Carretta et al. 2023), notable in the context of biological and fisheries monitoring surveys using similar gear types. From 1982 to 2017, 511 large whale entanglements in fishing gear were reported on the West Coast (Saez et al. 2021). Most confirmed entanglements involved nets (34 percent) and pot/trap gear (22 percent). Since 2000, entanglements in trap/pot gear have increased (32 percent), while those in nets have decreased (16 percent), possibly due to changes in gillnet fishery regulations and trap fishery gear marking requirements (Saez et al. 2021). Smaller marine mammal entanglement has been reported in various fisheries (Carretta et al. 2023; Reeves et al. 2011). Sea otters risk entanglement and entrapment in fishing gear with large fyke openings, such as those used in the live-finfish trap fishery, the Dungeness crab fishery, and the spiny lobster fishery, where they can become trapped and drown (Hatfield et al. 2011).

Commercial fishing–related risks to marine mammals are appreciably greater than those associated with biological surveys conducted on behalf of stock assessment and stock management. Between 2008 and 2019, Southwest Fisheries Science Center scientific trawl surveys in the California Current Research Area captured a total of 58 marine mammals, 50 of which were fatal, including 27 Pacific white-sided dolphins, 6 northern right whale dolphins, 14 California sea lions, and 3 northern fur seals (Rusin et al. 2015). During the same period, an additional 5 California sea lions were caught or entangled in pelagic longline gear but were released alive (2 with apparent injuries) (Rusin et al. 2015).

Active/under review NMFS Incidental Take Authorizations (ITA) for fisheries studies in the Affected Environment propose trawl surveys, purse seines, beach seines, minnow traps, plankton tows, hook and line surveys, demersal and pelagic longlines, sablefish pots, gillnets, and cast nets. Potential interaction between the fisheries surveys and marine mammals was identified for ESA-listed species/stocks, as well as other odontocetes, mysticetes, and pinnipeds (NOAA Fisheries 2024a). No fissipeds were identified for ITAs under USFWS. In the combined ITAs, some lethal take was requested. The requested takes over a 5-year period exceeded actual takes under issued ITAs over the past 15 years, making the expectation of lethal take exceptionally small. Further, NMFS' opinion on the Continued Prosecution of Fisheries and Ecosystem Research Conducted and Funded by the Northeast Fisheries Science Center and the Issuance of an Letter of Authorization (LOA) under the MMPA for the Incidental Take of Marine Mammals pursuant to those research activities (dated June 23, 2016) concluded that impacts on humpback, fin, sei, and blue whales because of trawl gear use would be improbable. Observations during mobile gear use have shown that entanglement or capture of large whale species is rare (NMFS 2016a).

Ongoing and planned surveys would contribute to cumulative impacts on pinnipeds and odontocetes because surveys would result in small numbers of mortalities over long time periods, but no population-level consequences would be expected. The degree of impact would less severe for mysticetes because while gear interaction may occur no mortality or injury is expected. Fissipeds are typically not present in the areas surveyed.

Invasive species: Invasive species can disrupt food webs and alter habitats, potentially leading to cascading effects on higher trophic levels, including marine mammals. In California, invasive species can outcompete or displace benthic and fish prey species and disrupt vegetative communities or fouling communities. Sources of invasive species include ballast water discharge, hull fouling, aquaculture, accidental releases, marine flotsam and debris, shore-based discharges, and climate-driven range changes or dispersion (NMFS n.d.).

Several invasive species currently documented in California waters may have indirect effects on marine mammals.

- The European green crab (*Carcinus maenas*) disrupts marine habitats by preying on a variety of benthic organisms, such as bivalves, small crustaceans, and juvenile fish. This predation can lead to changes in the structure and composition of benthic communities that marine mammals (particularly sea otters) rely on for prey.

- The Atlantic oyster drill (*Urosalpinx cinerea*) and Japanese bubble snail (*Haminoea japonica*) both prey on native bivalves directly, but also depredate on eggs and larvae. This predation can lead to declines in native shellfish populations.
- Asian kelp (*Undaria pinnatifida*) has become invasive in California where it competes with natural kelp and alters the structure and function of kelp ecosystems, which are foraging sites and refuges for pinnipeds and fissipeds.
- American shad (*Alosa sapidissima*), present in the Pacific Northwest, share a life history and diet with juvenile coho (*Oncorhynchus kisutch*) and Chinook salmon (*Oncorhynchus tshawytscha*), suggesting potential competition between these species. Chinook salmon remains a significant part of killer whale diets.
- The yellowfin goby (*Acanthogobius flavimanus*) is an invasive species that has established itself in various coastal and estuarine environments in California (Neilson et al. 2005). Some predators, such as harbor seals, have adapted to include yellowfin gobies in their diet. This dietary shift could have both positive and negative implications for their health and the ecosystem (Gibble et al. 2015).

Additionally, several species of nonnative tunicates and encrusting bryozoans can form dense colonies on submerged hard surfaces, outcompeting native species and altering habitats by smothering native marine organisms, including shellfish, seaweeds, and other sessile invertebrates, leading to a reduction in biodiversity and altering the structure of local benthic communities. Benthic prey quality and abundance play a crucial role in the foraging behavior of gray whales and can significantly impact the requirements for energy consumption needed for migration and reproduction (Hildebrand 2020).

Invasive species sources are not expected to change substantially within the Affected Environment. Indirect impacts from invasive species would be detectable and measurable, and of low intensity, but impacts on individuals and habitat would not lead to population-level effects.

Land disturbance: Cable landings would be the primary sources of planned and ongoing activities that could contribute to elevated levels of coastal erosion and sedimentation resulting from vegetation clearing, excavation, grading, and deposition of fill materials. Refer to the *Port utilization* IPF discussion regarding land disturbances associated with port improvements.

Marine mammal use of land is limited to pinniped and fissiped haulouts. Land disturbance near haulouts may potentially disturb individuals, causing animals to temporarily vacate. Planned and ongoing activities resulting in elevated coastal erosion may degrade habitat suitability for haulouts, potentially resulting in increased energy expenditure if adjacent habitat is unavailable or not selected. Disturbances would be localized to the area of impact and could be short or long-term depending on the nature of activities.

Cumulative land disturbance impacts could occur for pinnipeds and fissipeds. Impacts on individuals and their habitat would be short-term, localized, and would not lead to population-level effects. There would be no land disturbance impacts on mysticetes, odontocetes, or their habitat.

Lighting: Shoreline development, vessels, and existing oil/gas structures are sources of lighting in the Affected Environment. Artificial lighting may disrupt the diel migration (vertical distribution) of some prey species, including zooplankton, which may secondarily influence marine mammal distribution patterns (Orr et al. 2013). Nighttime observations at an offshore oil rig in Brazil, with a large pool of light generated by a gas flare, showed dolphin species foraging near the surface and staying for longer periods of time around the platform (Cremer et al. 2009). In the Gulf of Mexico, more fish were seen at lit platforms versus unlit platforms; however, their numbers declined at the surface at night, indicating that there may be nocturnal avoidance behavior in some species (Barker and Cowan 2018). The varied responses to artificial light in the pelagic environment are detailed in Marangoni et al. (2022), who also acknowledge that the effects of artificial light at night in the open ocean is difficult to assess due to the inherent challenges of sampling that requires introduction of artificial light to the environment.

While prey aggregations could be seen as a positive effect on some species that can take advantage of aggregations, generally, changes in prey distribution are not seen as a positive effect. Further, increased interaction with structures or vessels increases the risk of adverse effects, either primary or secondary. Currently there are no data that describe lighting impacts associated with existing oil and gas structures within the Affected Environment, or from existing vessel traffic.

Mysticetes, odontocetes, pinnipeds, and their habitat would experience cumulative lighting impacts. However, fissiped habitat would be largely unexposed to artificial lighting.

Noise: Ongoing and planned activities that cause underwater noise include G&G surveys, detonations of UXO and seal bombs, vessel traffic, aircraft, dredging/cable laying, and decommissioning of existing oil/gas facilities. More information on the different sources of noise is provided in the sections that follow, and an in-depth discussion of marine mammal hearing and potential noise effects on marine mammals is provided in Appendix H.

Ambient noise measurements vary by location, ranging from 55 to 90 dB re 1 µPa within the 10–1000 Hz frequency range near San Clemente Island and within the Santa Barbara Channel (Andrew et al. 2002; McDonald et al. 2008; McKenna et al. 2009). More recent analysis by Fowler et al. (2022) showed average ambient noise levels ranging from 114 to 116 dB re 1 µPa at approximately 328 feet (100 meters) from oil/gas platforms off Southern California.

Noise (aircraft): Vandenberg Space Force Base conducts aircraft operations, including space vehicle launches, intercontinental ballistic and small missile launches, and artillery/weapons testing. which produce noises such as launch sounds and sonic booms (high-energy impulsive sound overpressure).

Ongoing and planned activities at Vandenberg may disturb hauled out marine mammals, including the following pinniped and fissiped species: California sea lion, Steller sea lion, northern fur seal, Guadalupe fur seal, northern elephant seal, harbor seal, and sea otter. Pinnipeds have been observed displaying responsive behaviors to these noises, such as brief withdrawals, changes in direction, or reentering the water (84 FR 14314). Similarly, sea otter startle responses and other behavioral reactions have been observed near Vandenberg, though there was no change in the overall number of sea otters observed in this area detected following multiple launch events (U.S. Space Force [USSF] 2024). In general, marine mammal behavioral responses to aircraft have most commonly been observed at altitudes of less than 93 feet (150 meters) from the aircraft (Patenaude et al. 2002; Smultea et al. 2008). Aircraft operations have resulted in temporary behavioral responses including short surface durations (bowhead and belugas [Patenaude et al. 2002]; transient sperm whales [Richter et al. 2006]), abrupt dives (sperm whales [Smultea et al. 2008]), and percussive behaviors (i.e., breaching and tail slapping) (Patenaude et al. 2002). Responses appear to depend on the behavioral state of the animal, with the strongest reactions seen in resting individuals (Würsig et al. 1998).

Under the respective permits (i.e., MMPA LOA; ESA Biological Opinion), the USSF must implement required mitigation measures, which include avoiding launches during pinniped and fissiped pupping seasons and maintaining minimum separation and altitude distance to pinniped and fissiped haul outs and rookeries (84 FR 14314; USSF 2024). This minimizes the potential harassment of pinnipeds and fissipeds. The temporary nature of these sources and flight restrictions in place would preclude most impacts on marine mammals.

Noise (drilling): Drilling noise can occur from oil and gas well activities as well as sea-to-shore power and telecommunication cable connections. New oil and gas drilling is not anticipated off California due to state and federal moratoriums. Some existing wells or platforms could potentially require drilling for maintenance or for plugging an abandonment. The extent and duration of potential drilling scenarios for oil and gas is expected to be minimal. Refer to Appendix H for a description of drilling noise source characteristics. Generally, drilling is a non-impulsive source with sound pressure levels ranging from 145 to 162 dB re 1 µPa-m depending on the drill type (Erbe and McPherson 2017; Huang et al. 2023).

Marine mammal drilling noise sensitivity varies by species and context (Richardson et al. 1990). Ringed seals and harbor porpoises may tolerate drilling activities (Moulton et al. 2003; Todd et al. 2009). Todd et al. (2020) found harbor porpoises can detect drilling noise only up to approximately 230 feet (70 meters) from the source, unlikely to interfere with or mask echolocation clicks. Drilling activities may produce sound pressure levels exceeding the continuous noise behavioral disturbance threshold of 120 dB re 1 µPa up to approximately 427 feet (130 meters), assuming spherical spreading loss. Given the low-frequency nature of drilling sounds, mysticetes may be more vulnerable to disturbance. Most studies on mysticete responses to drilling noise have been on arctic species; these studies are the best available proxies. Bowhead whales have been reported to avoid a radius of about 6.2 miles (about 10 kilometers) around an operating drillship, with some individuals avoiding the site up to 12.4 miles (20 kilometers) away (Richardson et al. 1995). Richardson et al. (1990) observed bowhead whale responses to playback of drilling and dredging noises, showing predominantly behavioral reactions, such as orienting away from the sound; cessation of feeding; and altered surfacing, respiration, and diving cycles. Roughly half of the bowhead whales responded to drilling noise playback at a received level of 115 dB re 1 µPa (20 to 1000 Hz band) (Richardson et al. 1990). Blackwell et al. (2017) reported that bowhead whale calling rates were correlated with increasing levels of drilling noise, where calling rates initially increased, peaked, and then decreased.

In sum, drilling can cause behavioral responses in marine mammals, but the responses are expected to be short term and intermittent.

Noise (G&G surveys): G&G surveys could expose marine mammals to underwater noise above acoustic thresholds (Appendix H). These could include high energy seismic surveys, including use of airgun arrays. Such activities would require MMPA authorization along with project-specific mitigation measures. Review of Incidental Harassment Authorizations for such activities indicates that only behavioral disturbance to marine mammals (i.e., no PTS) is anticipated with mitigation applied. Surveys are expected to have some potential for behavioral disturbance on mysticetes, odontocetes, and pinnipeds. No seismic surveys are anticipated to occur in areas that would affect sea otters (fissipeds).

BOEM and USGS have characterized underwater sounds from HRG sources and their potential impact on marine mammals (Ruppel et al. 2022). While marine mammals can detect some HRG sources, most HRG sources would not cause substantial behavioral disturbances. Empirical studies on marine mammal responses to HRG are limited. Vires (2011) found no change in Blainville's beaked whale click durations during a survey using a 38 kHz EK-60 scientific echosounder. Short-finned pilot whales showed no change in foraging behavior but increased heading variance during EK-60 use (Quick et al. 2017). Beaked whale echolocation click detections decreased during EK 60 use (Cholewiak et al. 2017). Kates Varghese et al. (2020) found no change in three of four beaked whale foraging behavior metrics during two deepwater mapping surveys using a 12 kHz multibeam echosounder. Foraging continued in the survey area, and the animals did not leave (Kates Varghese et al. 2021; Kates Varghese et al. 2020). Behavioral disturbance is possible with higher-amplitude sources like bubble guns, some boomers, and high-power sparkers, but unlikely with mitigation (clearance zones, shutdowns, etc.). These sounds could cause temporary acoustic masking in low- or mid-frequency cetaceans (e.g., sperm whales) but would not cause behavioral disturbance due to their low source levels and intermittent use.

Geotechnical surveys may use vibracores, jet probes, bottom-grab samplers, deep borings, or other methods to obtain samples of sediments. Available data summarizing source characteristics of this equipment is provided in Appendix H. Previous assessments focusing on impacts on marine mammals specifically from geotechnical survey equipment are limited, but available MMPA authorizations and Biological Opinions indicate vibracore equipment noise may exceed the 120 dB re 1 µPa behavioral disturbance threshold for marine mammals out to 1.6 miles (2.5 kilometers) (NMFS 2016b). However, given the brief duration (within a day) this equipment is typically used, NMFS has determined that vibracore operations are unlikely to result in take of marine mammals (as defined by the MMPA) (80 FR 37466), meaning the likelihood of long-term, biologically meaningful behavioral disturbances is low.

Considering the empirical evidence together, G&G survey noise from planned and ongoing activities is expected to affect all marine mammal species; impacts on individuals and their habitat, if any, would be short term and localized, and would not lead to population-level effects.

Noise (impact and vibratory pile-driving): Coastal and inshore construction (bridges, ports, sea-to-shore cable connections, etc.) are sources of impact and vibratory pile-driving. There are roughly 15 active MMPA authorization applications for construction projects in California; among these, pile-driving is primarily for pier and port repairs. Pile-driving sound would vary depending on the method (impact or vibratory), pile material, pile size, hammer energy, water depth, and substrate type.

The most reported behavioral effect of impact and vibratory pile-driving on marine mammals has been short-term avoidance or displacement from the pile-driving site. This has been well documented for harbor porpoises, a species of high concern in European waters. In addition to avoidance behavior, several studies have observed other behavioral responses. A playback study on two harbor porpoises revealed that high-amplitude sounds, like pile-driving, may adversely affect foraging behavior by decreasing catch success rate (Kastelein et al. 2019). In another playback study, trained dolphins were asked to perform a target detection exercise during increasing levels of vibratory pile-driver playback sounds (up to 140 dB re 1 µPa) (Branstetter et al. 2018). Three of the five dolphins exhibited either a decrease in their ability to detect targets in the water or a near complete secession of echolocation activity, suggesting the animals became distracted from the task by the vibratory pile-driving sound. Masking, particularly during vibratory pile-driving, would result, but its extent would be highly location-dependent and would not result in long-term effects.

Sea-to-shore cable connections via HDD may involve driven or drilled piles. Ranges to thresholds have not been predicted for all variations or scenarios of sea-to-shore connection activity for power and telecommunication cables; PTS thresholds could be reached if large piles are required. However, due to the required time accumulation for meeting PTS thresholds and the short duration of piling, PTS would not be realized for any marine mammal. PTS thresholds would also not be expected during vibratory piling due to the short duration and non-impulsive nature of this activity (Appendix H).

Vibratory piling can produce large behavioral effect ranges, and some animals could be disturbed enough to temporarily vacate the immediate area; however, due to the location of piling near shore and the short duration of the piling, effects would be limited to temporary behavioral disturbances.

Construction involving pile-driving typically has requirements as conditions of compliance with the ESA, MMPA, and other state and federal regulations. The implementation of shutdown zones and seasonal restrictions based on species presence in an area would further reduce the intensity and likelihood of effects.

Noise (dredging, trenching, and cable laying): Dredging is common near multiple California ports; laying of telecommunication cables can also entail dredging or trenching with similar noise effects.

Given low source levels and the temporary, transitory nature of all these sources, marine mammal exceedance of PTS and TTS levels would be rare (Heinis et al. 2013). Of the few studies that have examined behavioral responses from dredging noise, most have involved other industrial activities, complicating the effects from dredging alone. Some found no observable response (beluga whales [Hoffman 2012]), while others showed avoidance behavior (bowhead whales in a playback study of drillship and dredge noise [Richardson et al. 1990], bottlenose dolphins in response to real dredging operations [Pirotta et al. 2013]). Noise produced from trenching and cable laying is expected to have similar spectral content and source levels along with similar variable responses. Impacts on individual marine mammals and their habitat, if any, would be at the lowest levels of detection and barely measurable, with no perceptible consequences to individuals or the populations.

Noise (underwater detonations): UXO on the seabed may be encountered during ongoing and planned activities. If encountered, the UXO may be left alone, shifted, or removed by low-order deflagration or explosive detonation. If explosive removal is used, the underwater explosion generates a shock wave characterized by extreme changes in pressure, both positive and negative. This shock wave can cause injury and mortality to a marine mammal. The physical range at which injury or mortality could occur will vary based on the amount of explosive material, size of the animal, and the location of the animal relative to the explosive. Injuries may include hemorrhages or damage to the lungs, liver, brain, or ears, as well as auditory impairment such as PTS and TTS (Ketten 2004). Smaller animals are generally at a higher risk of blast injuries.

Blast injuries have been documented in close association with UXO detonations, including after 42 British ground mines were cleared in the Baltic Sea in 2019 (Siebert et al. 2022). Within a week, and in the 2 months following the detonations, 24 harbor porpoises were found dead in the general area, 8 of which had clear signs of blast injury as the primary cause of death (i.e., dislocated ear bones, bleeding in the acoustic fat and melon). In San Diego in 2011, an underwater detonation (8.75 pounds [3.97 kilograms]) resulted in blast injury and death to at least 3 long-beaked common dolphins that had entered the 2,100-foot (640-meter) mitigation zone minutes before the detonation (Danil and Ledger 2011). Refer to Appendix H for further discussion of studies related to UXO detonation effects.

The number, charge mass, and location of UXOs that may need detonation are unknown until site-characterization surveys are performed. The scope of UXO detonations are thus hard to predict, but the likelihood of explosive UXO detonations is expected to be low. Formerly Used Defense Sites (FUDS), mapped UXO areas or locations, and Ocean Disposal Sites (ODS) are used to assess potential risk of encountering UXO or other munitions of concern. There are approximately 12 UXO areas, 53 ODSs, and 74 FUDS along the California coast (California Energy Commission 2023). While UXO areas and ODSs occur out to roughly 242 miles (390 kilometers) offshore San Francisco, the majority of UXO areas and FUDS are within 44 miles (70 kilometers) from shore. UXO may occur outside these designated areas; however, the highest risk for UXO to occur are within identified dump sites or within specific trajectories from military testing or training.

With typical mitigation measures (e.g., avoidance of high-risk areas, monitored clearance zones, single detonations, seasonal and time of day restrictions), the risk for non-auditory injury would so low as to be discountable. However, because mitigation measures are not yet formulated and the actual number of detonations is unknown, PTS ranges could be large; physical injury or mortality cannot be ruled out. However, even if PTS, injury, or mortality occurred, the population would sufficiently recover.

Ongoing activities occurring along the California coast also include fisheries use of “seal bombs”: explosive deterrents used to harass pinnipeds during commercial fishing, mainly purse seining, to decrease depredation by seals and sea lions. The underwater charges are relatively broadband in frequency, with SEL source levels between 190 and 203 dB re 1 μPa^2 s m. Seal bombs have the potential to cause auditory and non-auditory injury in marine mammals as well as behavior changes. Acoustic data collection in the Southern California Bight and near Monterey Bay recorded high volumes of charges, up to 2,800 per day. During peak periods, seal bombs were a major noise source off Southern California; detectable at the Channel Islands and Monterey Bay National Marine Sanctuary.

UXO and seal bomb detonations would have detectable and measurable impacts on individual marine mammals and their habitat. Impacts would be of medium intensity, short term in the case of UXO and long term in the case of seal bombs. Impacts could have population-level effects, but the population can sufficiently recover from the impacts or enough habitat remains functional to maintain the viability of the species both locally and throughout their range.

Noise (vessel noise): Generally, vessels produce noise lower than 1,000 Hz, often below 50 Hz, with tones related to engine and propeller size and type (Appendix H). Higher noise levels would occur in and around traffic lanes that are described in Section 3.4.7, *Navigation and Vessel Traffic*. Vessel noise associated with ongoing and planned activities would be present throughout the Affected Environment at a nearly continuous rate due to the prevalence of commercial shipping, fishing, and recreational boating activities. Noise levels would generally decrease with distance from shipping lanes or other vessel concentrations.

There have been several long-term ambient noise studies in California waters, all of which document increasing noise levels over the last several decades and all of which attribute these increasing noise levels to increased vessel traffic and/or type of vessel traffic (Andrew et al. 2002; McDonald et al. 2008; McKenna et al. 2009). Studies showed ambient noise levels ranged from 55 to 90 dB re 1 µPa within the 10–1000 Hz frequency spectrum and a 6 to 9 dB re 1 µPa (San Clemente Island) and 15 to 25 dB re 1 µPa (Santa Barbara Channel) increase in noise levels when vessels were present compared to periods when vessels were absent (McDonald et al. 2008; McKenna et al. 2009).

The most reported adverse effects of vessel noise are changes in behavior, though specific behavioral changes vary widely across species (Richardson et al. 1995; Erbe et al. 2019) and include changes to dive patterns (e.g., longer dives in beluga whales [Finley et al. 1990]), disruption to resting behavior (harbor seals [Mikkelsen et al. 2019]), increases in swim velocities (humpback whales [Sprogis et al. 2020]), changes in respiration patterns (bottlenose dolphins [Nowacek et al. 2006, Hastie 2006] and humpback whales [Sprogis et al. 2020]), and changes to foraging behavior (porpoises [Wisniewska et al. 2018] and killer whales [Holt et al. 2021]. Reactions to vessel noise may also be correlated with other contextual features, such as the number of vessels present, their proximity, speed, direction or pattern of transit, or vessel type.

Some marine mammals may change their acoustic behaviors in response to vessel noise, either due to a sense of alarm or to avoid masking. For example, in the presence of vessel noise, fin whales (Castellote et al. 2012) and belugas (Lesage et al. 1999) have altered their calls, bottlenose dolphins have increased the number of whistles (Buckstaff 2006; Guerra et al. 2014), sperm whales have decreased the number of clicks (Azzara et al. 2013), and humpbacks and belugas have been seen to completely stop vocal activity (Tsujii et al. 2018; Finley et al. 1990). Some species may change the duration of vocalizations (fin whales shortened their calls [Castellote et al. 2012]) or increase call amplitude (killer whales [Holt et al. 2009]) to avoid acoustic masking from vessel noise.

Acoustic masking is difficult to observe directly, but several studies have modeled the potential decrease in "communication space" when vessels are present (Clark et al. 2009; Erbe et al. 2016; Putland et al. 2017). Putland et al. (2017) showed that during the closest point of approach (<6.2 miles [<10 kilometers]) of a large commercial vessel, the potential communication space of Bryde's whale (*Balaenoptera edeni*) was reduced by 99 percent compared to ambient conditions.

Biological consequences of noise have been studied; one such study demonstrated a potential correlation between low-frequency anthropogenic noise and physiological stress in baleen whales. Rolland et al. (2012) showed that fecal cortisol levels in North Atlantic right whales, a low-frequency cetacean species, decreased following the 9/11 terrorist attacks, when vessel activity was significantly reduced.

Continuous, lower-level sources (e.g., vessel noise) are unlikely to result in auditory injury for fishes or invertebrates but could induce changes in behavior, including physiological stress and or acoustic masking for some marine invertebrate species (Solé et al. 2023; Wysocki et al. 2006; Harding et al. 2020). More detailed information about acoustic impacts on prey species can be found in Section 3.3.5.

Vessel noise generated from ongoing and planned activities is expected to remain at or above existing levels. The primary effects of vessel noise are behavioral, although some physiological effects may be realized, and the chronic nature of vessel noise degrades marine mammal habitat by masking of acoustic space. Vessel noise impacts on mysticetes would be detectable and measurable, of medium intensity within shipping lanes, long term, and extensive throughout the Affected Environment. Impacts would be of lower severity for odontocetes, pinnipeds, and fissipeds due to the differential sensitivity to underwater vessel noise.

Noise (decommissioning): Underwater explosives and mechanical cutting are the most probable methods for decommissioning existing oil and gas structures. Mechanical severance would cause non-impulsive noise that could lead to some behavioral responses. Mechanical cutting associated with the removal of jackets and other structures can generate noise within 500 Hz to 8 kHz, within the hearing range of some species. Mechanical cutting associated with platform and conductor removal produced SPLs ranging from 120 to 130 dB re 1 μPa at distances of more than 384 feet (117 meters) from the structure being cut; sound levels decreased to 114 to 124 dB re 1 μPa at 902 to 961 feet (275 to 293 meters) from the structure being cut (Fowler et al. 2022). Therefore, marine mammals within approximately 984 feet (300 meters) of mechanical severance noise could be exposed to sound above behavioral thresholds. Any behavioral reaction would be brief and localized and would not affect biologically important activities. In contrast, the use of explosives could result in TTS, PTS, and potentially mortality. While the use of explosive severance is not desired, it cannot be fully ruled out (88 FR 86378).

Regulations for the new Chumash Heritage National Marine Sanctuary may limit several noise-producing activities, such as oil and gas production, seafloor mineral exploration, drilling, and dredging. This would reduce underwater noise levels locally, potentially of benefit to marine mammals.

Underwater explosions and ongoing vessel noise would contribute to cumulative impacts on marine mammals and their habitat. Impacts would be detectable and measurable, of medium intensity, short or long term, and localized or extensive. Impacts on individuals and their habitat could have population-level effects, but the population can sufficiently recover from impacts or enough habitat would remain functional to maintain the viability of the species both locally and throughout their range.

Port utilization: Vessel traffic, port improvements, and dredging/maintenance activities are expected to continue. Potential effects include noise and bottom disturbance (comparable to cable installation and anchoring) from dredging, noise and traffic from vessels, accidental releases, and discharges/intakes. Detailed discussions of potential marine mammal impacts from these types of stressors are presented in the corresponding IPF sections above.

Cumulative port utilization impacts on mysticetes, odontocetes, pinnipeds, and fissipeds would be detectable and measurable but of low intensity that would not lead to population-level impacts. However, any future port expansion would be subject to independent NEPA analysis and regulatory approvals requiring full consideration of potential marine mammal effects.

Presence of structures: Structures in the water (such as oil and gas platforms) can result in hydrodynamic changes, altered surface wind currents, behavioral reactions, reefing effects, and secondary entanglement with debris. Furthermore, the presence of structures could displace or alter movement patterns. Cumulative impacts would be detectable and measurable but of low intensity and would not lead to population-level impacts.

Beneficial effects would primarily result from the reef effect, which concentrates fish and invertebrate prey species (Claisse et al. 2014; Schroeder et al. 2000; Schroeder and Love 2004). Such concentrations could have a beneficial impact on odontocetes, pinnipeds, and mysticetes. Modeled losses of habitat and fish from decommissioning estimated a 95 percent loss in fish biomass with complete removal of the structure (Meyer-Gutbrod et al. 2020). Consequently, the loss of these "reefs" after full decommissioning would have similar impacts on each marine mammal group.

Traffic: In addition to vessel noise (discussed above), vessel strikes can harm all marine mammals in the Affected Environment (Laist et al. 2001; Moore and Clarke 2002). Almost all vessel sizes and classes have collided with marine mammals, from container ships to whale-watch vessels, to jet-skis (Dolman et al. 2006; Jensen et al. 2003; Pfleger et al. 2021). Vessel strike research has focused largely on baleen whales given their size, slower movement, time at the surface spent foraging, and inability to actively detect vessels using sound (i.e., echolocation) (Laist et al. 2001; Vanderlaan and Taggart 2007).

Vessel strike probability and severity depend on vessel speed and size. Large vessels' size and bulk limit their ability to avoid marine mammals in their path. Tug-tow vessels, capable of navigating shallower waters outside shipping channels where humpbacks are often found, and high-speed passenger vessels are considered the highest threat to humpback whales (Brown et al. 2019). Most lethal or severe injuries are caused by ships 262 feet (80 meters) or longer, traveling at speeds over 13 knots (24 knots per hour) (Laist et al. 2001). Conn and Silber's analysis (2013), building on collision data (Vanderlaan and Taggart 2007; Pace and Silber 2005), included observations of serious marine mammal injury from vessel strikes at lower speeds (e.g., 2 and 5.5 knots [3.7 and 10.2 knots per hour]). Vessels over 263 feet (80 meters) in length are more likely to cause lethal or severe injury to large whales (Laist et al. 2001).

Among other marine mammal species, large baleen whales and sea otters are more susceptible to vessel strike than odontocetes and pinnipeds. Between 1998 and 2012, there were 25 reported probable vessel strike deaths of southern sea otters in California (Miller et al. 2020). Notably, 16 out of the 25 cases occurred within 1.9 miles (3 kilometers) of harbors at Santa Cruz, Moss Landing, Monterey, or Morro Bay. Sea otters are particularly susceptible to vessel strikes while foraging at the water surface. An assessment of risks to reintroduction of sea otters to San Francisco Bay identified both commercial shipping and recreational vessel traffic as a high-consequence risk (Rudebusch et al. 2020). While there are reports of odontocetes being struck by ships (Van Waerebeek et al. 2007; Wells and Scott 1997), these animals are at relatively low risk (Richardson et al. 1995). Of the 3,633 stranded harbor seals in the Salish Sea (Canada/United States) from 2002–2019, only 28 exhibited injuries consistent with propeller strike (Olson et al. 2021).

Vessel traffic in the Affected Environment is high and the composition of such traffic is diverse. Deep-draft vessels mainly follow existing vessel routing measures into and out of harbors and ports. A voluntary vessel speed reduction program, established in 2014, called Protecting Blue Whales and Blue Skies, is in place along the California coast that incentivizes shipping companies to reduce vessel speeds in seasonal slow speed zones to reduce ship strike risk as well as reduce greenhouse gas emissions. The program establishes voluntary speed reduction rules of 10 knots (18.5 knots per hour) or less annually from May through mid-December from approximately San Clemente to Point Arena. However, studies have shown that voluntary speed restrictions alone are not effective in ensuring vessel speed compliance, with only a small fraction adhering to these restrictions (Morten et al. 2022). Vessel strikes can result in severe injury and mortality of individual marine mammals and impacts would occur over long time periods; however, unrecoverable population consequences are not anticipated.

Cumulative vessel traffic impacts would be detectable and measurable and of medium intensity, with the potential for injury or mortality. Impacts on odontocetes and pinnipeds and their habitats would be detectable and measurable; however, they would be of low intensity because mortality risk is low and not expected.

3.3.6.3.4 Conclusions

Impacts of the No Action Alternative. Under Alternative A, baseline conditions would continue to be affected by existing environmental trends and ongoing activities. Climate change would continue to affect marine mammal foraging and reproduction through changes to the distribution and abundance of marine mammal prey. Stressors contributing to marine mammal impacts include vessel noise, vessel traffic, underwater detonations, gear utilization, and accidental releases.

Cumulative impacts of the No Action Alternative. The addition of planned activities would contribute to impacts on marine mammals. Impacts for ESA-listed or non-ESA-listed mysticetes, odontocetes, pinnipeds, and fissipeds would be the same among groups because no impacts would be greater for ESA-listed species even though their populations are more vulnerable; all populations are expected to recover from any impacts. BOEM anticipates that cumulative impacts would be detectable and measurable, long term, and of medium intensity with the potential for injury or mortality. Impacts on individuals and their habitat may or may not have population-level effects; however, if population-level effects are realized, the population would be expected to sufficiently recover from the impacts. Populations are expected to recover completely when IPF stressors are removed or remedial or mitigating actions are taken.

3.3.6.4 Impacts of Alternative B – Development with No Mitigation Measures – Marine Mammals

ESA Section 7 consultation with NMFS would be conducted for each COP or project-level review. It is assumed that the Letter of Authorization would include mitigation requirements that would reduce impacts.

3.3.6.4.1 Impacts of One Representative Project in Each WEA

Accidental releases: One representative project in each WEA could increase accidental releases of fuel, fluids, hazardous materials, and trash/debris. Such risks would occur primarily during construction and decommissioning, when vessel usage is highest, and particularly during the potential refueling of primary construction vessels at sea.

BSEE prohibits the discharge or disposal of solid debris into offshore waters during any activity associated with construction and operation of offshore energy facilities (30 CFR 250.300). USCG also prohibits dumping trash or debris capable of posing entanglement or ingestion risk (International Convention for the Prevention of Pollution from Ships, Annex V, Public Law 100–200 [101 Stat. 1458]). Each wind project would be required to comply with federal and international requirements to minimize releases. The impact from accidental releases of hazardous materials and trash/debris would, therefore, not increase the risk beyond that described under Alternative A.

In the unlikely event of an accidental oil spill, impacts would likely be sublethal due to quick dispersion, evaporation, and weathering, all of which would limit the amount and duration of exposure of marine mammals to hydrocarbons. The combined regulatory requirements would effectively avoid accidental debris releases and avoid and minimize the impacts from accidental spills such that effects on marine mammals would be improbable. Due to low occurrence, impacts from oil spills would be at the lowest levels of detection and barely measurable, with no perceptible consequences to individuals or the population. O&M–related accidental releases would be similar, though reduced because this phase would not involve at-sea refueling of construction vessels.

Anchoring: Anchoring associated with vessel activities would have temporary to long-term impacts on marine mammals, primarily due to bottom disturbance and increased turbidity. Anchoring associated with floating platform mooring for one representative project poses a long-term risk of bottom disturbance due to chain drag and long-term risk of secondary entanglement due to snagging of marine debris on lines in the water.

For vessel anchoring, bottom disturbance would temporarily increase suspended sediment and turbidity levels in and immediately adjacent to anchorage areas. Vessel anchoring impacts would occur intermittently throughout all project phases. Impacts from vessel anchoring for one representative project are expected to be localized and immeasurable.

Long-term bottom disturbance may occur from the WTG mooring structures associated with anchor chain movement on the seafloor. Use of a catenary or semi-taut mooring system would include some level of chain sweep or drag along the seabed in a radius or arc from the anchor. The anticipated seabed contact area for one WTG or OSS would range from 0.05 to 75 acres (200 to 300,000 square meters) depending on the selected mooring type. These long-term impacts would remain for the life of the project, but they would cease when structures are removed.

Vessel anchoring is not expected to cause primary or secondary entanglement. There is also no expected risk of direct (primary) entanglement with offshore wind anchoring components (Maxwell et al. 2022; Benjamins et al. 2014; Harnois et al. 2015). However, secondary entanglement due to the presence of anchor systems could result in long-term impacts on marine mammals during O&M.[4] Lost or discarded fishing gear could become ensnared on mooring lines, which then poses a secondary entanglement risk. Although no data exist for this risk associated with U.S. offshore wind structures at this time, large numbers of fishing gear are lost to the ocean every year. It is estimated that 2 percent of all fishing gear is lost annually, encompassing 1,144 square miles (2,963 square kilometers) of gillnets; 28,977 square miles (75,049 square kilometers) of purse seine nets; 84 square miles (218 square kilometers) of trawl nets; 459,554 miles (739,583 kilometers) of longline mainlines; and over 25 million pots and traps (Richardson et al. 2022).

A study assessed megafauna entanglement risk in renewable energy structures, concluding that such facilities, including offshore wind, pose a relatively modest risk to marine megafauna when compared to direct entanglement risk resulting from fisheries interactions (Benjamins et al. 2014). A summary of potential impacts of floating cables on marine life, including marine mammals, mentions secondary entanglement but does not quantify the risk (SEER 2022; Henry et al. 2023). The Marine Mammals Working Group at the State of the Science Workshop on Wildlife and Offshore Wind Energy identified entanglement as a major threat to pinnipeds (Southall et al. 2021). There is an ongoing BOEM study to model entanglement risk to fin and humpback whales, leatherback sea turtles, and other species offshore California in deep water renewable energy structure that will include moorings and power cables, as well as derelict fishing gear that could interact with such infrastructure (Copping and Grear 2018; https://www.boem.gov/about-boem/humpback-whales-and-floating-offshore-wind-farms). To date, results have been published of humpback whale simulation modeling of entanglement risk of mooring and cables (excluding derelict gear) (Copping and Grear 2018). Benjamins et al. (2014) and Harnois et al. (2015) specifically addressed the risk of entanglement in renewable energy mooring structures but excluded assessment of secondary entanglement risk, although both studies note that the

[4] Secondary entanglement is considered in the *Anchoring* IPF section due to the presence of the mooring (anchor) lines in the water column. The *Presence of structures* IPF section also considers secondary entanglement risk due to the presence of interarray cables suspended in the water column.

risk for secondary entanglement is expected to be considerably higher than direct entanglement in mooring lines. The lack of secondary entanglement data represents a significant data gap in the assessment of potential impacts. Therefore, although not currently quantifiable, secondary entanglement remains a potential long-term risk for marine mammals, with the possibility for impacts persisting until structures are removed (decommissioning).

One representative project in each WEA would introduce a substantial number of mooring lines for anchoring. For each WTG (up to 200 WTGs) and OSS (up to 6 OSSs), the maximum anchoring configuration assumes 12 mooring lines extending from the seabed to the floating platform, each with 3,281 feet (1,000 meters) of chain on the seabed. The minimum number of components would be for a TLP with three anchors. Refer to Appendix A, *Representative Project Design Envelope for Floating Offshore Wind Energy,* for more detail on prospective anchoring and mooring configurations.

These mooring configurations create potential for secondary entanglement that could result in marine mammal mortalities. Further, attraction to the structure and the associated reef effect (described in the *Presence of structures* IPF section) may increase interaction between mooring components and marine mammals. The number of mortalities cannot be predicted and there is no quantifiable estimate for the amount or type of debris that may accumulate on mooring lines. However, based on the best available science to date, large numbers of marine mammal mortalities are not anticipated. Impacts would be detectable and measurable, long term, and localized. Impacts would be of medium intensity with the potential for loss of individuals, though the viability of a species would not be affected, and populations are expected to be able to sufficiently recover from any impacts. No substantial anchoring impacts on fissipeds are expected due to minimal overlap with habitat.

Cable installation and maintenance: The combined length of export cables per project is assumed to be between 19 and 27 nm (35 to 400 kilometers) per cable, with an estimated corridor width of 43 feet (13 meters) and target burial depth between 3 and 10 feet (1 and 3 meters). Several cable burial methods are possible. Export cables are expected to be a combination of floating (i.e., suspended in the water column) and buried, though burial may not be required along the full cable route.

Export cable burial would disturb the seafloor, resulting in turbidity effects with the potential to have temporary impacts on some marine mammal prey species (Section 3.3.5). Trenching in areas of shallower water depths could cause plumes to nearly reach the surface of the water.

Array cables would be suspended in the water column and, therefore, would not require cable installation in the seabed. The effects from suspended cables in the water column, including installation and maintenance, would be limited to noise and vessel traffic and are not considered further in this section of the analysis.

During O&M, only intermittent, localized cable maintenance is expected. In case of insufficient burial or cable exposure, whether attributable to natural or human-caused issues, appropriate remedial measures would be taken, including reburial or placement of additional protective armoring. If a cable failure occurs, an appropriate cable repair spread would be mobilized. During these remedial activities, if they occur, sediment plumes would be expected to remain localized to the area of disturbance and settle quickly to the seafloor. Elevated turbidity levels would be short term, localized, and temporary.

Cable installation and maintenance would affect pinnipeds and fissipeds due to increased turbidity. Impacts would be detectable and measurable, but would be short term and localized, and would not lead to population-level effects. Similar activities are not expected to result in impacts on mysticetes and odontocetes. Impacts on individual marine mammals and their habitat, if any, would be at the lowest levels of detection and barely measurable, with no perceptible consequences to individuals or populations.

Discharges/intakes: Offshore wind development would cause discharges and intakes associated with HVDC converters (if used) and vessel activity during all phases. Because this PEIS precedes any project-specific COP submission, detailed information about HVDC cooling systems is currently unavailable. These systems could include open-loop, closed-loop, or other types of cooling systems. The use of HVDC cables may require HVDC converter intakes on up to six OSSs.

Open-loop systems, considered the most efficient for HVDC systems, take in sea water and discharge warmer water back into the ocean (Middleton and Barnhart 2022). Potential effects include altered micro-climates of warm water surrounding outfalls, altered hydrodynamics around intakes/discharges, prey entrainment, and association with (attraction to) intakes if prey is aggregated on intake screens from which marine mammals scavenge. The warm water discharged is generally considered to have a minimal effect as it would be absorbed by the surrounding water and returned to ambient temperatures. Other types of cooling systems would not result in water discharges, so these effects would not be relevant. Entrainment of potential prey resources would be minimal given the small number of OSSs proposed per project. Entrainment of marine mammals that may depredate on aggregated prey is discounted due to physical impedance by intake safety screens.

Permitted offshore discharges are regulated and include uncontaminated bilge water and treated liquid wastes. The largest increase in project-related discharges would occur during construction and decommissioning. These activities and the resultant impacts would be staggered over time and localized.

Impacts on marine mammals cannot be definitively stated without clarity on the specific HVDC system(s) involved. However, given the small number of OSSs and the isolated and intermittent nature of all discharges, impacts from discharges and intakes, though long term, would be low in intensity, localized, and non-measurable for mysticetes, odontocetes, pinnipeds, and fissipeds.

EMFs and cable heat: Array cables would generate EMFs and cable heat in their immediate vicinity. Additionally, ICCP systems could potentially be used on the WTG/OSS structures (Jessup 2015).

Array cables would be suspended in the water column and/or partially buried. Export cables would require burial, although burial might not be required along the full cable route. Both HVAC and HVDC technologies could be considered.

While information regarding EMF effects can be garnered from buried cable data, the configuration of suspended cables for offshore floating wind presents more potential for EMF interaction with pelagic species. However, there have been limited investigations and data regarding EMF conditions for floating offshore wind cables (Maxwell et al. 2022; Farr et al. 2021). As there are no existing offshore wind projects in the Pacific, this assessment uses EMFs from an Atlantic coast project. Exponent Engineering, P.C. (2018) estimated induced magnetic field levels ranging from 13.7 to 76.6 milligauss on the bed surface above the buried and exposed South Fork Wind Farm export cable and 9.1 to 65.3 milligauss above the interarray cable, respectively. Induced field strength would decrease effectively to 0 milligauss within 25 feet (7.6 meters) of each cable.

HVDC cables can produce EMF levels up to 207 milligauss; however, this level was associated with shallower cable burial depths, and cables buried deeper under the seafloor would produce EMFs closer to 4 milligauss (Hutchison et al. 2018). Normandeau et al. (2011) concluded that marine mammals are unlikely to detect magnetic field intensities below 50 milligauss, suggesting that they would not be sensitive to EMF effects from renewable energy projects. EMFs would be below the threshold detectable to marine mammals and, therefore, indistinguishable from natural variability. EMF intensity diminishes rapidly with distance, limiting potential long-term exposure impacts. However, impacts would be considered long-term as EMF effects would be present in the environment for the life of the project.

Cables would be installed with appropriate thermal cable shielding and scour protection (where needed), which would effectively limit marine mammal exposure to EMFs and cable heat originating from project cables. Cable heat would dissipate rapidly with distance from the cable and is not expected to have any discernible effect on marine mammals (Middleton and Barnhart 2023).

Potential effects from EMFs and cable heat would be at the lowest levels of detection with no perceptible consequences to individuals or populations of marine mammals.

Gear utilization: Pre- and post-construction biological and fisheries monitoring surveys would result in an increase in the amount of fishing gear in the water. Prior to COP submittal, it is assumed that fisheries monitoring surveys conducted for each project would be of limited frequency and duration, though any sampling that utilizes in-water gear may pose an entanglement or capture risk to marine mammals. As discussed for Alternative A, fishing gear increases risk of marine mammal entanglement. Impacts from interactions with gear could result in injury or mortality. However, the likelihood of any mortality or serious injury due to project-related survey gear is considered very low given the expected limited extent and duration of monitoring surveys for each project compared to ongoing fisheries survey monitoring. At this time, the extent and number of animals potentially at risk of entanglement cannot be determined without project-specific information.

Gear utilization would pose only a slightly heightened entanglement/entrapment risk to marine mammals. If entanglement or entrapment were to occur, the potential loss of individuals is not expected to result in population-level consequences.

Invasive species: As discussed in Section 3.3.6.3.2, vessels traveling from non-local ports risk carrying invasive species in ballast water and on vessel hulls. Hard substrate would be introduced on floating wind foundations, anchor structures, and cable or scour armoring; such hard substrates provide recruitment and settlement habitat for invasive marine species. There could also be vessels coming from other U.S. ports.

There is a BWM convention in place through the IMO designed to minimize transport of nonnative species between ports. In addition to the BWM convention, the limited transoceanic travel and local port use expected from offshore wind vessels significantly limits the risk of transporting invasive species. Due to the introduction of hard substrate within the WEAs and associated cable routes, impacts from invasive species would be long term and potentially wide ranging; however, no population-level effects would occur.

Land disturbance: Land disturbance from onshore construction associated with installation of export cables, landfalls, onshore substations and converter stations, and transmission facilities could result in direct impacts on marine mammal habitat. However, such impacts are expected to be limited because, based on BOEM's experience with offshore wind projects on the Atlantic OCS, onshore facilities would most likely be in existing developed areas, such as roads, parking lots, and utility ROWs.

Multiple installation methods can be used to make the sea-to-shore transition, including open-cut (i.e., trenching), which would require evacuation of the seabed through jetting or dredging to lay the cable, or trenchless methods such as HDD. This analysis assumes that trenchless methods are preferred and that open-cut methods would be used only in limited and isolated circumstances. Under this assumption, direct shoreline impacts would be minimized. If dredging were to occur, it could expose marine mammals to increased levels of underwater noise (refer to the *Noise* IPF section) and increased turbidity (refer to the *Anchoring* IPF section), affecting individual marine mammals or their prey.

Land disturbance that does occur, especially on shoreline parcels, could cause short-term erosion and sedimentation impacts in coastal habitat. Noise (refer to the *Noise* IPF section) and activity in these areas, if they coincide with or are adjacent to marine mammal shoreline usage (i.e., haulouts, rookery sites), may disturb individuals, resulting in a behavioral reaction that could include flushing into the water. Disturbances would be localized to the area and expected to be short term. However, long-term effects could be realized if individuals abandoned one or more haulout sites entirely.

Based on these factors and given the localized and limited extent of potential activities that may disturb marine mammals, land disturbances would have no impact on mysticetes and odontocetes given no overlap with activities. Some impacts would occur for pinnipeds and fissipeds, as consequences to individuals may be detectable and measurable but would be short -term and localized and would not lead to population-level effects.

Lighting: Navigation, safety, and work lighting would increase artificial lighting in the marine environment, potentially attracting prey species, and thus aggregating some marine mammal species (primarily odontocetes). This could expose such species to greater harm, particularly vessel strikes. Lighting associated with offshore structures (i.e., WTGs and OSSs) would also introduce additional lighting, though only in a limited area around the structures and would be in accordance with FAA, USCG, and BOEM guidelines to aid safe navigation within the lease areas. Given the localized nature of artificial lighting associated with each representative project, BOEM anticipates that lighting impacts on mysticetes, odontocetes, pinnipeds, and fissipeds, if any, would not result in perceptible consequences to individuals or populations.

Noise: Underwater noise effects on marine mammals would result from aircraft; drilling of piles; G&G surveys; dredging, trenching, and cable laying, including rock placement; UXO detonations; vessel noise; WTG operations; and decommissioning. Each of these activities is discussed below.

Construction of wind energy facilities activities would generate underwater noise and could result in auditory injury (i.e., PTS), behavioral disturbance, and masking effects on marine mammals. Underwater noise levels are expected to increase locally during construction due to an increase in vessel traffic, including DP vessels for construction. Drilling, dredging, and cable laying would increase noise levels above vessel noise alone; however, rock placement noise is not expected to increase noise appreciably above vessel noise for extended time periods.

Decommissioning is expected to generate comparable sounds and impacts as construction within each noise category because the equipment, operations, and durations are relatively similar. Therefore, decommissioning noise is not re-analyzed for each category and is assumed to have the same impact determinations as the construction phase.

O&M-related noise sources include vessels and WTG operations. WTG operational noise includes the rotor and blade complex and sounds of the physical structure and associated anchoring structures as they move within the water. Cable maintenance during O&M could include similar activities as construction, but at lower occurrence, geographic extent, and time period.

Noise (aircraft): At this time, it is unknown if or how aircraft would be employed for offshore wind development. However, helicopters and fixed-wing aircraft could transport construction, maintenance, or monitoring crews. Sound propagation across different media (e.g., air and water) results in only a small portion of the acoustic energy from aircraft operations coupling into the water for a brief period of time (Appendix H). Depending on flight operations, aircraft could fly over mainland pinniped rookeries or haulouts. However, flights over offshore rookeries would not be anticipated. Standard flight restrictions are expected to result in minimal impacts on pinnipeds and fissipeds given their surfacing and haul out behavior; impacts on other marine mammals are less likely as they spend less time at the surface than pinnipeds and fissipeds.

Rotary-winged aircraft (helicopters) could be used for crew changes or supply runs. However, these are anticipated to be intermittent trips occurring irregularly throughout the construction period. Aircraft noise, though audible to most marine mammals, would only result in temporary behavioral responses such as shortened surface durations or abrupt dives (Patenaude et al. 2002; Richter et al. 2006; Smultea et al. 2008). With adherence to regulatory requirements, and the irregular occurrence of aircraft traffic, impacts are not expected.

Noise (drilling): Drilling activities may be used during construction of anchoring piles. HDD drilling may be used to link offshore cables at onshore connection points. As described in Section 3.3.6.3.3, *Impacts of Alternative A – No Action – Marine Mammals,* drilling noise could potentially lead to behavioral disturbance. The level of impacts is dependent on the sensitivity of marine mammals to drilling noise, as it varies between and within species and is context-dependent (Richardson et al. 1990). Given the low-frequency nature of drilling sounds, mysticetes may be more vulnerable to disturbance.

There is no information regarding noise associated with drilling for anchor moorings. However, noise is expected to be comparable to other drilling activities (Appendix H). Although the effect of individual drilling events would be small, the potential geographic extent of piling for even one project could be extensive and lengthy. Without mitigation, behavioral responses may occur during important biological functions; but individual behavioral responses would be short term and intermittent. Impacts would be limited to the construction period and proximity of one representative project and thus would be of low intensity, and temporary, concluding at the end of construction.

Noise (G&G surveys): G&G surveys may occur prior to and during project construction to identify potential obstructions. Geophysical surveys are not expected to employ high energy seismic sources such as airguns but would be expected to use lower energy, higher frequency HRG sources. As discussed in Section 3.3.6.3.3, it is improbable that G&G survey noise would result in any PTS impacts on marine mammals. TTS thresholds for marine mammals could be exceeded during use of some sparker or boomer equipment, but the thresholds would only be exceeded within approximately 33 feet (10 meters) based on source levels from Crocker and Fratantonio (2016). Additionally, these sources operate at low frequencies (<2 kHz) so high-frequency cetacean species are less likely to be affected than other hearing groups, despite the lower TTS threshold (Section 3.3.6.1.3). For all HRG sources, operational parameters utilized for offshore wind surveys reduce the likelihood of biologically notable behavioral disturbances (Ruppel et al. 2022). Geotechnical surveys may introduce low-level, intermittent noise into the marine environment. G&G surveys may also occur irregularly throughout O&M of a representative project and potentially also during decommissioning.

Sounds produced by G&G surveys could result in acoustic masking; however, these are not expected to result in biologically notable behavioral disturbance given their minimal propagation ranges and intermittent use.

Noise (dredging, trenching, and cable laying): The construction of WTG and OSS structures, as well as installation of interarray and export cables, may require jetting, plowing, or removal of soft sediments. As discussed in Section 3.3.6.3.3, noise produced by these activities may result in behavioral disturbances for some marine mammals, though these are expected to be low intensity and localized (Hoffman 2012; Pirotta et al. 2013). Low-frequency cetacean species may face a nominally higher risk of behavioral effects or masking given the overlap between their hearing and the frequency of cable-laying noise. However, effects of noise produced by these activities are expected to be short-term and localized. Noise produced by these activities could also affect marine mammal prey species, but as discussed in Section 3.3.5, only short-term impacts on fish and invertebrate species from this noise source are expected.

Noise (impact and vibratory pile-driving): The sea-to-shore export cable connection and TLP anchoring could require pile-driving during construction. Refer to Appendix A for details on piling methods associated with HDD and TLP foundations.

As described in Appendix H, the sea-to-shore export cable connection may include installation of temporary steel casing pipes (goal posts) and/or steel sheet piles (cofferdams) to accommodate the conduit used for pulling the cable from the seabed through to the shore after HDD. This activity usually occurs within a few kilometers from shore. Piles would be driven using a combination of vibratory and impact driving methods and, as discussed in Section 3.3.6.3.3, can produce large behavioral threshold ranges for short periods of time; however, any disturbance realized would be brief and not have biological consequences, and no auditory injury is anticipated.

For impact and vibratory pile-driving of TLP anchor piles, no measurements are available, but ranges to thresholds can be estimated by the pile size using the NMFS Multi-Species Calculator Tool (Appendix H, Table H-4). Table H1-4 contains estimations of PTS and behavioral disturbance thresholds for marine mammals exposed to impact and vibratory hammering using a 96-inch (2.4-meter) steel pipe without noise mitigation. Though the deep-water location of TLP piling would limit marine mammal presence in the ensonified area, because no mitigation would be applied under Alternative B and the PTS ranges were estimated to be large (0.6 mile [1 kilometer] or more) the risk of PTS cannot be discounted for any species. However, the NMFS Multi-Species Calculator Tool does not account for local bathymetric and oceanographic features that would influence underwater sound propagation, which are not known for this programmatic assessment. Site-specific information used in a project-specific model would likely alter the predicted threshold ranges for sea turtles, but such information would not be available until future project-specific consultations are initiated. It is worth nothing that the behavioral disturbances thresholds do not account for duration of exposure, nor do they equate to a biologically significant response that could affect behaviors related to reproduction or foraging.

Overall, impact and vibratory piling for the sea-to shore cable connection would not be expected to have biological consequences. However, the risk of PTS cannot be discounted for marine mammals during TLP anchor piling; therefor, impacts on marine mammals are possible for that mooring option.

Noise (UXO detonations): UXOs can be encountered during construction; their removal by detonation would generate high pressure levels that could cause PTS and injure marine mammals.[5] UXO detonation may also cause non-auditory injury or even mortality at close range.

The physical range at which injury or mortality could occur would vary based on the amount of explosive material in the UXO, size of the animal, and location of the animal relative to the explosive. Refer to the ranges presented from Hannay and Zykov (2022) (Appendix H), used here to approximate risk. UXO detonation is anticipated to be infrequent, localized, and temporary. All marine mammal species could be affected by an unmitigated UXO detonation, given the large ranges to auditory and non-auditory injury, the risk for mortality, and the severity of consequences to an exposed individual. This is because

[5] Refer to Section 3.3.6.3.3 for modeled threshold ranges resulting from UXO detonations.

although detonations may result in mortality, the impact would be localized and short term with an overall low likelihood of UXO detonations being required. The number of mortalities in a detonation event is expected to be small; all populations would be expected to recover.

Noise (vessel noise): Vessels that may be used to support all project phases include utility boats, offshore supply/crew vessels, general cargo, barges and tugs, cable lay, DP and jack-up crane vessels, crew housing vessels, and survey vessels. During O&M, vessel traffic is expected to be limited to the use of relatively smaller vessels, which would limit the level of noise produced during the maintenance trips.

Vessel noise is not expected to elicit PTS for any marine mammal species, though behavioral disturbances are possible. One representative project would increase vessel traffic. The exact extent of this increase is unknown but is assumed to be similar to the estimated number of vessels planned to operate during construction of other offshore wind projects,[6] and result in up to 51 vessels operating at any given time. Effects are expected to be greatest for low-frequency cetaceans due to the low frequency of vessel noise and the relatively large propagation distances of low frequency- sounds. BOEM anticipates construction vessel noise impacts to be of low intensity, temporary, and localized.

Noise (WTG operations): Given the relative newness of floating WTG technology, there is a lack of empirical sound measurements. This analysis assumes noise impacts of floating WTGs to be similar to those associated with bottom-founded WTGs.

Operations of the floating WTG would result in long-term, low-level, continuous noise, which could result in behavioral disturbances and auditory masking at close distances (Lucke et al. 2007; Tougaard et al. 2005, 2020; Thomsen and Stöber 2022). Maximum anticipated noise levels produced by operational WTG are estimated to be between 125 and 130 dB re 1 µPa-m (Lindeboom et al. 2011; Tougaard et al. 2009). Noise produced by operational WTGs would be within the auditory hearing range for all marine mammals, but the potential for impacts is improbable outside a relatively small radius surrounding project structures.

Noise would also be produced by heaving movements of mooring lines, chains, and WTG platforms. Based on a study of wave energy devices, the main noise source was anchor chains, which emitted sporadic sounds between 3 and 4 kHz (Beharie et al. 2015). The acoustic measurements in that study found source levels of the anchor chain noise of 131 to 200 dB re 1µ Pa^2 for 4.2- to 5 3/8-inch chains. It is expected that noise produced by the physical structures required for flotation and mooring would not produce sounds of sufficient amplitude to risk PTS or TTS in marine mammals because the noise events would be discrete, and mammals would not accumulate sound energy long enough to realize onset of PTS or TTS. However, behavioral disturbance could be realized.

Some studies have shown an increase in acoustic occurrences of marine mammals during the operational phase of wind farms (harbor seals [Russell et al. 2016], harbor porpoise [Scheidat et al. 2011]), while another study showed a decrease in the abundance of porpoises 1 year after operation (Tougaard et al. 2005). In these studies, it is unclear if behavioral responses result from operational

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[6] Empire Wind (OCS-A 0512), Ocean Wind 1 (OCS-A 0498), and Atlantic Shores South (OCS-A 0499).

noise or other factors. Regardless, these findings suggest that turbine operational noise did not have any immediately obvious effects on animal behavior.

Behavioral disruption resulting in avoidance or attraction to the structure and moorings, particularly for odontocetes and pinnipeds could be experienced long term during O&M. Deep-diving species, such as beaked whales, may show behavioral reactions if noise is produced at seabed moorings. The overall lack of knowledge regarding the sound produced from floating wind installations is problematic in drawing conclusions. However, because chain noise has the potential to exceed behavioral disturbance thresholds and the above thresholds events could occur over the long term and over a potentially broad geographic area, operational noise impacts could occur for mysticetes, odontocetes, and pinnipeds. No impacts on fissipeds are expected because they are not expected to be in the vicinity of WTG operations.

Port utilization: Use of California ports to support wind energy activities would increase vessel traffic and noise. Refer to the *Traffic* and *Noise (vessel)* IPF discussions. However, noise and traffic levels associated with vessels using the port would not differ substantially from ambient conditions within the port.

Presence of structures: Potential effects from the presence of WTGs include displacement/barriers to movement, hydrodynamic changes, reef effects, and secondary entanglement. Table 2-2 in Chapter 2, *Proposed Action and Alternatives,* provides information about the number and alignment of structures that would be installed for one representative project within each WEA.

Based on documented lengths (Wynne and Schwartz 1999), the largest blue whale (89 feet [27 meters]), fin whale (79 feet [24 meters]), sei whale (59 feet [18 meters]), and sperm whale (59 feet [18 meters]) would fit end to end between two WTGs spaced at 0.4 nm (800 meters) approximately 30 times over. This simple assessment of spacing relative to animal size indicates that the physical presence of the WTGs and OSSs is unlikely to pose a physical barrier to the movement of large or small marine mammals. However, the long-term presence of WTG and mooring structures could behaviorally displace marine mammals from preferred habitats or alter movement patterns even though there would be ample physical space available for animals to navigate. As discussed in Section 3.4.1, *Commercial Fisheries and For-Hire Recreational Fishing*, some displacement of gear activities could occur, which could potentially increase or decrease fisheries interactions with marine mammals. These fisheries interactions may result in demographic impacts on marine mammal species. However, no long-term data exist to identify these potential effects, so this analysis is speculative.

Additionally, large floating structures are known to attract a wide variety of large mobile fauna. Their ability to create a habitat with permanent, semi-permanent, and transient fauna suggests they can be a net ecosystem benefit (e.g., Gooding and Magnuson 1967; Robert et al. 2012; Kramer et al. 2015). These structures, also known as FADs, create shade and provide shelter for small fishes, as well as orientation points for larger mobile species such as marine mammals (Helfman 1981; Taquet 2013). Floating FADs are generally distinguished from bottom-founded artificial reefs in the kinds of fishes and other biota they attract. As discussed in Section 3.3.6.3.3, fish-eating odontocetes and pinnipeds are the groups most likely to benefit from increased prey availability due to the reef effect. While a concentration of prey is likely to be comparable for floating structures, such structures may not be as attractive or accessible to pinnipeds as stationary foundations due to their movement and placement in deep water. The artificial reef effect created by these structures forms biological hotspots that could support species range shifts and expansions and changes in biological community structure resulting from a changing climate (Degraer et al. 2020; Methratta and Dardick 2019; Raoux et al. 2017), though it is unknown how marine mammals may ultimately respond.

Current understanding of deepwater, floating offshore wind farms on ocean dynamics is limited. Surface water temperature and wind speed changes associated with offshore wind installations can be expected. However, these changes would revert quickly beyond the wind farm and result in nominal effects on marine mammals compared to normal fluctuations in wind and surface conditions (Christiansen and Hasager 2005; Integral 2021; Raghukumar et al. 2022). Changes in wind and surface conditions, as well as the presence of floating structures, may also influence vertical mixing in deep water, resulting in stratification changes of temperature profiles, salinity, primary productivity, and planktonic organisms. Modeling conducted by Integral (2021) found that a roughly 5 percent reduction in wind speeds led to an approximately 10 to 15 percent decrease in upwelled volume transport and resulting nutrient supply to the coastal zone in the vicinity of the Morro Bay and Diablo Canyon call areas. Hydrodynamic changes modeled for build-out of California offshore wind, comprising 877 WTGs in federal OCS waters, showed a change in upwelling processes at different locations and intensities (Raghukumar et al. 2023). Modeling showed changes near the Humboldt lease area, but they were substantially smaller than those seen near Morro Bay. These changes could affect foraging and temperature-related movements for marine mammals.

As aggregations of plankton are concentrated by physical and oceanographic features, increased mixing may disperse aggregations and may decrease efficient foraging opportunities. However, while broadscale hydrodynamic impacts could alter zooplankton distribution and abundance (van Berkel et al. 2020), there is considerable uncertainty as to the magnitude and extent of these changes, especially when coupled with broader ecological conditions such as climate change. Given this, the National Academies of Sciences, Engineering, and Medicine evaluated this issue in the Atlantic, with particular emphasis on assessing potential impacts on copepod availability (NASEM 2024). Their results showed that while there is a general lack of robust models or data that can account for the complexity and rapidly changing systems that affect zooplankton distribution in the study area (i.e., Nantucket shoals), the potential exists for regional scale effects from wind farms on dynamic oceanographic processes affecting zooplankton; and recommended a precautionary approach to wind development along with further studies. This possible effect is relevant to mysticete species that forage primarily on planktonic prey, whose aggregations are primarily driven by hydrodynamic processes. Increased mixing may disperse aggregations and may decrease efficient foraging opportunities. It is not clear if nektonic prey aggregations (i.e., euphausiids such as krill) would be similarly affected by these broadscale hydrodynamic impacts.

Potential changes in hydrodynamics from project infrastructure could result in impacts on marine mammals that forage on planktonic species and fish species by changing prey distribution or concentrations. These effects would be long term and may be measurable and detectable through inference from long-term oceanographic data collection; however, impacts are not expected to result in population-level effects.

The number of mooring lines in each WEA, assuming a minimum of three mooring lines per WTG, range from 90 to 600 surface to seabed lines in the water column in each WEA. There would also be 30 to 200 suspended sections of dynamic power cable extending between WTGs and the seabed. While there is no expected direct entanglement with these components, the structures in the water pose a secondary entanglement hazard due to snagged debris on lines and cables, and an increased physical barrier from large amounts of snagged debris (Maxwell et al. 2022; SEER 2022; Henry et al. 2023).

As described in the *Anchoring* IPF, there is a lack of data regarding the secondary entanglement risk in floating WTGs structures. The geographic extent of the secondary entanglement risk for the WTGs is large and potentially overlaps with critical habitat and BIAs for 11 marine mammals. The risk is long term (e.g., 30+ years) and there is a high potential for mortality if entanglement occurs. Impacts on individual marine mammals and their habitat would be detectable and measurable, long term, and with population-level effects for some species; however, populations would be expected to fully recover.

The presence of structures would result in impacts on mysticetes, odontocetes, and pinnipeds. Impacts on individuals and their habitat would be detectable, measurable, and long term and could have population-level effects for some species; however, populations would be expected to fully recover. Beneficial impacts due to prey concentrations from the reef effect are possible for odontocetes and pinnipeds. No detectable or measurable effects are anticipated for fissipeds.

Traffic: Vessels may be used to support all project phases. Specialized vessels would be required for survey and installation activities (Appendix A), and the majority of the vessels are expected to have conventional propeller- or thruster-based propulsion systems. Smaller vessels designed primarily for crew transfer applications are expected to employ conventional propeller-propulsion systems and water jet-drive based systems.

As explained under the *Noise* IPF section, this analysis proceeds with using known details from offshore wind projects on the Atlantic OCS,[7] and estimates up to 51 project vessels operating at any given time. It is estimated that one representative project would generate approximately 3,285 vessel roundtrips during the construction and installation phase; this would equate to up to approximately 12 vessel roundtrips per day. Vessel activity would decrease following construction. Vessel activity associated with O&M is anticipated to consist of scheduled inspection and maintenance activities, with corrective maintenance as needed. Each WEA is estimated to generate approximately 8 vessel roundtrips per day throughout the operating period (approximately 35 years). This would equate to approximately 2,902 vessel roundtrips annually. During O&M, crew transfer vessels would be predominant, followed by

[7] Empire Wind (OCS-A 0512), Ocean Wind 1 (OCS-A 0498), and Atlantic Shores South (OCS-A 0499).

support vessels, supply vessels, and jack-up vessels.[8] Approximately the same number of vessel trips per year would be expected during decommissioning as during construction and installation.

If a vessel strike does occur, the impact on marine mammals would depend on the species and strike severity. Vessel strike effects on marine mammal populations would be considered severe in intensity. This is because potential receptors include listed species (Section 3.3.6.1.1, *Threatened and Endangered Marine Mammals*) and other large baleen whales (Section 3.3.6.1.2, *Non-Endangered Marine Mammals*), which have a higher susceptibility to vessel strikes compared to certain odontocetes (excluding sperm whales) and pinnipeds (Section 3.3.6.3.3). As vessels would operate throughout all project phases, vessel strike potential would be continuous. Effects from vessel strikes range from short term in duration for minor injuries to permanent in the case of death of an animal. Although all marine mammals are at risk of vessel strike, most odontocetes and pinnipeds are at lower risk.

Impacts on individuals and their habitat would be detectable and measurable; they would be of medium intensity with the potential for injury or mortality, and long term for all project phases. Impacts on individuals and their habitat could have population-level effects, but it is anticipated the population can sufficiently recover from the impacts to maintain the viability of the species both locally and throughout their range. Impacts on odontocetes and pinnipeds would be of low intensity; impacts on individuals and their habitat would not lead to population-level effects.

3.3.6.4.2 Impacts of Five Representative Projects

The same types of design parameters described for one representative project in each WEA would apply to a total of five representative projects, except that the number and length of each parameter would be scaled up. The increase in activity/duration would increase the likelihood of impacts for all IPFs.

Effect severity is not anticipated to increase substantially for several IPFs, including accidental releases, cable installation and maintenance, discharges/intakes, EMFs and cable heat, gear utilization, impact pile driving associated with HDD and TLP foundations, invasive species, land disturbance for pinnipeds and fissipeds, lighting, and noise (from all sources). Land disturbance would continue to have no effect on mysticetes and odontocetes.

While five projects would increase activity levels, levels would be tempered by separation in time and space. Vessel traffic would increase proportionally with increasing numbers of wind farms. This could create more effects or expose more marine mammals to risk; however, the impacts of those activities would not increase the intensity, duration, or population consequences on individual marine mammals or their habitats. Vessel strikes due to offshore wind are not expected to increase such that there would

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[8] If service operations vessels were used instead of crew transfer vessels, the number of vessel transits to and from port would substantially decrease as these vessels are meant to operate for several weeks at sea. However, transits within the lease area made by crew vessels moving personnel from the service operations vessel to other areas of the windfarm would increase. Currently, no data exist to quantify the number of within-lease area transits that would be expected for a project using service operations vessels instead of crew transfer vessels; for this assessment, it is assumed that the number of transits is of similar magnitude to that generated by crew transfer vessels.

be unrecoverable population-level effects on mysticetes or fissipeds and would not increase impact severity for odontocetes or pinnipeds.

Five representative projects would increase impact levels for anchoring, presence of structures, and port utilization, as discussed below.

Anchoring and presence of structures: Five representative projects would substantially increase the number of mooring lines and interarray cables. Five representative projects could thus entail up to 1,000 WTGs and 12,000 mooring lines (assuming up to 12 mooring lines per WTG), plus additional lines for OSSs (up to 30, plus up to 360 mooring lines for the OSSs). Although these would be spread across the five lease areas (spanning more than 580 square miles [1,502 square kilometers] of sea surface area), they would collectively increase the risk of secondary entanglement. Because empirical data are lacking, it is not possible to rule out population consequences from secondary entanglement mortality. Therefore, impacts would increase for mysticetes, odontocetes, and pinnipeds depending on the PBR and stock. Because of minimal habitat overlap, no measurable or detectable impacts on fissipeds are expected.

Port utilization: Five representative projects would increase port utilization, entailing more vessel traffic and noise, thus potentially increasing marine mammal impacts. Additional vessel noise is not expected to be discernible given already high noise environments of commercial ports. However, additional vessel traffic would increase strike risk. Impacts would increase in severity; effects would be detectable and measurable but would not lead to population-level impacts.

3.3.6.4.3 Impacts of Alternative B on ESA-listed Species

Impacts on ESA-listed mysticetes, odontocetes, pinnipeds, and fissipeds would be the same under Alternative B as for non-ESA-listed members of the same species. While ESA-listed populations may be more affected by impacts due to their smaller abundances and lower PBR values (Table 3.3.6-1) impacts on ESA-listed species are more likely to result in population-level effects.

3.3.6.4.4 Cumulative Impacts of Alternative B

Five representative projects would contribute to all impacts associated with the No Action Alternative with the addition of noise from WTG operations. Some of the contributions would be incremental and likely undetectable such that impact determinations would not change from the No Action Alternative's cumulative scenario. However, five representative projects would produce noticeable contributions and elevate the impact determination for the following: anchoring, cable installation and maintenance, drilling noise, pile-driving noise, and presence of structures. Cumulative impacts related to secondary entanglement risk would be associated largely with anchoring and the presence of wind energy structures; both would increase the risk of debris becoming ensnared and thus posing increased risk to marine mammals. There is significant uncertainty regarding the type and number of debris that may accumulate, and there are no data for debris monitoring on similar mooring structures. However, risk of entanglement is expected to be incremental and detectable in that the potential for impacts increases with the number of mooring structures in the water and that entanglement often leads to mortality.

Therefore, mortality could potentially reach a level from which population effects are not recoverable for some populations.

Any beneficial impacts for odontocetes and pinnipeds may be offset by an increased risk of secondary entanglement and would cease following decommissioning. Gear utilization is mainly due to ongoing fisheries surveys active in the California coastal current ecosystem. Fisheries surveys associated with offshore wind projects would not contribute significantly to the impacts posed by ongoing surveys. Vessel traffic would be a higher risk for mysticetes overall but would not be appreciably greater than the existing risk from ongoing activities.

3.3.6.4.5 Conclusions

Impacts of Alternative B. Alternative B would have the greatest potential for impacts on mysticetes, odontocetes, and pinnipeds; impacts on fissipeds could also occur but at a lesser severity. Potentially beneficial impacts for odontocetes and pinnipeds could occur, though such benefits (from prey concentrations due to presence of structures) may be offset by increased entanglement risk with those structures/their moorings.

Increased vessel traffic and secondary entanglement associated with anchoring and the presence of structures could result in population-level effects (on some ESA-listed and non-ESA-listed species). Though population-level impacts would be less likely to threaten the viability of non-ESA-listed marine mammal populations, the magnitude of mortality resulting from secondary entanglement is not known. Therefore, unrecoverable population effects on ESA and non-ESA-listed species cannot be ruled out.

Cumulative impacts of Alternative B. Accidental releases, anchoring, gear utilization, pile driving, noise (from vessels, UXO detonations, and WTG operations), the presence of structures, and vessel traffic would be the primary contributors to cumulative impacts on marine mammals. Due to their typical habitat, less frequent/severe impacts on fissipeds could occur. Beneficial impacts could occur for some marine mammal species, but such impacts could be offset by an associated risk of entanglement with structures/moorings. Population-level effects would be the same as for Alternative B.

In context of other reasonably foreseeable environmental trends, incremental impacts contributed by five representative projects to cumulative impacts on marine mammals would range from undetectable to appreciable. Five representative projects would contribute to cumulative impacts primarily through anchoring, land disturbance, drilling noise, pile-driving noise, G&G survey noise, WTG noise, and presence of structures. Incremental impacts contributed by Alternative B would therefore be noticeable and appreciable for these IPFs. Incremental impacts associated with other IPFs (i.e., accidental releases, cable installation and maintenance, discharges/intakes, EMFs and cable heat, gear utilization, lighting, port utilization, traffic and noise from aircraft, dredging, trenching, cable laying, underwater detonations, and vessels) would be undetectable when added to the No Action Alternative.

3.3.6.5 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Marine Mammals

Alternative C, the Proposed Action, is the prospective adoption of mitigation measures intended to avoid or reduce Alternative B's potential marine mammal impacts. Accordingly, the analysis considers the change in impacts relative to Alternative B. Appendix E, *Mitigation*, identifies the mitigation measures that would be included in the Proposed Action. Table 3.3.6-3 summarizes relevant mitigation measures.

Table 3.3.6-3. Summary of mitigation measures for marine mammals

Measure ID	Measure Summary
MM-1	This measure requires implementation of a near real-time PAM system to detect baleen whales to provide awareness to mariners involved in offshore wind activities to reduce the risk of vessel strike and impacts from project activities.
MM-2	This measure requires long-term PAM monitoring to inform future predictions of potential impacts on marine mammals.
MM-3	Vessels and facilities must have adequate equipment available and be prepared to address entanglements, consistent with current guidelines and local marine stranding centers.
MM-4	All offshore wind-related vessels will travel at 10 knots (18.5 kilometers per hour) or less during project-related activities and while operating in lease areas. The only exception is when the safety of the vessel or crew necessitates deviation from this vessel speed limit.
MM-5	This measure requires submittal and approval of an Alternative Monitoring Plan to ensure visual monitoring can be achieved when nighttime or poor visibility monitoring is required.
MM-7	To the extent reasonable and practicable, follow the most current IMO guidelines for the reduction of underwater radiated noise including propulsion noise, machinery noise, and dynamic positioning systems of any vessel associated with the project.
MM-8	This measure requires that PSOs are NMFS approved for monitoring during applicable project activities and also requires vessel crew training for protected species identification to reduce vessel strike risk. Furthermore, PSOs must have a 360-degree visual coverage around the vessel at all times that noise-producing equipment <180 kHz is operating, or the vessel is transiting. The alternative Monitoring Plan may include requirements for PSOs for activities at nighttime and other instances of low visibility. PSO data must be collected in accordance with standard data reporting.
MM-11	This measure requires lessees to comply with vessel strike avoidance measure for all marine wildlife. Vessels must avoid transiting through areas of visible aggregations of birds If operational safety prevents avoidance of such areas, vessels must slow to 4 knots while transiting through such areas.
MM-19	This measure requires lessees to submit an Anchoring Plan that identifies and maps locations of interest including hard-bottom and sensitive habitats, potential shipwrecks, potential hazards, and existing and planned infrastructure. The plan will require all vessels deploying anchors to use, whenever feasible and safe, mid-line anchor buoys to reduce the amount of anchor chain or line that touches the seafloor.

Measure ID	Measure Summary
MM-20	This measure requires lessees to submit a Sensitive Marine Species Characterization and Monitoring Plan for biological species and habitats that may be affected by a project's activities. Species and habitats that are particularly sensitive to impacts will be identified and avoided and will require monitoring, allowing for the identification of adverse effects and evaluation of mitigation efforts. Consolidated seafloor sediments are equivalent to sensitive habitats and species and shall be avoided from direct and indirect impacts unless data exist to demonstrate no harm to sensitive species.
MM-27	This measure recommends static cable design elements, including burial below the seabed where feasible, avoidance of methods that raise the profile of the seabed, and removal of large marine objects and decommissioning instrumentation and/or anchors as soon as practicable and within required regulations and permits. This measure should reduce possible damage to fishing gear. Future mitigations may include gear identification and/or lost survey gear monitoring and reporting.
MM-32	This measure encourages lessees to coordinate transmission infrastructure among projects by using, for example, shared intra- and interregional connections, meshed infrastructure, or parallel routing, which may minimize potential impacts from offshore export cables.
MM-33	This measure requires monitoring of cables periodically after installation to determine cable location, burial depths, and site conditions to determine if burial conditions have changed and whether remedial action or additional mitigation measures are warranted.
MM-34	Lessees should use standard underwater cables that have electrical shielding to reduce the intensity of EMFs.
MM-36	This measure requires the lessee to develop an Oceanographic Monitoring Plan. Monitoring reports are a required component of the plan and will be used to determine the need for adjustments to monitoring approach, consideration of new monitoring technologies, and/or changes to the frequency of monitoring. Components of the plan to consider include coordination with relevant regulatory agencies and neighboring lessees; monitoring strategies for pre-construction, construction, post-construction, and decommissioning phases; comparisons with available model outputs; technologies; and appropriate physical and biochemical measurement.
MM-40	Lessees are encouraged to coordinate monitoring and survey efforts of long-term scientific surveys across lease areas to standardize approaches, understand regional potential impacts, and maximize efficiencies in monitoring and survey efforts.

3.3.6.5.1 Impacts of One Representative Project in Each WEA

Proposed mitigation measures could potentially reduce some marine mammal impacts associated with Alternative B. Notably, mitigation measures limited to required reporting procedures would not directly reduce marine mammal impacts but would provide information that could potentially lead to new or revised mitigation measures. For the IPFs that are not discussed below, mitigation measures would not reduce the impacts. Consequently, the impact levels under Alternative C for those IPFs remain the same as under Alternative B.

Anchoring: MM-19 would require an Anchoring Plan to minimize bottom disturbance to hard-bottom resources. While an Anchoring Plan could assist in assessing secondary entanglement risk, it would not measurably reduce such risk. MM-19 could result in future mitigations that could include gear identification and/or lost survey gear monitoring and reporting to potentially help avoid or reduce impacts from lost fishing gear. MM-3 would reduce impacts from entanglement of marine mammals by having vessels and facilities with adequate equipment available and being prepared to address entanglements. In sum, anchoring would primarily affect mysticetes, odontocetes, and pinnipeds. Mitigation measures would not reduce the risk of secondary entanglement, MM-3 provides response measures in the event of an entanglement; however, any entanglement could result in mortality.

Cable installation and maintenance: MM-32 would consolidate the extent of transmission cables (where feasible), potentially reducing the affected area. MM-33 would require periodic cable inspection to ensure proper cable burial depth and integrity. These measures would functionally reduce impacts from turbidity and sedimentation that could affect marine mammal prey species, though impacts would remain for pinnipeds and fissipeds.

EMFs and cable heat: MM-32 could reduce EMF effects by grouping transmission cables and, thus, reducing the geographic extent of such effects. MM-33 would require periodic cable inspection to ensure proper cable burial depth and integrity. MM-34 proposes to use standard underwater cables that have electrical shielding to control EMF intensity, which could potentially reducing such impacts from floating array cables. There are no measures that would reduce potential EMF effects from ICCP systems. Collectively, these measures would reduce but not eliminate impacts.

Gear utilization: MM-19 could result in future mitigations that could include gear identification and/or lost survey gear monitoring and reporting to potentially reduce the risk of entanglement. MM-3 would reduce impacts from entanglement of sea turtles by having vessels and facilities with adequate equipment available and being prepared to address entanglements. The risk of entanglement would remain and mortality and injury cannot be eliminated without full evaluation of individual survey plans.

Noise: MM-7 would require vessel noise reductions by following the most current IMO guidelines. Measures for project vessels/activities to avoid encounters with marine mammals (including MM-1, and MM-8) would reduce marine mammals exposure to noise. Reporting requirements (MM-8) would not reduce impacts directly but could evaluate impacts and potentially lead to additional mitigation measures. Furthermore, monitoring clearance and shutdown zones during low visibility (MM-5) and ensuring PSO requirements are met when noise-producing equipment under 180 kHz is operating (MM-8) would also play a role in reducing noise exposure. These measures would lessen the degree of impacts but not change impact levels for the following activities: G&G surveys, pile driving, and UXO detonation. Impacts would remain the same as Alternative B for these activities. MM-7 would individually and collectively reduce vessel noise; however, vessel noise impacts would remain since the guidelines in MM-7 are not well defined or tested. Measures that require reporting (including but not limited to MM-8) and long-term monitoring of marine mammals (MM-2) would not directly reduce impacts but could provide important information leading to further adaptive management practices and mitigation. MM-20 would reduce noise through avoidance of sensitive habitats, leading to a reduction in noise in those habitats, but any such reductions would be highly localized. These measures would not, however, reduce WTG operation noise impacts, mainly owing to the lack of information on such noise sources, including the technical feasibility of mitigating such noise.

Port utilization: As vessel noise and traffic are the primary impacts associated with port utilization, refer to those IPF discussions for how mitigation would lessen related effects.

Presence of structures: As part of the Oceanographic Monitoring Plan required by MM-36, physical oceanographic measurements (e.g., ocean temperature, salinity, pH, current velocity, biogeochemistry, and nutrients) will be collected and considered. While monitoring would not directly reduce the hydrodynamic effects of wind farms on marine mammals, the information gathered could be evaluated for efficacy and potentially lead to changes in or additions to existing mitigation measures. MM-33 involves monitoring cables and reporting entanglement events, which reduce the risk of secondary entanglement for marine mammals. MM-3 would reduce impacts from entanglement of sea turtles by having vessels and facilities with adequate equipment available and being prepared to address entanglements. However, impacts would remain, primarily for mysticetes, odontocetes, and pinnipeds. Beneficial impacts due to the reef effect remain possible for odontocetes and pinnipeds.

Traffic: Several mitigation measures would reduce vessel strike risk, which is a concern for all marine mammals. The most direct reduction of this risk would come from limiting vessel speeds and implementing strike-avoidance protocols (MM-11, MM-4, and MM-8). Vessel-speed restrictions are a known and effective mechanism for reducing potential strike risk to all marine mammal species. Slower speeds allow both vessels and animals to take evasive action; if a strike occurs, slower speeds would also reduce injury severity and mortality potential.

Other measures would further seek to avoid vessel strikes through training, watch protocols, monitoring plans and ongoing monitoring/reporting (MM-2, MM-19, and MM-8). Individually and collectively, these measures would increase situational awareness. Reporting measures would not directly reduce impacts, but information gathered would assist in adaptive management and potentially introduce new mitigation measures.

In sum, effective implementation of the measures above would minimize encounters that could result in a vessel strike and also reduce potential severity of strikes. Alternative C would reduce the severity of impacts on all marine mammals.

3.3.6.5.2 Impacts of Five Representative Projects

Five representative projects would increase the likelihood of impacts, particularly during O&M. If lease areas were constructed concurrently, individual marine mammals could be exposed to multiple projects' impacts in generally the same area at the same time.

Mitigation measures, when combined with spatial separation (i.e., the distance between the Humboldt and Morro Bay WEAs), would result in impact levels similar to one representative project in each WEA for some IPFs. MM-36 would require the development of an Oceanographic Monitoring Plan, and MM-40 encourages lessees to coordinate monitoring and survey efforts across lease areas to standardize approaches, understand potential impacts on resources at a regional scale, and maximize efficiencies in monitoring and survey efforts. While these measures would not directly reduce impacts on marine mammals, the information gathered could be evaluated for efficacy and potentially lead to changes in or additions to existing mitigation measures.

Therefore, impact levels for five representative projects from accidental releases, cable installation and maintenance, discharges/intakes, EMFs and cable heat, gear utilization, lighting, noise, and vessel traffic are expected to be the same as discussed for one representative project in each WEA.

Mitigation measures would lessen but not substantively reduce secondary entanglement risk. Relative to one representative project, secondary entanglement risk associated with anchoring and the presence of structures would increase for mysticetes, odontocetes, and pinnipeds. Five representative projects, even with mitigation, would increase port utilization impacts because the increased concentration of activities over long periods of time could lead to behavioral modifications.

3.3.6.5.3 Impacts of Alternative C on ESA-Listed Species

As noted above, ESA-listed marine mammals are more vulnerable to impacts from secondary entanglement (anchoring and presence of structures) and vessel traffic. Species utilizing the high-risk areas regularly would be at risk of encountering an ecological "sink" whereby features resulting in mortality within the habitat are diminishing population viability even though the habitat may be used regularly. While ESA-listed populations may be more affected by impacts due to their smaller abundances and lower PBR values (Table 3.3.6-1) impacts on ESA-listed species are more likely to result in population-level effects. Because of lack of empirical data necessary to fully quantify the risk of mortality in relation to PBR analysis of ESA-listed stocks, population consequences cannot be wholly eliminated from secondary entanglement mortality across the large geographic and temporal scale of five representative projects. Because no existing or developing mitigation measures have been identified that substantively address secondary entanglement, there would be no change in the severity of impacts on ESA-listed mysticetes, odontocetes, and pinnipeds.

3.3.6.5.4 *Cumulative Impacts of Alternative C*

The mitigation measures proposed in Alternative C would reduce impacts for some individual IPFs associated with full wind development (five projects), but the measures would not avoid or lessen the impacts of ongoing and planned activities. The most acute impacts on marine mammals would be associated with anchoring and the presence of structures. Other impacts on marine mammals would be associated with accidental releases, underwater detonations ("seal bombs"), vessel noise and traffic, and gear utilization (particularly for odontocetes and pinnipeds).Cumulative impacts for accidental releases are driven primarily by ongoing activities associated with the potential for a large oil spill. Anchoring and the presence of structure impacts are mainly derived from the risk of secondary entanglement in debris that may become snagged on the offshore wind mooring lines and interarray cable. The risk of entanglement is incremental in that the potential for impacts increases with the number of structures in the water, and entanglement often leads to mortality; therefore, mortality could reach a level from which population effects are not recoverable. There is significant uncertainty regarding the type and amount of debris that may accumulate, and there are no data for debris monitoring on similar mooring structures. Gear utilization is mainly due to ongoing fisheries surveys active in the California coastal current. Fisheries surveys associated with offshore wind projects would not contribute significantly to the impacts posed by ongoing surveys. Vessel traffic would be a higher risk for mysticetes overall but would not be appreciably greater than the existing risk from ongoing and planned activities.

3.3.6.5.5 Conclusions

Impacts of Alternative C. Relative to Alternative B, Alternative C's mitigation measures would reduce the severity and frequency of many impacts, including vessel strike risk, but no mitigation would fully eliminate any impacts at the programmatic level.

Secondary entanglement risk (from anchoring and presence of structures) has the potential to result in population-level effects compromising the viability of ESA-listed species. Similarly, WTG noise is expected to result in recoverable population impacts, mainly driven by the uncertainty of that IPF. Uncertainty also surrounds presence of structures–related impacts associated with hydrologic and oceanographic effects.

Cumulative Impacts of Alternative C. Mitigation measures comprising Alternative C would reduce the occurrence or severity of marine mammal impacts for some IPFs. In context of other reasonably foreseeable environmental trends, incremental impacts contributed by Alternative C would range from undetectable to appreciable. Secondary entanglement risk to population viability would persist for both ESA- and non-ESA-listed species.

3.3 Biological Resources

3.3.7 Sea Turtles

This section discusses potential impacts on sea turtles from the Proposed Action, alternatives, and ongoing and planned activities in the Affected Environment (Figure 3.3.7-1). Sea turtles have large geographic ranges including the CCLME and the Gulf of Alaska LME, where some migratory sea turtle species may occur seasonally. However, the analysis in this draft PEIS focuses on sea turtles likely to occur in California coastal and OCS waters, including the five California lease areas and surrounding areas where impacts are most likely to occur.

3.3.7.1 Description of the Affected Environment and Baseline Conditions

Seasonal migrations and local foraging patterns influence sea turtle movement. Sea turtles cover considerable distances in their lifetime between their foraging/resting and reproductive areas (CDFW 2021). Species occurrence in the Affected Environment is not uniform; some species have different migratory routes and foraging patterns. Some species are pelagic and occur farther offshore, some are coastal and are found nearshore, and others occur in both near- and offshore areas (NMFS and USFWS 2014, 2016, 2020a, 2020b). The abundance and availability of prey also influence migratory routes and foraging patterns, both of which are tied to oceanographic properties and processes (NMFS and USFWS 2014; Welch et al. 2019).

Water temperature affects the distribution of some sea turtle species. Loggerheads are typically found in waters with surface temperatures ranging from 59 to 77°F (15 to 25°C). Green turtles are known to inhabit areas with sea surface temperatures of 59°F (15°C) or higher. Olive ridleys prefer warmer waters, with sea surface temperatures ranging from 73 to 82°F (23 to 28°C) (Polovina et al. 2004). In contrast, leatherbacks adapt to a broader range of water temperatures; they can maintain a core temperature between 77 and 81°F (25 and 27°C), even in the presence of colder surface seawater conditions ranging from 52 to 62°F (10.9 to 16.7°C) (Davenport et al. 2015). Waters north of Point Conception are usually above 59°F (15°C) for less than 3 months per year and occasionally drop below 50°F (10°C) (Polovina et al. 2004; NMFS 2023a).

Figure 3.3.7-1. Sea turtles Affected Environment

Wind pattern and current changes can affect seasonal upwelling location, timing, and intensity, which can affect species distribution and health. Section 3.3.2, *Benthic Resources*, contains a more detailed discussion of upwelling. There are several examples of ongoing climate changes to oceanographic conditions and resulting effects on the biological components in the Affected Environment. Bond et al. (2015) identified a warmwater anomaly (i.e., up to 5.4°F [3˚C] change in sea surface temperatures) in the northeast Pacific, which affected mainly the Gulf of Alaska but persisted into Northern California, with some changes seen as far south as Baja California, producing measurable effects on temperatures and a shallow mixing layer (Di Lorenzo and Mantua 2016). Changes in sea surface temperatures related to El Niño-Southern Oscillation climate patterns are known to affect the presence of loggerheads in coastal California, resulting in interannual changes in their relative occurrences (Eguchi et al. 2018). Additionally, climate change can have long-lasting biological consequences for sea turtles, including alterations in distribution patterns; however, predictions of these changes and effects are uncertain.

Four sea turtle species have geographic ranges that include the Humboldt and Morro Bay WEAs (Table 3.3.7-1). Data regarding the population, abundance, and occurrence of each species are derived from species-specific studies. There is currently a lack of standardized habitat-based density models for sea turtles covering the entire U.S. West Coast. There are no documented nesting sites of sea turtles along the California coast or on California's offshore islands.

Green sea turtle: Green sea turtles occur globally in tropical to subtropical waters. Individuals occurring off California are part of the East Pacific DPS (NMFS 2023a). The East Pacific DPS distribution spans from the California–Oregon border to central Chile; nesting for this DPS ranges from Mexico to Peru. Genetic studies indicate that green sea turtles feeding in Southern California originate from various nesting sites, with a significant contribution from the Revillagigedo Islands and Michoacan (Dutton et al. 2018). The East Pacific DPS population is estimated at 20,112 nesting females, with an increased trend in population (NMFS and USFWS 2016).

Approximately 60 individuals are thought to inhabit the Southern California Bight (NMFS 2023a). Some of these individuals are known to enter the San Gabriel River when offshore water temperatures drop below 59°F (15°C) (Crear et al. 2016). Given their proclivity for warmer waters, green sea turtles are anticipated to be present year-round off Southern California but rarely encountered in the Humboldt and Morro Bay lease areas.

Green sea turtles are attracted to dense seagrass beds that serve as their primary feeding grounds and their diet consists of seagrass (especially eelgrass), but when seagrass is scare, they feed on algae and invertebrates that attach to hard surfaces such as rocky bottoms and artificial structures (Crear et al. 2017; Eguchi et al. 2020). Eelgrass beds provide sustenance and function as habitats for prey species, particularly invertebrates (Lemons et al. 2011).

Table 3.3.7-1. Sea turtles likely to occur in with geographic ranges that include the Humboldt and Morro Bay WEAs

Common Name	Scientific Name	DPS/ Population	Listing Status ESA	Minimum Population (Abundance) Estimate Nmin[1]	Population Trend	Critical Habitat	Humboldt WEA		Morro Bay WEA	
							Relative occurrence[2]	Seasonality[3]	Relative occurrence[2]	Seasonality[3]
Green sea turtle	*Chelonia mydas*	East Pacific	Threatened	20,112	Increasing	Yes[4]	Rare	N/A	Common	Year-Round
Leatherback sea turtle	*Dermochelys coriacea*	West Pacific	Endangered[4]	1,277	Decreasing	Yes[5]	Common	Summer, Fall	Common	Summer, Fall
Loggerhead sea turtle[6]	*Caretta caretta*	North Pacific	Endangered	4,074	Increasing	No	Uncommon	N/A	Regular	Summer, Fall[7]
Olive ridley sea turtle	*Lepidochelys olivacea*	East Pacific	Endangered	1.1 million	Increasing	No	Rare	N/A	Uncommon	N/A

Source: Population abundance, trend and seasonal occurrence were derived from NMFS and USFWS reports (NMFS and USFWS 2016, 2020a) and species-specific studies (Benson et al. 2020; Eguchi et al. 2007; Martin et al. 2020).

[1] The best available minimum population (abundance) estimates (Nmin) are based on nesting females and correspond to the global population of a species in its entire range.

[2] Relative occurrence is defined as: Common = occurring consistently in moderate to large numbers; Regular = occurring in low to moderate numbers on a regular basis or seasonally; Uncommon = occurring in low numbers or on an irregular basis; Rare = limited records exist for some years.

[3] Seasons are defined as: spring (March–May); summer (June–August); fall (September–November); winter (December–February). Seasonality is not applicable (N/A) when occurrence is rare or uncommon.

[4] National Oceanic and Atmospheric Administration has proposed to designate a critical habitat for green sea turtles in Southern California. The proposed rule is currently under revision (NMFS 2023a).

[5] There is an approximately 284-square-nm overlap between this critical habitat and the Morro Bay WEA (BOEM 2022).

[6] Leatherback sea turtle is also listed as endangered under the California Endangered Species Act.

[7] Loggerheads are anticipated to experience an increase in numbers during warmwater periods, particularly in the presence of El Niño events.

DPS = Distinct Population Segment, ESA = Endangered Species Act, Nmin = best available minimum population (abundance) estimates, N/A = not applicable

Most green sea turtles that occur off Southern California are juveniles, although some adults are present (NMFS 2023a). There is an indication that the local population is increasing, potentially linked to conservation initiatives targeting Mexican nesting sites. NOAA has proposed green sea turtle critical habitat designations off the coast of Southern California (NMFS 2023a). These proposed areas cover nearshore waters along the coast, extending from San Diego Bay to Santa Monica Bay (excluding waters adjacent to Camp Pendleton), including Catalina Island. Furthermore, it includes coastal waters south of San Diego to the Mexican border, a migration route for green sea turtles. The proposed critical habitat overlaps with vessel routes out of Southern California ports (although Port of Los Angeles and Port of Long Beach are not a part of this proposed critical habitat).

Primary threats to this species include degradation of nesting beaches, harvesting of eggs, bycatch in fisheries, and collisions with vessels.

Leatherback sea turtle: Leatherback sea turtles have a broad global distribution, occupying various locations throughout their lifetime. Although early life stages prefer oceanic waters, adult leatherback turtles are typically found in mid-ocean, continental shelf, and nearshore waters (NMFS and USFWS 1992). Leatherbacks off California belong to the West Pacific subpopulation and nest on beaches in Indonesia, Papua New Guinea, and the Solomon Islands (NMFS and USFWS 2020a).

Like other sea turtle species, leatherback movement patterns are influenced by prey availability. A subset of West Pacific leatherback adults and subadults travel long distances between their reproductive areas to forage in the northern West Coast, including the coastal waters of Central California (CDFW 2021). These turtles migrate during the summer and fall months when large aggregations of prey are present (Benson et al. 2007; NMFS and USFWS 2020a). Their diet consists of jellyfish and other gelatinous prey, although they may incidentally consume sea urchins, squid, crustaceans, fish, and vegetation (Eckert et al. 2012).

The West Pacific subpopulation of leatherbacks has an estimated 1,277 nesting females (NMFS and USFWS 2020a). Aerial surveys from 1990 to 2003 showed an average annual abundance of 128 individuals off the California coast, but no clear population trend. However, data from 2004 to 2017 indicated a decline to an average of 55 individuals per year, an 80 percent drop from the earlier period (Benson et al. 2020). Major nesting beaches like Jamursba Medi and Wemon have seen significant declines in nesting females (78.3 and 62.8 percent, respectively), with an overall annual decrease of 5.9 percent (Tapilatu et al. 2013). Mortality rates, influenced by fishing and human impacts on nesting beaches, exceed sustainable levels. Any rate above 1.54 fatalities per year could lead to further population decline (Curtis et al. 2015).

In 2001, the Pacific Leatherback Conservation Area was created to reduce leatherback bycatch mortality by banning seasonal swordfish drift gillnet fishing in California, Oregon, and Washington. In addition, critical habitats for leatherbacks are present off the west coast. Off California, critical habitats span from Point Arena to Point Arguello, east of the 9,843-foot (3,000-meter) depth contour and overlap with the Morro Bay WEA. Additional habitats extend from Cape Flattery, Washington, to Cape Blanco, Oregon, east of the 6,562-foot (2,000-meter) depth contour. The Humboldt WEA is situated between these two areas of critical habitat (for feeding); leatherback presence is anticipated mainly during summer and fall.

Loggerhead sea turtle: Loggerhead sea turtles offshore California are part of the North Pacific DPS (NMFS 2011). The range of this DPS spans waters north of the Equator and south of 60º N latitude (Conant et al. 2009). The best available nesting female population estimate for this DPS is 4,074 (NMFS and USFWS 2020b). This DPS nests primarily on the coast of Japan, later transitioning to the central Pacific during juvenile years (NMFS and USFWS 2020b).

The North Pacific DPS of loggerhead sea turtles is distinct from the South Pacific DPS that nests primarily in Australia and New Caledonia. However, all loggerheads in the Pacific are known to undertake extensive trans-Pacific migrations (NMFS and USFWS 2020b). Through satellite tracking, it has been discovered that hatchlings from nesting beaches in Japan (North Pacific DPS) and Australia (South Pacific DPS) migrate across the Pacific Ocean to feed off the coasts of Baja California, Mexico, Peru, and Chile. Loggerhead sea turtles are omnivorous, consuming crabs, mollusks, jellyfish, and vegetation. However, most adult loggerheads target benthic invertebrates (ADFG 2024; NMFS 2023b). They spend many years in these feeding grounds, possibly up to 20 years, growing to maturity before migrating back to the beaches where they hatched in the western Pacific to mate, nest, and live out the remainder of their lives. This migration behavior indicates that, although the North Pacific DPS and South Pacific DPS are geographically and reproductively distinct, their feeding grounds may overlap, leading to some level of interaction among different DPSs during their oceanic phase (NMFS and USFWS 2020b).

Aerial surveys offshore California show significant variability in loggerhead abundance, with high densities in certain years and none in others. Loggerhead sightings in Southern California were initially linked to turtles migrating north from foraging off Baja California. However, some individuals off California have been found to originate from the central Pacific (Allen et al. 2013).

Loggerhead strandings in California have occurred south of Point Conception during summer months. In recent years, there has been an increase in strandings in Northern California, Oregon, and Washington linked to rising water temperatures (Eguchi et al. 2018).

The Pacific Loggerhead Conservation Area is south of Point Conception, California; it coincides with California drift gillnet fishing grounds (and potential vessel routes from Southern California ports). Within this designated zone, the large mesh drift gillnet fleet is subject to closure during specific conditions, such as the occurrence or an El Niño forecast of higher-than-normal sea temperatures. This precaution is intended to minimize bycatch in response to observed/expected higher density of loggerheads in the waters off Southern California during warmer water years (Welch et al. 2019).

Loggerheads are more likely to be present in or near the Morro Bay WEA; they are less likely in the Humboldt WEA.

Olive ridley sea turtle: Olive ridley sea turtles likely to occur in the WEAs belong to the East Pacific population, which is typically found in subtropical and tropical waters between Southern California and Peru. East Pacific olive ridleys nest in Mexico and Costa Rica, including some areas of Baja California

(Kelez et al. 2009; NMFS and USFWS 2014). The East Pacific population is estimated to have approximately 1.1 million nesting females, showing an increasing trend, according to NMFS and USFWS (2014). However, there is no available estimate for the annual abundance of this species occurring specifically offshore California.

Olive ridley sea turtles are present in both oceanic and neritic waters. During the non-breeding phase of their life cycle, these turtles reside in the oceanic zone. During breeding, they migrate to the neritic zone (extending from mean low water down to 660-foot [200-meter] depths). After the reproductive migration, members of this population display nomadic behavior, traversing vast oceanic expanses without settling into feeding grounds (NMFS and USFWS 2014).

Most olive ridley sightings north of Southern California involve dead or stranded turtles. Although there have been recorded sightings of live olive ridleys off Central California, such instances are rare because these turtles typically prefer warmer waters. Sea turtles, however, are known to expand their habitat range and migrate into northern latitudes during warm water years (Steiner and Walder 2005). Olive ridleys are thus anticipated to occur in the Morro Bay WEA but not in the Humboldt WEA.

Baseline conditions: Baseline conditions, including ongoing impacts of climate change on sea turtles, are not expected to change significantly in the immediate future. Climate-driven oceanographic conditions that are globally manifested in distributional shifts will likely produce impacts that will have long-term turtle population consequences. In addition to climate effects, sea turtles in the Affected Environment are expected to continue to be exposed to several primary stressors that can result in declined health, injury, or mortality. California is home to three of the 10 busiest ports in the United States (Los Angeles, Long Beach, and Oakland) and the busiest container port in the Western Hemisphere (Los Angeles) (Port of Los Angeles 2023). The ongoing risk related to vessel strikes off the coast of California has been documented (NMFS and USFWS 2020a). Fisheries will continue to present a risk of bycatch, entanglement, resource competition, and habitat disruption.

Predicting future baseline conditions for California sea turtle species is complex because of their long-lived nature; the significant area of use, which crosses geopolitical boundaries; and the difficulty in detecting measurable population changes. Population estimates are based on sea turtle nesting, which may reflect population changes that occurred 10 years or more prior to nesting. However, based on the most recent reviews (NMFS and USFWS 2014, 2020a, 2020b), current population trends for each species (Table 3.3.7-1) are not expected to change significantly. It is likely that climate-driven changes in nesting and foraging will be the most influential population drivers for future baseline conditions.

3.3.7.2 Impact Background for Sea Turtles

Sea turtle ear anatomy distinguishes sea turtles from their terrestrial and semi-aquatic counterparts. Sea turtles can hear sounds both in air and water, though the ecological significance of sound for them is not well understood. While our understanding of sea turtle sound production and hearing is limited, the growing body of knowledge suggests sound may be crucial to these animals.

A number of studies have examined sea turtle hearing, both in air and in water, over a limited number of life stages. In general, sea turtles in water hear best between 200 and 750 Hz; they do not hear well above 1 kHz. However, there are species-specific and life-stage-specific differences in sea turtle hearing. Sea turtles are also generally less sensitive to sound than marine mammals, with the most sensitive hearing thresholds underwater measured at or above 75 dB re 1 µPa (Reese et al. 2023; Papale et al. 2020). Appendix H, *Background on Underwater Sound*, provides an in-depth discussion of the importance of sound to sea turtles, hearing anatomy, and thresholds for non-auditory injury, auditory injury, and behavioral disturbance.

IPFs associated with sea turtle impacts include accidental releases, cable installation and maintenance, discharges/intakes, EMFs and cable heat, gear utilization, noise, port utilization, presence of structures, and vessel traffic. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.3.7-2. Refer to Section 3.1.2, *Impact Terminology,* for definitions of beneficial impacts.

Table 3.3.7-2. Issues and indicators to assess impacts on sea turtles

Issue	Impact Indicator
Underwater noise from construction, operation, and decommissioning	Extent, frequency, and duration of impacts resulting from noise above established effects thresholds, as noted in Section 2.5 (Table 4-5) in the Construction and Operations Plan Modeling Guidelines[1]
Vessel collisions	Qualitative estimate of potential collision risk
Water quality impacts	Quantitative estimate of intensity and duration of suspended sediment effects. Qualitative analysis of impacts from potential discharges (e.g., fuel spills, trash, debris) relative to baseline
Artificial light	Intensity, frequency, and duration of impacts relative to baseline
Power transmission	Theoretical extent of detectable electric and magnetic field effects
Seabed and water-column disturbance/alteration	Water-column volume and acres of seabed disturbance, loss, or conversion by structure presence
Habitat alteration	Acres of land disturbance (e.g., nesting habitat), loss, or conversion due to onshore construction or cable landfall
Prey impacts	Extent, frequency, and duration of impacts resulting from activities associated with offshore wind development on prey species for sea turtles
Entanglement risk from gear/ wind equipment	Qualitative estimate of potential entanglement risk
Invasive Species	Qualitative estimate of sources of invasive species, introduced habitat, and propagation or expansion of invasive species

[1] BOEM 2023a.

3.3.7.3 Impacts of Alternative A – No Action – Sea Turtles

When analyzing the impacts of the No Action Alternative on sea turtles, BOEM considers the impacts of ongoing activities on baseline conditions for sea turtles. The cumulative impacts of the No Action Alternative consider the impacts of the No Action Alternative on existing baseline trends, plus other planned activities (Appendix C, *Planned Activities Scenario*).

3.3.7.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for sea turtles would continue to follow regional trends and respond to ongoing activities in the Affected Environment. Ongoing activities that can affect sea turtles include undersea transmission lines, gas pipelines, and other submarine cables; military use; ongoing vessel traffic; scientific research; fisheries use, management, and monitoring surveys; oil and gas activities; onshore development activities; and global climate change.

Ongoing activities are relevant to numerous impacts, including the following. Sea turtle mortality mainly results from vessel strikes and entanglement in fishing gear.

- Accidental releases, which can have physiological effects on sea turtles
- Anchoring, which can disturb benthic habitats and affect water quality
- Discharges/intakes, which can result in altered microclimates of warm water surrounding outfalls and entrainment risk (e.g., the Diablo Canyon Power Plant's once-through cooling system)
- EMFs and cable heat, which can result in behavioral changes in sea turtles
- Cable installation and maintenance and port utilization, which can disturb benthic habitats, affect water quality, and present an entrainment risk for sea turtles
- Gear utilization, which can result in an increased entanglement risk; lighting, which can affect aggregations of prey
- Noise, which can have physiological and behavioral effects on sea turtles
- Presence of structures, which can result in behavioral changes in sea turtles and effects on prey species and increase the risk of interactions with fishing gear
- Vessel traffic, which can increase the risk of vessel strikes

Global climate change is also an ongoing risk for sea turtles in the Affected Environment. Increases in temperatures, ocean acidity, sea levels, freshwater runoff, and frequency and intensity of storms, along with changing ocean circulation and precipitation patterns, would alter existing habitat, potentially change the sex ratio of sea turtle populations, change nesting and migration activity, increase invasive species, and inhibit population growth (Patrício et al. 2019; Varela et al. 2019; Marn et al. 2017; Hays et al. 2014).

3.3.7.3.2 Impacts of Alternative A – No Action on ESA-Listed Species

As all sea turtle species expected to occur in the Humboldt and Morro Bay WEAs are ESA-listed as either threatened or endangered, the same impacts described above for the No Action Alternative are applicable to ESA-listed sea turtle species.

3.3.7.3.3 Cumulative Impacts of the No Action Alternative

Planned activities that may affect sea turtles include new submarine cables and pipelines, tidal energy projects, oil and gas activities, dredging and port improvement, marine minerals extraction, military use (i.e., sonar, munitions training), marine transportation, research initiatives, and construction of new structures (e.g., artificial reefs) on the OCS.[1] These activities could displace, injure, or kill individual sea turtles.

The designation of the Chumash Heritage National Marine Sanctuary in late 2024/early 2025 would impose regulations within its boundaries that would likely have beneficial impacts on sea turtles.

BOEM expects ongoing and planned activities to affect sea turtles through the IPFs discussed below.

Accidental releases: Accidental releases of contaminants and debris from ongoing and planned activities can injure or kill sea turtles through exposure to contaminants and ingestion of foreign objects. Accidental releases of fuel, fluids, hazardous materials, trash, and debris are expected to remain constant in the Affected Environment. Oil and gas activities have a higher potential to result in larger volume spills. Two significant oil spills off Santa Barbara (1969 and 2015) resulted in mortality for sea birds and marine mammals. According to a database maintained by the California Office of Spill Prevention and Response (https://calspillwatch.wildlife.ca.gov/Spill-Archive), there were 12 reportable spills offshore California between 2015 and 2020 from tanker, port, and platform/pipeline incidents. BOEM anticipates such trends will continue.

Accidental releases may pose a long-term risk, potentially leading to injury or death for turtles in proximity and impacts on prey species (Camacho et al. 2013; Bembenek-Bailey et al. 2019; Mitchelmore et al. 2017; Shigenaka et al. 2021; Vargo et al. 1986). Oil and fuels from accidental spills may also be transported away from the initial spill site or undergo weathering processes, which can have unforeseen effects on marine life (Passow and Overton 2021). However, the potential for exposure and impacts on prey species would be low, given the isolated nature of these accidental releases when following available regulations, such as those set forth by the International Convention for the Prevention of Pollution from Ships (IMO 2019), and the variable distribution of sea turtles in the Affected Environment.

Sea turtles inhabiting coastal waters of urbanized Southern California exhibit elevated concentrations of trace metals in comparison to their counterparts in non-urbanized areas (Barraza et al. 2019). In

[1] Refer to BOEM's Environmental Assessment for more discussion of the site assessment activities associated with the Brookings and Coos Bay WEAs: https://www.boem.gov/renewable-energy/state-activities/oregon-wind-energy-areas.

addition, these sea turtles demonstrate detectable levels of persistent organic pollutants. Given that green sea turtles are year-round residents in these waters, they are vulnerable to prolonged exposure to contaminants. Research indicates that exposure to substances such as persistent organic pollutants is associated with decreased hatchling success and survival, lower growth rates, and compromised immune function.

Trash and debris may be accidentally released through fisheries use, ocean disposal of dredged material, marine mineral extraction, marine transportation, navigation and traffic, survey activities, and laying cables, lines, and pipelines. River outflows and wind can also introduce land-based debris from onshore areas. Sea turtles directly ingest plastic, mistaking it for prey (Bugoni et al. 2001; Gregory 2009; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). Sea turtles have been found to ingest tar, paper, Styrofoam™, wood, reeds, feathers, hooks, lines, and net fragments (Thomás et al. 2002). Ingestion of marine debris varies among species and life history stages (Nelms et al. 2016) and can result in both lethal and sublethal effects, the latter more difficult to detect (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). Long-term effects can include dietary dilution, chemical contamination, depressed immune system function, poor body condition, and reduced growth rates, fecundity, and reproductive success (Nelms et al. 2016).

Impacts from accidental releases and discharges from ongoing and planned activities would be measurable, long term, and may result in the loss of individuals but are not expected to result in population-level effects.

Anchoring: Vessel anchoring associated with ongoing commercial and recreational activities heightens seabed turbidity, which can change sea turtle behavior and prey availability. Increased turbidity may affect sea turtle prey distribution. Studies on fish indicate that suspended solids can reach high concentrations (thousands of mg/L) before causing acute reactions (Wilber and Clark 2001). Sedimentation effects are localized and temporary and anchoring in the Affected Environment is limited, so turbidity effects on sea turtle prey are expected to be minimal.

The Chumash Heritage National Marine Sanctuary would allow anchoring but prohibit seabed alterations. However, benefits from such restrictions would be localized to the proposed sanctuary, not significantly altering the effects of ongoing activities outside its boundaries. Accordingly, cumulative impacts on sea turtles are not anticipated.

Cable installation and maintenance: Installation of telecommunication cables, pipelines, and power cables would disturb the seabed, temporarily increasing suspended sediment. As discussed for the anchoring IPF, elevated turbidity could cause temporary behavioral responses in some sea turtles (e.g., avoiding the turbidity zone or changing foraging behavior).

Twenty-two telecommunications cables are installed in the Affected Environment as of 2024; two additional projects are planned. Additional oil- and gas-related pipelines and power cables are present. Installation of new cables and maintenance and future decommissioning of cables and pipelines are anticipated to disturb the seafloor, locally elevating turbidity.

In general, during trenching of offshore areas, plumes generated by suspended sediments would remain close to the seabed and would not extend into the water column. Sediment transport modeling for Atlantic OCS activities suggests that sediment displacement is low, with suspended sediments dissipating within 4 hours (Tetra Tech 2022). Cable installation by jet plowing is predicted to result in suspended sediment concentrations below 500 mg/L, lasting minutes to hours. All sediment plumes are expected to settle within 24 hours after jetting operations. Jet plow trenching in shallower water depths may cause plumes to nearly reach the water surface. Jet plowing would result in short-term and localized heightened turbidity.

Elevated suspended sediments may alter normal turtle movements and behaviors. However, these changes are expected to be too small to be detected (NOAA 2020). Sea turtles would be expected to swim away from a sediment plume. A turbidity plume could affect normal behaviors, but no impacts would be expected from swimming through the plume (NOAA 2020). Turbidity may result in short-term, temporary impacts on some prey species, as well as any SAV present along potential cable routes. Long-term changes in benthic habitat associated with cable protection are possible, potentially affecting the presence of prey and changing foraging behavior (Janßen et al. 2013; Hutchison et al. 2020).

Impacts from cable installation, maintenance, and decommissioning from ongoing and planned activities may result in short-term, localized consequences for individuals that would be detectable and measurable but would not lead to the loss of individuals or have population-level effects.

Discharges/intakes: Permitted vessel discharges of uncontaminated bilge water, ballast, grey water, and treated liquid wastes, along with existing intakes and discharges (e.g., Diablo Canyon) can affect sea turtles through altered microclimates and hydrodynamics, direct entrainment, and prey entrainment (Wilcox 1985; Martin and Ernest 2000; Villalba-Guerra 2017). Sea turtles may be attracted to warm water surrounding large-volume outflow areas, especially in fall or early winter when surrounding waters are cool, increasing the risk for cold stunning when the animal leaves the outflow area.

Diablo Canyon uses a once-through cooling system in which up to 2.5 billion gallons of ocean water per day is taken in, used to condense steam, and then discharged back into the ocean at an elevated temperature. Discharged water is regulated to be non-radioactive and not exceed 22°F (11°C) above ambient conditions (Pacific Gas and Electric Company n.d.). In 2012, a green sea turtle was found inside Diablo Canyon's intake structure and was released alive (Pacific Gas and Electric Company n.d.).

The Chumash Heritage National Marine Sanctuary would prohibit most discharges, resulting in a localized benefit.

Impacts from intakes and discharges would be low in intensity and localized. Although the risk of entrainment is low, it cannot be discounted as it could result in the loss of individuals. Therefore, impacts would be measurable, could result in the loss of individuals via entrainment, but would not affect population viability.

EMFs and cable heat: Existing power and telecommunication cables along the Pacific coastline produce magnetic and electrical fields and transmit heat that can raise temperatures of nearby sediments and waters (Taormina et al. 2018). Electrical telecommunications cables are likely to induce a weak EMF, on the order of 1 to 6.3 microvolts per meter within 3.3 feet (1 meter) of the cable path (Gill et al. 2005). Fiber optic communications cables with optical repeaters would not produce EMF effects.

ICCP systems can also produce EMF. These systems work by supplying a controlled amount of DC to submerged surfaces (e.g., vessels, offshore oil and gas structures and equipment) using mixed metal oxide anodes and zinc reference electrodes. To date no studies have been conducted examining ICCP's potential EMF effects on sea turtles; further research is anticipated. However, based on the best available scientific research, EMF effects on sea turtles are expected to be minimal.

Ambient EMFs driven by saltwater movement are also present in the marine environment. Surface and internal waves, tides, and coastal ocean currents all create weak induced EMFs. Their magnitude at a given time and location depends on the strength of the prevailing magnetic field, site, and time-specific ocean conditions.

In recent reviews, Bilinski (2021) found minimal EMF effects on marine species. Sea turtles appear to be magnetosensitive with behavioral responses at levels as low as 0.047 mG for loggerhead turtles and 293 mG for green turtles (Normandeau 2011). Foraging sea turtles may be able to detect magnetic fields if near cables and potentially up to 82 feet (25 meters) in the water column above cables. There are no data on sea turtle impacts from underwater cable–generated EMFs, although anthropogenic magnetic fields can induce migratory deviations (Luschi et al. 2007; Snoek et al. 2016, 2020). Overall, any potential impacts from cables on turtle navigation or orientation would likely be undetectable under natural conditions and, therefore, would be insignificant (Normandeau 2011).

Measurable EMF effects are generally limited to within tens of feet of cable corridors; heat transmission effects would be even less. Therefore, overall impacts would likely be difficult to measure, with no perceptible consequences for individuals or populations.

Gear utilization: Biological and fisheries monitoring surveys pose a direct entanglement risk to sea turtles. The likelihood of sea turtle entanglement in such gear is considered low, given the expected limited total extent of possible monitoring surveys. Sea turtle entanglement could result in loss of individuals but would not have population-level effects.

Invasive species: Invasive species can alter sea turtle habitat structure, food sources, and overall health (CDFW 2024). Such species can outcompete or displace prey species, disrupt vegetative communities or fouling communities, and can potentially be conduits for disease, parasites, or other harmful pathogens that increase stressor sensitivity in sea turtle populations (CDFW 2024). Sources of invasive species include ballast water discharge, hull fouling, aquaculture, accidental releases, marine flotsam and debris, shore-based discharges, and climate-driven range changes or dispersion (NMFS n.d.). Several invasive species currently documented in California waters may have indirect effects on sea turtles.

- The European green crab (*Carcinus maenas*) disrupts marine habitats by preying on a variety of benthic organisms, changing the structure and composition of such communities.

- The Atlantic oyster drill (*Urosalpinx cinerea*) and Japanese bubble snail (*Haminoea japonica*) both prey on native bivalves directly, but also depredate on eggs and larvae, potentially reducing native shellfish populations.
- Several species of tunicates and encrusting bryozoans can form dense colonies on submerged hard surfaces, outcompeting native species and altering habitats by smothering native marine organisms, including shellfish, seaweeds, and other sessile invertebrates, reducing biodiversity and altering the structure of local benthic communities.
- Asian kelp (*Undaria pinnatifida*) has become invasive in California, competing with natural kelp and altering the structure and function of kelp ecosystems that provide shelter and prey for sea turtles.

Invasive species sources are not expected to change significantly in the future. Although the invasive species IPF itself is long term and wide-ranging, which could decrease habitat suitability and prey resources, effects on sea turtles encountering invasive species or degraded habitat would be low intensity and temporary given the availability of other suitable habitat.

Lighting: Artificial lighting from ongoing and planned activities may be produced by vessel traffic or project structures. Most sources of artificial lighting in the Affected environment (i.e., commercial vessel traffic, recreational and fishing vessels, and scientific and academic research traffic) feature navigational, deck, and interior lights that have limited potential to attract sea turtles, although the impacts, if any, would be expected to be localized and temporary. Decades of oil and gas platform operation in the Gulf of Mexico, which can have considerably more lighting than activities offshore California, has not resulted in any known sea turtle impacts (BOEM 2019). Based on available information, artificial lighting from ongoing and planned activities may result in individual impacts, but impacts would not be detectable or measurable.

Noise: G&G surveys, military activities, underwater detonations, vessel traffic, aircraft, cable laying and trenching, platform decommissioning, and dredging are all existing/anticipated noise sources. As discussed in Appendix H, sea turtle hearing is restricted to a range of low frequencies. Noise associated with the ongoing and planned activities and their expected impacts on sea turtles are summarized below.

Noise (aircraft): Commercial and military aircraft noise is expected to continue in the Affected Environment. Commercial air traffic is not expected to contribute underwater noise at any impact level due to altitude. Military exercises that have low or variable flight patterns may produce underwater noise with the potential to elicit stress or behavioral responses (e.g., diving, swimming away, altered dive patterns) (BOEM 2017; NSF and USGS 2011; Samuel et al. 2005). Regional military bases conduct various aircraft operations, including space vehicle launches, intercontinental ballistic and small missile launches, and artillery/weapons testing. Such activities produce short-term noises like launch sounds and sonic booms (high-energy impulsive sound overpressure).

Sea turtle sensitivity to airborne noise is not well studied, but available information indicates that potential disturbances would likely be minimal. Bevan et al. (2018) observed no behavioral changes in sea turtle to drones flown directly overhead at altitudes ranging from 50 to 102 feet (18 to 31 meters).

Due to the temporary nature of these sound sources, effects from ongoing military aircraft and spacecraft operations would be unmeasurable. Accordingly, cumulative impacts on sea turtles are not anticipated.

Noise (drilling): Drilling noise can occur from oil and gas well activities as well at sea-to-shore power and telecommunication cable connections. New oil and gas drilling is not anticipated off California due to state and federal moratoriums. Some existing wells or platforms could require drilling for maintenance or for plugging and abandonment, but the extent and duration of these drilling scenarios would be minimal.

Drilling sounds are non-impulsive, nearly continuous (although potentially variable depending on the type of substrate encountered) with SPL source levels ranging from 145 to 162 dB re 1 µPa m, depending on the drill type (Richardson et al. 1995; Erbe and McPherson 2017; Huang et al. 2023). Appendix H describes the source characteristics of drilling noise. A drill bit can generate tonal sound; mechanical noise can be transferred through a ship's hull, along with vessel noise. HDD uses equipment that is generally located on shore; therefore, sound that propagates into the water is expected to be negligible. All these measured drilling activities fall below acoustic thresholds established for sea turtle auditory and behavioral responses.

Although behavioral responses may occur from drilling in some circumstances, effects would be so small that they would not be measurable or detectable. Accordingly, cumulative impacts on sea turtles are not anticipated.

Noise (G&G surveys): G&G survey equipment, including deep penetration seismic airguns, shallow- to mid-penetration HRG sources, vibracores, and cone penetration test tests generate sound that may be audible to sea turtles, potentially leading to short-term behavioral disturbance. Geotechnical surveys may be conducted for scientific research and oil and gas activities and are not related to the drilling IPF. Noise produced from geotechnical surveys is expected to be of low intensity and localized; any impacts would be so small they would be impossible to measure or discern. Geophysical surveys for well analysis activities may require seismic surveys using large-volume airguns. Such surveys are expected to be infrequent in the Affected Environment, but geophysical surveys comprising bathymetric mapping and archaeological, earthquake, and hazard assessments use HRG sources and are common along the U.S. coastlines.

Sea turtles are likely to hear low-frequency, impulsive sources like airguns, boomers, and sparkers. Airgun use could result in behavioral responses but is unlikely to elicit PTS. Such responses could be measurable but would not result in biologically notable consequences or population-level effects. Recently, BOEM and USGS characterized underwater sounds produced by HRG sources and their potential to affect marine animals, including sea turtles (Ruppel et al. 2022). Given the intensity of such noise (Crocker and Fratantonio 2016; Crocker et al. 2019) and short duration of proposed surveys, the noise is unlikely to result in TTS or PTS for any turtle species. In addition to frequency range, other characteristics of the source make it unlikely that these sources would result in sea turtle behavioral disturbance (Ruppel et al. 2022).

Noise (impact and vibratory pile driving): Coastal and inshore construction (bridges, ports, sea-to-shore cable connections, and other infrastructure) are sources of impact and vibratory pile driving. Pile-driving noise may be audible to sea turtles, potentially leading to short-term behavioral disturbance, avoidance, or stress.

There are roughly 15 active MMPA authorization applications for construction projects in California; more are expected in the future. Most authorizations are for pier and port repairs. Pile-driving sound would vary depending on the method (impact or vibratory), pile material, size, hammer energy, water depth, and substrate type. Such construction-related sounds may affect sea turtle species in the area. The impacts would vary in extent and intensity based on the scale, design, and construction schedule of projects.

Sea-to-shore cable connections via HDD may involve driven or drilled piles for installation of temporary steel casing pipes (goal posts) and/or steel sheet piles (cofferdams). This activity usually occurs within a few kilometers of shore and piles. Ranges to thresholds have not been predicted for all variations or scenarios of sea-to-shore connection activity for power and telecommunication cables; and PTS threshold ranges for sea turtles could be relatively large if large piles are required. However, due to the required time accumulation for meeting PTS thresholds and the short duration of piling, PTS would not be realized. PTS thresholds would also not be met during vibratory piling. Vibratory piling can produce large behavioral effect ranges, and some animals could be disturbed enough to temporarily vacate the immediate area; however, due to the location of piling very near shore and the short duration of the piling, effects would be limited to temporary behavioral disturbances.

The coupling of the driven pile with the seabed generates stress waves and vibrations, and while related, stress waves and vibrations are different physical concepts of particle motion related to the transfer of energy between the pile and seabed; and particle motion in this context is different than particle motion discussed in hearing for fish. Stress waves are the initial disturbances that propagate through materials due to external forces, and vibrations are the resultant oscillatory motions. The propagation and intensity of stress waves and vibrations resulting from pile driving is dependent upon sediment properties, pile-driving method and energy, pile type and size, and geological features. While sea turtles would be able to perceive the resulting vibration from pile driving, impacts from seabed stress waves and vibration on sea turtles would not be measurable, especially in combination with the noise produced by pile driving. Impacts from impact and vibratory pile driving on sea turtles, considering both the noise and vibrations created, would be temporary and short term.

Noise (trenching, cable laying, and dredging): Dredging is common near multiple California ports, channels, rivers, and embayments. Jetting, plowing, and trenching for telecommunication cables will result in similar noise effects.

Dredging, trenching, and cable installation are expected to have non-measurable noise impacts on sea turtles given the low intensity of the sound sources and the location of such activities (i.e., nearshore and inshore). Of the few studies that have examined behavioral responses from dredging noise, most have involved other industrial activities, making it difficult to attribute responses specifically to dredging. Cable installation vessels are likely to use dynamic positioning systems and sound from those systems generally dominates over other sound sources present. However, given low source levels and the transitory nature of these sources, exceedance of PTS and TTS levels is not likely (Heinis et al. 2013).

Impacts from noise resulting from trenching, cable laying, and dredging on sea turtles would not be measurable, or would be so small they would be extremely difficult to discern. Accordingly, cumulative impacts on sea turtles are not anticipated.

Noise (underwater detonations): UXOs may be encountered in the seabed. If found, UXO may be left alone, moved, or removed by controlled explosive detonation or low-order deflagration. If explosive removal is used, the underwater explosion generates a shock wave characterized by extreme changes in pressure, both positive and negative. Such a shockwave can injure or kill sea turtles, depending on how close an animal is to the blast. Like effects seen in mammals, the physical range at which injury or mortality could occur would vary based on the amount of explosive material, turtle size, the turtle's distance from the explosion, whether the UXO is buried, the water depth of the blast, and local seafloor conditions, among other factors. Both low- and high-order detonation methods could be used. Low-order detonations would cause less intense pressure and noise. High-order detonation methods would potentially result in sea turtle mortality or non-auditory injuries (i.e., hemorrhages or damage to the lungs, liver, brain) (Ketten 2004; Finneran et al. 2017); auditory injuries such as PTS or TTS would be measurable and could result in the loss of individuals but would not be expected to result in population-level effects, given the expected irregular occurrence of high-order detonations.

Hannay and Zykov (2022) modeled ranges involving detonation of a UXO at 39-, 66-, 98-, and 148-foot (12-, 20-, 30-, and 45-meter) depths, finding that the mortality threshold for sea turtles could extend up to 1,903 feet (580 meters) from the source. Modeling included a range of UXO masses from 5 to 1,000 pounds (2.3 to 454 kilograms), finding that non-auditory injury (e.g., gastrointestinal injury, lung injury) thresholds for such masses and depths may extend up to 3,451 feet (1,052 meters). Distances to the PTS threshold may exceed 4,134 feet (1,260 meters) (Hannay and Zykov 2022). Modeled distances to the TTS threshold (which is used to determine potential behavioral disturbances for single detonations) may extend up to 15,997 feet (4,876 meters) (Hannay and Zykov 2022).

Ongoing activities occurring along the California coast include the use of "seal bombs" as deterrents in fisheries. The underwater charges are relatively broadband in frequency, with SEL source levels between 190 and 203 dB re 1 μPa^2 m^2 s. Acoustic data collection (in Southern California and near Monterey Bay) recorded high charge volume of up to 2,800 per day. During peak periods, seal bombs were a major noise source off Southern California; they were detectable at the Channel Islands and Monterey Bay National Marine Sanctuary and have the potential to cause auditory and non-auditory injury in sea turtles and can result in TTS and behavioral disturbance.

Impacts on individuals and their habitat would be detectable and measurable; impacts would be of medium intensity, short term in the case of UXO and long term in the case of seal bombs. Impacts could result in loss of individuals but would not affect population viability.

Noise (vessel): Most acoustic energy produced by vessels is less than 1,000 Hz, often below 50 Hz, with tones related to engine and propeller size and type. The sound can also vary directionally; directionality can be more pronounced at higher frequencies.

Sea turtles are less sensitive to sound than marine mammals. No injury or behavioral effects from ongoing/planned vessel noise are anticipated. It is unlikely that received levels of underwater noise from vessel activities would exceed sea turtle PTS thresholds; the PTS threshold for non-impulsive sources is an SEL_{24h} of 200 dB re 1 μPa^2 s (NMFS 2023c), comparable to the maximum source level reported for large shipping vessels. Hazel et al. (2007) demonstrated that sea turtles appear to respond behaviorally only to vessels at approximately 33 feet (10 meters) or closer.

Sea turtle impacts from ongoing/planned vessel noise would not be measurable. Accordingly, cumulative impacts on sea turtles are not anticipated.

Noise (decommissioning): Underwater explosives and mechanical cutting are likely methods to be used in decommissioning existing oil and gas platforms. Mechanical severance would cause non-impulsive noise that could lead to behavioral responses. Mechanical cutting associated with the removal of jackets and other structures can generate noise within 500 Hz to 8 kHz, which is within the hearing range of some sea turtle species. Explosives could result in TTS, PTS, or sea turtle mortality and while the use of explosive severance is not desired, it cannot be fully ruled out (BOEM 2023b). Given the unknown specifics of decommissioning and the variability in potential effects, impacts from decommissioning of oil and gas platforms would vary.

Port utilization: Port utilization includes noise and bottom disturbance (comparable to cable installation and anchoring) from dredging, noise and traffic from vessels, accidental releases, and discharges/intakes. Detailed discussions of potential impacts on sea turtles from these types of stressors are presented in corresponding sections. Dredging can further pose a risk of sea turtle impingement or entrainment.

Maintenance dredging may incrementally increase entrainment risks to individual turtles; however, typical best practices such as timing restrictions, sea turtle deflectors, and operational monitoring should minimize this potential. Dredging impacts on sea turtles are relatively common, although most observed injury and mortality events in the United States are associated with hopper dredging in and around core habitat areas outside the Affected Environment (Michel et al. 2013). Leatherback sea turtles are most often found further offshore and thus port utilization would be unlikely to affect the species, whereas green sea turtles are known to inhabit areas offshore of the Ports of Los Angeles and Long Beach (Massey et al. 2023). These areas serve as year-round foraging grounds and refuge for green sea turtles. Consequently, green sea turtles would be more susceptible to ongoing and planned port utilization.

Ongoing and planned activities could result in impacts that would be measurable and detectable, particularly for green sea turtles. Entrainment risk associated with dredging could result in mortality but would not affect population viability.

Presence of structures: Structures in the water (e.g., oil and gas platforms) can result in hydrodynamic changes, altered surface wind currents, behavioral reactions, reefing effects, and secondary entanglement of debris. Furthermore, the presence of structures could displace or alter movement patterns, which may subsequently increase sea turtle exposure to other risks (including gear entanglement and ship strikes).

Sea turtles in the Gulf of Mexico have shown preferential use of bottom-founded offshore structures and semi-submersible structures (Lohoefener et al. 1990). Such altered use patterns have not resulted in detrimental effects there. Effects could be different for the Pacific's more seasonal and migratory sea turtle populations; however, no data are available on this subject.

Given the relatively few offshore structures in the Affected Environment, long-term displacement from primary habitat is not expected. Any effects would cease after structures are removed. Localized hydrodynamic changes and displacement of individuals would result in sea turtle impacts that would likely be too small to be measurable. Beneficial impacts due to the reef effect are possible.

Traffic: Vessel strikes are a known source of sea turtle injury and mortality. Vessel traffic in coastal areas of the Affected Environment is high, with a wide range of vessel classes. Strandings of loggerheads attributed to vessel strikes increased from approximately 10 percent in the 1980s to a record high of 20.5 percent in 2004 (NMFS and USFWS 2008). Of leatherback strandings documented in Central California between 1981 and 2016, 7.3 percent were determined to be the result of vessel strikes (NMFS and USFWS 2020a). Sea turtles are most susceptible to vessel collisions in coastal waters where they forage. Vessel speeds frequently exceed 10 knots in such waters; evidence suggests that sea turtles cannot reliably avoid being struck by vessels traveling faster than 2 knots (Hazel et al. 2007).

Sea turtle impacts from traffic would be detectable and measurable and could result in injury or mortality of individuals, although population viability is expected to be maintained.

3.3.7.3.4 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, sea turtles would continue to be affected by existing environmental trends and ongoing activities. Climate change would continue to affect foraging and reproduction behavior through changes in prey distribution and abundance. In addition to climate change, BOEM expects a range of not measurable to measurable sea turtle impacts (disturbance, displacement, injury, mortality, and reduced foraging success). Ongoing activities are expected to continue to result in impacts. Although impacts on individual sea turtles and their habitat are anticipated, they would be recoverable and would not affect the population viability of any sea turtle species.

Cumulative Impacts of the No Action Alternative. BOEM anticipates that ongoing and planned activities would likely result in impacts on sea turtles due to accidental releases, discharges and intakes, gear utilization, port utilization, vessel traffic, and noise from underwater detonations, including detonations related to decommissioning. Impacts from these activities are expected due to the potential for losses of individuals but would not have population-level effects. BOEM anticipates that cumulative impacts of the No Action Alternative would be measurable, but populations would be expected to recover completely when stressors are removed.

3.3.7.4 Impacts of Alternative B – Development with No Mitigation Measures – Sea Turtles

ESA Section 7 consultation with NMFS would be conducted for each project, and it is assumed that the Letter of Authorization would include mitigation requirements that would reduce impacts.

3.3.7.4.1 Impacts of One Representative Project in Each WEA

Accidental releases: One representative project in each WEA has the potential to result in accidental releases of contaminants and debris, posing a risk of sea turtle injury or mortality (via contaminant exposure and/or ingestion). Such risks would be highest during construction and decommissioning when vessel usage is highest, and particularly during the potential refueling of primary construction vessels at sea. All vessel activity would be required to comply with federal and international requirements to minimize releases, including BOEM's prohibition on discharges/disposal during any activity associated with offshore energy (30 CFR 250.300). USCG also prohibits dumping of trash or debris capable of posing entanglement or ingestion risk (International Convention for the Prevention of Pollution from Ships, Annex V, Public Law 100–200 [101 Stat. 1458]). In the unlikely event of an accidental oil spill, impacts would likely be sublethal due to quick dispersion, evaporation, and weathering, all of which would limit the amount and duration of exposure to hydrocarbons. In sum, accidental release impacts associated with one representative project in each WEA would be detectable and measurable, but temporary, localized, and unlikely to result in population-level effects.

Anchoring: Vessel anchoring and mooring of floating structures would cause bottom disturbance and turbidity, potentially leading to changes in sea turtle behavior changes and prey availability. Mooring lines associated with floating platforms can also introduce the risk of secondary entanglement due to snagging of marine debris on lines in the water. Vessel anchoring is anticipated to take place throughout all project phases and would temporarily elevate suspended sediment and turbidity levels.

Mooring and anchoring would involve up to 200 WTGs and 6 OSSs for each representative project. For each WTG or OSS, up to 12 mooring lines would be used, extending from the seabed to the floating platform for the entirety of the water depth, each with up to 3,281 feet (1,000 meters) of chain on the seabed. Appendix A, *Representative Project Design Envelope for Floating Offshore Wind Energy*, provides more detail on prospective anchoring and mooring configurations.

While the extent of bottom disturbance could be large, sea turtles have limited use/dependency on deepwater offshore bottom habitats. Lease area water depths range from 1,739 feet (530 meters) to more than 3,281 feet (1,000 meters). Leatherbacks, the deepest-diving sea turtle species, forage primarily on jellyfish, a species unlikely to be adversely affected by bottom disturbance. Accordingly, bottom disturbance from anchoring is not expected to result in substantial effects on sea turtles.

Mooring configurations and floating interarray cables create potential for secondary entanglement of turtles in abandoned or lost fishing gear. Although no U.S. data exist for this risk, the National Academy of Sciences (1975) estimated that around 1,000 metric tons of commercial fishing gear are lost in the world's oceans annually. The Scottish Natural Heritage Commission (Benjamins et al. 2014) assessed the entanglement risk of megafauna in renewable energy structures, concluding that facilities, including offshore wind, pose a relatively modest risk for marine megafauna when compared to entanglement risk posed directly by fisheries. However, the risk to turtles can be elevated by turtles' attraction to floating structures (via the reef effect).

Such potential long-term and intermittent impacts would persist until decommissioning is complete. Large numbers of sea turtle mortalities are not anticipated. Impacts would be detectable and measurable and could result in the loss of individuals, but species viability would not be affected. Populations would be able to sufficiently recover from impacts.

Cable installation and maintenance: Seafloor disturbance from cable installation and maintenance can elevate turbidity resulting in some behavioral responses in sea turtles (e.g., avoidance, change in foraging behavior) and temporary effects on prey species.

Based on modeling from U.S. Atlantic Coast cable installation in water depths less than 164 feet (50 meters), suspended sediment concentrations are predicted to be less than 500 mg/L. Suspended sediment is expected to be localized, lasting from minutes to hours, and settling within 24 hours. Any dredging necessary prior to cable installation would generate additional impacts, including entrainment risk. Dredging activities, if conducted, would be intermittent and short term.

Only intermittent, localized cable maintenance is expected. In case of insufficient burial or cable exposure, whether attributable to natural or human-caused issues, appropriate remedial measures would follow, including reburial or placement of additional protective measures.

BOEM anticipates impacts on sea turtles from cable installation and maintenance, with effects that would be localized, short term, and detectable but would not lead to individual loss or any population-level consequences.

Discharges/intakes: Offshore wind development would cause discharges and intakes associated with HVDC converters (if used) and vessel activity during all phases. Since this PEIS precedes any project-specific COP submission, detailed information about HVDC cooling systems is currently unavailable. These systems could include open-loop systems, closed-loop systems, or other types of cooling systems. The use of HVDC cables may require HVDC converter intakes on up to six OSSs.

Intakes and discharges from open-loop systems, considered the most efficient method for cooling, may affect sea turtles by creating microclimates of warm water around the converter and introducing an entrainment risk of sea turtles and prey (Middleton and Barnhart 2023). Sea turtles could be attracted to warmer waters discharged from a converter or to the increase in algae and small organisms. Heat and food source could shift or extend occupancy of microclimates that could benefit sea turtles or result in adverse behavioral modification. Other types of cooling systems would not result in water discharges, so these effects would not be relevant.

Intake systems increase the risk of turtles becoming entrained. Entrainment risk for prey species would be minimal given the small number of OSSs proposed per project. Permitted offshore discharges are also regulated. The largest increase in project-related discharges would occur during construction and decommissioning. However, these activities and the resultant impacts would be staggered over time and localized.

Impacts on sea turtles cannot be assessed without knowing the specific HVDC system that would be employed. Given the small number of OSSs and the isolated and intermittent nature of most discharges, discharge/intake impacts on sea turtles would be unmeasurable.

EMFs and cable heat: Each WTG would have up to 2.7 nm (5 kilometers) of array cables suspended in the water column; each representative project would include up to eight export cables, each 19 to 270 nm (35 to 500 kilometers) in length (buried or protected). As discussed in Section 3.3.7.3.3, *Cumulative Impacts of the No Action Alternative*, studies of buried power transmission cables from offshore wind energy projects concluded that sea turtles would be insensitive to EMF effects (Normandeau 2011; Bilinski 2021; Gill et al. 2022).

Turtles can be exposed to EMF when near suspended cables. However, these effects are unlikely to persist once the turtle is beyond the detectable influence of the EMFs (from cables and/or ICCP systems). Cable heat would dissipate rapidly with distance and is not expected to have any discernible effect on sea turtles.

Impacts from EMFs and cable heat would be so small that they would be difficult to measure.

Gear utilization: Sea turtles can be injured or killed by being caught in biological and fisheries monitoring survey gear (including gear for trawling and dredging but also longlines, gillnets, hook-and-line, seine nets, and pots/traps). Specific monitoring plans are not known currently, but it is expected that fisheries monitoring surveys conducted for each project would be limited in frequency and duration. Based on this assumption, turtle interactions with gear would be rare and would not pose a substantial entanglement risk. Impacts would be detectable and measurable and could result in the loss of individuals but would not lead to population-level effects.

Invasive species: Vessels traveling from non-local ports risk carrying invasive species in ballast water and on vessel hulls and hard substrates provide settlement habitat for invasive species. Hard substrate would be introduced with floating wind foundations, anchor structures, and cable or scour armoring.

There is a BWM convention in place through the IMO designed to minimize transport of nonnative species between ports. In addition to this convention, the limited transoceanic travel expected would limit the risk of introducing invasive species. Invasive species impacts on sea turtles would be brief and temporary, occurring only during encounters with the species or altered habitats.

Lighting: Navigation, safety, and work lighting would be sources of stress for juvenile sea turtles and can disorient these turtles, but the significance of artificial light in offshore environments is less clear (Gless et al. 2008). Orr et al. (2013) summarized available research on potential operational lighting effects from offshore wind energy facilities, noting that flashing and intermittent lighting would likely not be disruptive (Limpus 2006). Orr et al. (2013) concluded that effects on sea turtle distribution, behavior, and habitat use were unknown but likely negligible when recommended design and operating practices are implemented. Artificial lighting impacts on sea turtles are expected to be too small to be measurable or discernible.

Noise: Activities in all phases of project development would cause underwater noise, potentially affecting sea turtles through auditory injury or behavioral disturbance. Noise from decommissioning, given what information is available, would be comparable to the noise sources and impacts expected during construction. Subsections below summarize sources and potential impacts.

Noise (aircraft): Helicopters and fixed-wing aircraft could transport construction and maintenance crews. As discussed in Section 3.3.7.3.3, there is limited information regarding sea turtle responses to airborne aircraft noise. Based on available information, it is expected that short-term, non-biologically notable behavioral responses may occur (BOEM 2017; NSF and USGS 2011; Samuel et al. 2005). These changes in behavior are expected to end when aircraft leave the area. Due to its anticipated irregular occurrence, aircraft traffic impacts on sea turtles would be too small to be measurable.

Noise (drilling): Drilling may be required for anchoring and connecting offshore cables at onshore landings (HDD). Noise from drilling for anchor moorings is expected to be comparable to other drilling activities described in Appendix H and fall below acoustic thresholds established for sea turtle auditory and behavioral responses.

Drilling would have a small potential for sea turtle impacts, given the depth of pile drilling and short duration of potential HDD. Drilling associated with anchor installation is not expected to intersect significantly with high levels of sea turtle use or exposure. Because drilling noise is not expected to exceed sea turtle auditory or behavioral thresholds, any impacts would be too small to be measurable or detectable.

Noise (G&G surveys): G&G surveys (to identify possible obstructions to wind energy development) are expected to employ lower-energy, higher-frequency HRG sources, which generate noise in the 1.1- to 200-kHz frequency range (exceeding sea turtle behavioral thresholds). HRG survey equipment is not anticipated to cause injurious impacts, but behavioral disturbances may occur up to 295 feet (90 meters) from impulsive sources and up to 6.6 feet (2 meters) from non-impulsive sources, when equipment is operating at the highest power setting (Baker and Howsen 2021). While low-level behavioral disturbances could occur during HRG surveys, the short duration of these surveys would reduce exposure risk to a minimal level. Likewise, geotechnical surveys, which may introduce low-level, intermittent, broadband noise, are unlikely to result in behavioral disturbance given their low source levels and intermittent use.

Noise from G&G surveys could result in temporary acoustic masking but would be unlikely to result in behavioral disturbance given their low source levels and intermittent use. Impacts would be low intensity and short term.

Noise (impact and vibratory piling): The sea-to-shore export cable connection and TLP anchoring could involve pile driving. Based on sound levels presented in available MMPA applications comprising similar activities (e.g., 88 FR 22696; 88 FR 28656; 88 FR 72562) that employ vibratory piling, PTS acoustic threshold ranges for sea turtles are expected to be considerably large (>3,281 feet [1,000 meters]). However, due to the 24-hour exposure time required to meet PTS thresholds (Appendix H), and the short duration of HDD piling (less than 4 hours of active piling per day), only behavioral disturbance would occur, and PTS would not be expected.

For impact and vibratory pile driving of the TLP anchor piles, no measurements are available but ranges to thresholds can be estimated by the pile size using NMFS Multi-Species Calculator Tool as described in Appendix H. The NMFS Multi-Species Calculator Tool does not account for local bathymetric and oceanographic features that would influence underwater sound propagation and that are not known for this programmatic assessment. Site-specific information used in a project-specific model would likely alter the predicted threshold ranges for sea turtles.

PTS is not expected for any sea turtle species; however, because no mitigation measures would be applied to this activity under Alternative B, the risk of PTS cannot be wholly eliminated. Behavioral disturbances are the most likely effects. Given the risk of PTS occurring during impact and vibratory pile driving for the TLP anchor piles, impacts on sea turtles would be detectable, measurable, and long term. However, this is only expected to affect a few individuals and would not affect population viability.

Noise (trenching, cable laying, and dredging): During construction, jetting, plowing, or removal of soft sediments may be required prior to construction of WTGs and OSSs as well as installation of cables (interarray and export). As described in Section 3.3.7.3.3, these activities may result in behavioral disturbances for sea turtles, although these are expected to be low intensity, localized, and unmeasurable (Hoffman 2012; Pirotta et al. 2013).

Noise (underwater detonations): As described in Section 3.3.7.3.3, non-explosive methods may be employed to lift and move UXO that may be encountered, but deflagration or removal by explosive detonation may also be needed. Underwater explosions of this type generate high pressure levels that could cause TTS, PTS, and non-auditory injury to sea turtles.

UXO detonation is anticipated to be infrequent, localized, and temporary. However, given the large ranges for auditory and non-auditory injury, the risk for mortality, and the severity of consequences to an exposed individual, there is the potential for unmitigated UXO detonation impacts.

Noise (vessel): A variety of vessels are likely to be needed to support all project phases (utility boats, offshore supply/crew vessels, general cargo boats, barges and tugs, cable lay vessels, DP and jack-up crane vessels, crew housing vessels, and survey vessels). As discussed in Section 3.3.7.3.3, vessel noise is not likely to result in TTS or PTS for any sea turtle species, although behavioral disturbances are possible. One representative project in each WEA would increase vessel traffic (and thus noise) over existing levels, although the exact extent of this increase is uncertain. Behavioral impacts, if they were to occur, would be too small to be measurable.

Noise (WTG operations): Because floating WTG technology is relatively new, there is a lack of empirical sound measurements during operations. For the purposes of this analysis, noise impacts of floating WTGs are assumed to be like those associated with bottom-founded WTGs and are expected to produce noise levels between 125 and 130 dB re 1 µPa m, which are within the auditory hearing range for all sea turtles (Lindeboom et al. 2011; Tougaard et al. 2009). SPLs below 120 dB re 1 µPa were measured 164 feet (50 meters) from operating turbines at the Block Island Wind Farm, under the thresholds expected to affect sea turtles (NMFS 2023c). Current-generation WTGs use direct-drive motors, potentially reducing sound by about 10 dB compared to gear box WTGs. However, an increase in underwater source levels (up to 177 dB re 1 µPa) has been identified with a nominal 10-MW WTG (Stöber and Thomsen 2021).

The potential for impacts on sea turtles from operational noise is unlikely outside a small radius. Operation of the floating WTGs would result in long-term, low-intensity, continuous noise, which could result in behavioral disturbances and auditory masking at close distances (Lucke et al. 2007; Tougaard et al. 2005, 2020; Thomsen and Stöber 2022).

Noise produced by the physical structures required for flotation and mooring would not produce sounds of sufficient amplitude to risk PTS or TTS in sea turtles because the noise events would be discrete and sea turtles would likely not accumulate sound energy long enough to experience PTS or TTS; however, behavioral disturbance could occur. Synthetic mooring line is expected to lower the source levels, but there is still significant uncertainty regarding chain and structure noise for offshore floating wind.

Some behavioral responses may be measurable but would not be expected to result in any losses of individuals.

Port utilization: One representative project in each WEA would increase vessel activity within and near port areas, increasing noise (discussed above) as well as the potential for harm to sea turtles (discussed below in traffic). Increased vessel activity at the ports of Los Angeles and Long Beach would increase the potential for interactions with green sea turtles, documented in the vicinity of those ports. Port utilization is less likely to affect sea turtle species more commonly found offshore, such as leatherbacks and loggerheads.

Impacts from port utilization are expected to be so small that they would be difficult to measure.

Presence of structures: The addition of WTGs and OSSs would result in hydrodynamic effects, reef effects, and displacement/barriers to movement. Interarray cables can also create secondary entanglement risk (secondary entanglement in mooring lines is discussed in the anchoring IPF).

There are no long-term datasets regarding hydrodynamic effects of floating offshore wind; therefore, impacts are uncertain. This assessment draws on a variety of structures, including fixed wind and non-wind structures and floating non-wind structures.

Surface water temperature and wind speed changes can be expected; however, these changes would recover quickly beyond the wind farm and result in nominal effects on sea turtles compared to normal fluctuations in wind and surface conditions (Christiansen and Hasager 2005; Integral 2022; Raghukumar et al. 2022). Changes in wind and surface conditions, as well as the presence of floating structures, may also influence vertical mixing in deep water, resulting in stratification changes of temperature profiles, salinity, primary productivity, and planktonic organisms. Modeling (Integral 2022) found that a roughly 5-percent reduction in wind speeds led to an approximately 10- to 15-percent decrease in upwelled volume transport and resulting nutrient supply to the coastal zone in the vicinity of the Morro Bay and Diablo Canyon call areas. Hydrodynamic changes modeled for build-out of California offshore wind, assuming 877 WTGs in federal OCS waters, showed a change in upwelling processes at different locations and intensities (Raghukumar et al. 2023). This modeling showed changes near both the Humboldt and Morro Bay WEAs, with lower levels of such changes near Humboldt.

Hydrodynamic changes could affect sea turtles' foraging by altering prey distribution or concentrations and could affect the sea turtle's temperature-related movements, potentially exposing them to colder temperatures and hypothermic effects. Such effects may be measurable and detectable through inference from long-term oceanographic data collection; however, impacts from those oceanographic effects would not be measurable or would be so small that they would be difficult to measure.

Large floating structures are known to attract a wide variety of large mobile fauna, and their ability to create a habitat with permanent, semi-permanent, and transient fauna suggests they can be a net ecosystem benefit (reef effect) (e.g., Gooding and Magnuson 1967; Roberts et al. 2012; Kramer et al. 2016). As previously discussed, such structures can serve as FADs, creating shade and providing shelter for small fishes as well as orientation points for larger mobile species such as sea turtles (Helfman 1981; Taquet 2013). Floating FADs are distinguished from bottom-founded artificial reefs in the kinds of fishes and other biota they attract. In the Gulf of Mexico, both bottom-founded and floating (but moored) oil and gas structures (spars, TLP, and catenary moored) have been documented to attract various sea turtles and be incorporated into home ranges with equal use when compared to utilization of natural hard-bottom habitat (Lohoefener et al. 1990). Given the added structure, the reef effect on sea turtles could have a beneficial impact.

Proposed spacing of WTGs (no less than 0.5 nm) relative to the size of an individual sea turtle would not present a movement barrier and would thus be unlikely to displace or measurably alter movement patterns.

Interarray cables would not be buried but suspended in the water and, therefore, could also introduce the risk of secondary entanglement of sea turtles due to snagging of marine debris on suspended cables as described in the anchoring IPF. In summary, the presence of structures would result in impacts likely to be too small to be measurable. Beneficial impacts due to the reef effect are possible, as sea turtles could benefit from increased prey abundance as well as prospective use of structures for shelter. There would be the potential for impacts from secondary entanglement in interarray cables because entanglement may result in loss of individuals.

Traffic*:* Vessel activity would increase with one representative project in each WEA, increasing risks of collision-related injury and mortality within vessel transit routes and lease areas.

Because this PEIS precedes any project-specific COP submittal and no detailed vessel information is available, this analysis uses proxies from Atlantic OCS offshore wind projects and assumes similar levels to the estimated number of vessels planned to operate during construction of other offshore wind projects.[2] Constructing (or decommissioning) one representative project in each WEA is assumed to involve up to 51 vessels operating at any given time. In a year, construction is expected to generate around 3,285 vessel roundtrips, averaging about 12 trips per day. Vessel strike effects would range from short term for minor injuries to permanent if a turtle were killed. Vessel strike risk would be higher at night or other times of reduced visibility. Vessel strikes could result in the loss of individuals, although populations are expected to remain viable.

3.3.7.4.2 Impacts of Five Representative Projects

The same impacts and mechanisms described above for one representative project in each WEA would apply to five representative projects. The increase in activity/duration would increase the likelihood of impacts. For certain impacts, the activity/duration increase would increase impacts in a manner that would be small or unmeasurable and would thus not change the impact level from what was described for one representative project in each WEA. Accordingly, there is no further discussion of the following: discharges/intakes, EMFs and cable heat, invasive species, gear utilization, and lighting.

IPFs that have a greater potential for impact under five representative projects include: accidental releases, anchoring, cable installation and maintenance, gear utilization, noise, port utilization, WTG operations, and vessel traffic. Noise from decommissioning, given what information is available, would be comparable to the noise sources and impacts expected during construction.

Accidental releases: Five representative projects would increase the potential for accidental releases, but the likelihood of such releases remains low. Accordingly, sea turtle impacts would be unlikely to result in population-level effects, although consequences to individuals would be detectable and measurable.

Anchoring: Five representative projects would significantly increase the number of mooring lines and bottom disturbance. More mooring lines would increase the risk of secondary entanglement. Sea turtles have limited use or dependency on deepwater bottom where anchoring would occur. Overall, effects would be detectable and measurable and could result in the loss of individuals, but species viability would remain functional or able to sufficiently recover.

Cable installation and maintenance: Five representative projects would increase the number of cables and thus increase the total area of seafloor disturbance. Because export cables are expected to be both floating and buried (all interarray cables would be floating), the potential increase in dredging during cable installation is expected to be limited and localized. Sea turtle impacts would be unlikely to result in population-level effects, although consequences to individuals would be detectable and measurable.

[2] Empire Wind (OCS-A 0512), Ocean Wind 1 (OCS-A 0498), and Atlantic Shores South (OCS-A 0499).

Noise: Five representative projects would increase the number of noise sources, also increasing noise duration and extent. The relative contribution from several additional sources (aircraft, dredging, trenching, cable laying, and vessel noise) would remain small; thus, increases in these sources still would not have measurable effects on sea turtles.

With five representative projects, drilling noise and noise produced by G&G surveys would increase in duration and geographic range and could produce localized, temporary behavioral disturbance. However, drilling noise and G&G noise impacts would remain the same as those described for one project per WEA.

Noise from impact and vibratory piling is expected to increase in volume and geographical range. However, the resulting impacts would still be the same as those described for one project due to the risk of PTS.

WTG operational noise would substantially increase in geographic range and could result in behavioral changes. There is limited information regarding noise produced from floating WTG operations or their associated moorings. Given what is known about bottom-founded WTG operational noise, impacts on sea turtles are not expected to result in population-level consequences or losses of individuals; however, given the geographic extent of potential behavioral disturbance over the life of five projects, impacts increase relative to one project.

Noise from UXO detonations is not expected to increase appreciably with five projects due to the low likelihood of occurrence for any UXO detonations. UXO detonations could result in sea turtle mortality but would not have population-level or unrecoverable consequences.

Port utilization: Five representative projects would increase port utilization and also increase vessel traffic (discussed below) and noise (discussed above). Increased port utilization would increase the risk of vessel strike but would not be likely to increase noise discernably, given already high-noise environments of commercial ports. Port utilization impacts would increase; effects would be detectable and measurable but not lead to population-level impacts.

Presence of structures: Additional WTGs and OSSs could potentially affect sea turtle populations through an increased extent of hydrodynamic changes. However, hydrographic influences would not result in the loss of individuals or have population-level consequences. Although impacts would be long term, the relative spatial and temporal extent of individual behavioral impacts would be limited and temporary, occurring close to individual turbines. Given the increased extent of five projects, there may be some elevation in measurable impacts and therefore hydrodynamic changes could result in impacts. Displacement or altered movement effects are not anticipated. The additional number of floating array cables expands the risk of entanglement, but population consequences would not result from the potential mortality. Beneficial impacts due to the reef effect are still possible.

Traffic: Five representative projects would substantially increase the number of vessels operating in the project area throughout all project phases. This would result in impacts for sea turtles, as effects would be detectable and measurable and could result in the loss of individuals, although the viability of the species is likely to remain functional.

3.3.7.4.3 Impacts of Alternative B on ESA-Listed Species

Because all sea turtle species present in the Humboldt and Morro Bay lease areas are listed under the ESA, the impact determinations provided in the sections above would apply.

3.3.7.4.4 Cumulative Impacts of Alternative B

Cumulative impacts on sea turtles from five representative projects combined with ongoing and planned activities within the Affected Environment are anticipated.

Five representative projects would contribute to all impacts described for the No Action Alternative as well as noise – WTG operations. However, some of the contributions would be incremental and likely undetectable such that impact severities would not change from the No Action cumulative scenario. To this end, Alternative B's cumulative sea turtle impacts would not change, except for the following IPFs.

- For noise produced by drilling and WTG operations, Alternative B would increase the amount and extent of drilling noise and would introduce WTG noise into the Affected Environment.
- Anchoring impacts would increase relative to the No Action Alternative due to additional subsea mooring lines that would increase the secondary entanglement risk (which can result in turtle injury or death).
- The presence of structures would increase impacts primarily due to secondary entanglement in interarray cables and the introduction of oceanographic effects of offshore wind structures.
- Ongoing and planned activities would increase impacts of accidental releases due to the potential for oil spills not associated with offshore wind activities. Similarly, discharges and intakes would increase impacts due to ongoing discharges and entrainment occurring to sea turtles in limited areas of the Affected Environment not associated with offshore wind.

3.3.7.4.5 Conclusions

Impacts of Alternative B. Construction and installation, O&M, and decommissioning of Alternative B, whether one representative project in each WEA or five representative projects, would result in habitat disturbance (cable installation and maintenance, port utilization, presence of structures, invasive species), habitat conversion (presence of structures), noise, and increased risks of entanglement (anchoring, gear utilization), vessel strikes, and accidental releases.

Impacts would be noticeable and measurable but impacts would not affect the continued viability of any sea turtle populations. Impacts are expected mainly from secondary entanglement associated with anchoring, gear utilization and presence of structures, mortality resulting from vessel traffic, and PTS from noise produced by underwater detonations and potentially WTG operations, although there is minimal data on which to make a definitive conclusion regarding floating WTG operational noise. Beneficial impacts are expected from the presence of structures primarily due to an increase in foraging opportunity because of the artificial reef effect for both one and five representative projects. These beneficial effects could be offset by increased risk of entanglement due to derelict fishing gear on the structures.

Cumulative Impacts of Alternative B. BOEM anticipates that cumulative impacts on sea turtles in the Affected Environment under five representative projects would vary and could include beneficial impacts. Impacts may occur for individual sea turtles from accidental releases, anchoring, discharges/intakes, gear utilization, port utilization, presence of structures, vessel traffic, and noise from piling, underwater detonations, and WTG operations. Impacts would be recoverable and would not affect population viability. Once again, beneficial impacts for sea turtles due to the reef effect from the presence of structures may result.

In the context of other reasonably foreseeable environmental trends, incremental impacts contributed by five representative projects to the cumulative impact on sea turtles would range from undetectable to appreciable. Five representative projects would contribute to cumulative impacts primarily through anchoring that could increase the risk of secondary entanglement, hydrological effects resulting from the presence of structures, and noise from drilling and WTG operations. The incremental impacts associated with all other IPFs would be undetectable when added to the No Action Alternative.

3.3.7.5 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Sea Turtles

Alternative C, the Proposed Action, is the prospective adoption of mitigation measures intended to avoid or reduce Alternative B's potential impacts. Accordingly, analysis considers the change in impact relative to Alternative B. Appendix E, *Mitigation*, identifies the mitigation measures that would be included in the Proposed Action. Table 3.3.7-3 summarizes mitigation measures relevant to sea turtles.

Table 3.3.7-3. Summary of mitigation measures for sea turtles

Measure ID	Measure Summary
MM-3	This measure requires vessels and facilities to have adequate equipment available and be prepared to address entanglements consistent with current guidelines and local marine stranding centers.
MM-4	This measure requires all offshore wind-related vessels to travel at 10 knots (18.5 kilometers per hour) or less during project-related activities and while operating in lease areas. The only exception is when the safety of the vessel or crew necessitates deviation from this vessel speed limit.
MM-5	This measure requires submittal and approval of an Alternative Monitoring Plan to ensure visual monitoring can be achieved when nighttime or poor visibility monitoring is required.
MM-7	To the extent reasonable and practicable, follow the most current IMO guidelines for the reduction of underwater radiated noise, including propulsion noise, machinery noise, and dynamic positioning systems of any vessel associated with the project.

Measure ID	Measure Summary
MM-8	This measure requires that PSOs are NMFS approved for monitoring during applicable project activities and requires vessel crew training for protected species identification to reduce vessel strike risk. Furthermore, PSOs must have a 360-degree visual coverage around the vessel at all times that noise-producing equipment <180 kHz is operating or the vessel is transiting. The Alternative Monitoring Plan may include requirements for PSOs for activities at nighttime and other instances of low visibility. PSO data must be collected in accordance with standard data reporting.
MM-11	This measure requires lessees to comply with vessel strike avoidance measures for all marine wildlife. Vessels must avoid transiting through areas of visible aggregations of birds. If operational safety prevents avoidance of such areas, vessels must slow to 4 knots while transiting through such areas.
MM-19	This measure requires lessees to submit an Anchoring Plan that identifies and map's locations of interest including, hard-bottom, sensitive habitats, potential shipwrecks, potential hazards, and existing and planned infrastructure. The plan will require all vessels deploying anchors to use, whenever feasible and safe, mid-line anchor buoys to reduce the amount of anchor chain or line that touches the seafloor.
MM-20	This measure requires lessees to submit a Sensitive Marine Species Characterization and Monitoring Plan for biological species and habitats that may be affected by a project's activities. Species and habitats that are particularly sensitive to impacts will be identified, avoided, and require monitoring, allowing for the identification of adverse effects and evaluation of mitigation efforts. Consolidated seafloor sediments are equivalent to sensitive habitats and species and will be avoided from direct and indirect impacts unless data exists to demonstrate no harm to sensitive species and habitat.
MM-27	This measure recommends static cable design elements, including burial below the seabed where feasible, avoidance of methods that raise the profile of the seabed, and removal of large marine objects and decommissioning instrumentation and/or anchors as soon as practicable and within required regulations and permits. This measure may reduce possible damage to fishing gear. Future mitigations may include gear identification and or lost survey gear monitoring and reporting.
MM-32	This measure encourages lessees to coordinate transmission infrastructure among projects by using, for example, shared intra- and interregional connections, meshed infrastructure, or parallel routing, which may minimize potential impacts from offshore export cables.
MM-33	This measure requires monitoring of cables periodically after installation to determine cable location, burial depths, and site conditions to determine if burial conditions have changed and whether remedial action or additional mitigation measures are warranted. The lessee must provide BSEE and BOEM with a cable incident report in the event of entanglement with or accidents involving vessels.
MM-34	This measure requires lessees to use standard underwater cables that have electrical shielding to reduce the intensity of EMFs.
MM-36	This measure requires the lessee to develop an Oceanographic Monitoring Plan. Monitoring reports are a required component of the plan and will be used to determine the need for adjustments to monitoring approach, consideration of new monitoring technologies, and changes to the frequency of monitoring. Components of the plan to consider include coordination between relevant regulatory agencies and neighboring lessees; monitoring strategies for pre-construction, construction, post-construction, and decommissioning phases; comparisons with available model outputs; technologies; and appropriate physical and biochemical measurement.

Measure ID	Measure Summary
MM-37	To the extent practicable, lessees should incorporate technologies for detecting tagged (e.g., Innovasea) sea turtles and tagged fish in their projects to monitor the effect of increases in habitat use and residency around WTG foundations and share monitoring results and/or propose new or additional mitigation measures and/or monitoring methods, if appropriate.
MM-38	This measure requires disengaging dredge pumps when dragheads are not in use for activities requiring the use of a trailing suction hopper dredge offshore to prevent impingement or entrainment of sea turtle species.
MM-40	Lessees are encouraged to coordinate monitoring and survey efforts of long-term scientific surveys across lease areas to standardize approaches, understand regional potential impacts, and maximize efficiencies in monitoring and survey efforts.

3.3.7.5.1 Impacts of One Representative Project in Each WEA

Alternative C's mitigation measures could potentially reduce some sea turtle impacts identified in Alternative B. Measures that are limited to reporting procedures would not directly avoid or lessen impacts. However, information from such reporting could be evaluated and potentially lead to changes in or additions to other mitigation measures. For the impacts not listed below, mitigation measures did not reduce the impacts. Consequently, the impact level under Alternative C remains the same as under Alternative B.

Anchoring: MM-19 would require an anchoring plan to minimize bottom disturbance to hard bottom resources. While an anchoring plan could assist in assessing secondary entanglement risk, it would not measurably reduce such risk. MM-20 would require lessees to reduce or avoid impacts on important environmental resources, such as sensitive habitats and species, to the extent feasible. Implementing these measures would likely reduce the impacts on sea turtles. MM-27 could result in future mitigations that could include gear identification and/or lost survey gear monitoring and reporting to potentially help avoid or reduce impacts (risk of entanglement) on sea turtles resulting from lost fishing gear. MM-3 would reduce impacts on sea turtles from entanglement by having vessels and facilities with adequate equipment available and being prepared to address entanglements.

Anchoring impacts on sea turtles under Alternative C would remain, as impacts from secondary entanglement would persist. Impacts would remain detectable and measurable, potentially resulting in the loss of individuals, but not population level effects.

Cable installation and maintenance: MM-32 proposes use of both intra- and interregional shared transmission infrastructure, where possible. This would consolidate the extent of transmission cables, which could reduce the geographic extent of impacts, including cable installation and maintenance. MM-33 would require periodic cable inspection to ensure proper cable burial depth and integrity. These measures would reduce the amount of seabed disturbance expected during cable installation. However, turbidity effects would persist. Effects would remain localized and short term; therefore, mitigation would not reduce the impact level. MM-38 would reduce direct impingement of turtles and prey species by requiring suction hopper dragheads be turned off when not actively dredging. Impacts would remain measurable but of low intensity and would not result in population-level effects.

EMFs and cable heat: MM-32 could reduce EMF effects by grouping transmission cables and thus reducing the geographic extent of such effects. MM-33 would require periodic cable inspection to ensure proper cable burial depth and integrity. Any exposed export cables may inadvertently subject organisms to higher EMFs; MM-33 would minimize these risks. Moreover, MM-34 proposes the use standard underwater cables that have electrical shielding to control EMF intensity, which could potentially reduce impacts from floating array cables. There are no measures that would reduce potential EMF effects from ICCP systems. The extent of impacts would be reduced.

Gear utilization: MM-27 could result in future mitigation that could include gear identification and/or lost survey gear monitoring and reporting to potentially reduce the risk of entanglement. MM-3 would reduce impacts on sea turtles from entanglement by having vessels and facilities with adequate equipment available and being prepared to address entanglements. While the risk of entanglement would be functionally lower, mortality and injury cannot be eliminated without full evaluation of individual survey plans.

Noise: MM-7 would require vessel noise reduction by following the most current IMO guidelines. Measures for project vessels/activities to avoid encounters with turtles (including MM-5 and MM-38) would reduce sea turtle exposure to noise. Reporting requirements (i.e., MM-8) would not reduce impacts directly but could evaluate impacts and potentially lead to additional mitigation measures.

Furthermore, monitoring clearance and shutdown zones during low visibility (MM-5) and ensuring PSO requirements are met when noise-producing equipment under 180 kHz is operating (MM-8) would also play a role in reducing noise exposure. The measures above would lessen the degree of impacts for the following activities: pile driving and UXO, G&G surveys, aircraft, drilling, dredging/trenching, and vessel noise. There is no mitigation to address noise from WTG operations, and these impacts would remain the same as Alternative B.

Port utilization: Vessel noise, pile driving, and traffic are the primary impacts associated with port utilization. Refer to those subsections for discussions of how mitigation would lessen related effects. These measures would reduce but not eliminate impacts.

Presence of structures: As part of the Oceanographic Monitoring Plan required by MM-36, physical oceanographic measurements (e.g., ocean temperature, salinity, pH, current velocity, biogeochemistry, and nutrients) will be collected and considered. While monitoring would not directly reduce the hydrodynamic effects of wind farms on sea turtles, the information gathered could be evaluated for efficacy and potentially lead to changes in or additions to existing mitigation measures.

The presence of structures, including mooring lines, increases entanglement risk associated with active or abandoned fishing gear. MM-33 involves monitoring cables and reporting entanglement events, which reduce the risk of secondary entanglement for sea turtles. However, as any secondary entanglement can result in mortality, impacts would remain. MM-37 would incorporate technologies for detecting tagged sea turtles to monitor the effect of increases in habitat use and residency around WTG foundations, potentially leading to the development of new or additional mitigation measures. MM-3 would reduce impacts from entanglement of sea turtles by having vessels and facilities with adequate equipment available and being prepared to address entanglements.

MM-19 and MM-20 could result in avoidance of sensitive habitats, lessening but not fully eliminating other impacts. Mitigation would not alter the potential for beneficial impacts due to the reef effect.

Traffic: Vessel strikes is a significant concern for sea turtles. Vessel strike risk would be reduced with several mitigation measures. The most direct reduction of this risk would come from limiting vessel speeds and implementing strike avoidance protocols (MM-11, MM-4, and MM-8). Vessel speed restrictions are a known and effective mechanism for reducing potential strike risk for all sea turtles. Slower speeds allow both vessels and animals to take evasive action; if a strike occurs, slower speeds would also reduce injury severity and mortality potential.

Other measures would further seek to avoid vessel strikes through training, watch protocols, monitoring plans, and ongoing monitoring/reporting (MM-2, MM-5, and MM-8). Individually and collectively, these measures would increase situational awareness. Reporting measures would not directly reduce impacts, but information gathered would assist in adaptive management and potentially introduce new mitigation measures.

With all of the above measures, the loss of individuals is not expected but could still occur due to the difficulty of detecting and avoiding sea turtles. Mortality could occur, but effects would likely be recoverable and not affect population viability.

3.3.7.5.2 Impacts of Five Representative Projects

Five representative projects would pose a greater likelihood for certain impacts due to the increased amount of offshore development. However, mitigation measures, when combined with spatial separation (i.e., the distance between the Humboldt and Morro Bay WEAs), would result in impacts similar to one representative project in each WEA. Specifically, impacts would be similar for one and five representative projects for: accidental releases, anchoring, cable installation and maintenance, discharges/intakes, EMFs and cable heat, gear utilization, lighting, noise (other than pile driving and G&G surveys), presence of structures, and vessel traffic.

MM-36 would require the development of an Oceanographic Monitoring Plan, and MM-40 encourages lessees to coordinate monitoring and survey efforts across lease areas to standardize approaches, understand potential impacts on resources at a regional scale, and maximize efficiencies in monitoring and survey efforts. While these measures would not directly reduce impacts on sea turtles, the information gathered could be evaluated for efficacy and potentially lead to changes in or additions to existing mitigation measures.

Relative to one representative project, port utilization impacts would increase because of the increased concentration of activities over long periods that could lead to behavioral modifications. Noise from

WTG operations would also increase due to the absence of mitigation measures to address WTG noise. However, these impact levels are comparable to the ones for Alternative B under five representative projects.

Relative to Alternative B, noise mitigation measures would reduce sea turtle exposure to noise impacts, however noise impacts would remain the same.

3.3.7.5.3 Impacts of Alternative C on ESA-Listed Species

Because all involved sea turtle species are ESA-listed, impact discussions provided above would be applicable.

3.3.7.5.4 Cumulative Impacts of Alternative C

Similar to Alternative B, under Alternative C, the same ongoing and planned activities would continue to contribute to impacts on sea turtles.

3.3.7.5.5 Conclusions

Impacts of Alternative C. BOEM anticipates that most impacts on sea turtles would be measurable but would not affect the continued viability of any sea turtle populations. Impacts are expected from anchoring due to the increased risk of secondary entanglement, gear utilization, vessel traffic, and G&G and impact pile driving noise. Beneficial impacts are expected from the presence of structures/reef effect.

Cumulative Impacts of Alternative C. Cumulative impacts are anticipated and could include beneficial impacts. Vessel traffic and entanglement associated with anchoring, gear utilization and presence of structures could result in individual mortalities. However, the loss of individuals would be recoverable and would not affect population viability. Beneficial impacts due to reef effects would result from the presence of structures.

In the context of other reasonably foreseeable environmental trends, the incremental contributions of five representative projects would range from undetectable to appreciable (anchoring, gear utilization, noise, presence of structures, and vessel traffic). The incremental contributions of other impacts (accidental releases, anchoring, cable installation and maintenance, discharges/intakes, EMFs and cable heat, invasive species, lighting, port utilization) would not be detectable.

3.4 Socioeconomic Conditions and Cultural Resources

3.4.1 Commercial Fisheries and For-Hire Recreational Fishing

This section discusses potential impacts on commercial and for-hire recreational fisheries from the Proposed Action, alternatives, and ongoing and planned activities in the Affected Environment Figure 3.4.1-1). The Affected Environment includes the waters within specific fishery management areas (i.e., Klamath Zone and Fort Bragg in northern California; Monterey in central/southern California), both of which are managed by the PFMC (NOAA 2024). The boundaries of the Affected Environment allow for an assessment of potential impacts on fisheries arising from operation of federally permitted vessels in state and U.S. EEZ waters within and surrounding the Humboldt and Morro Bay lease areas. Section 3.4.9, *Recreation and Tourism,* discusses private recreational fishing from shore or personal vessels.

3.4.1.1 Description of the Affected Environment and Baseline Conditions

PFMC oversees fisheries in federal waters off the Washington, Oregon, and California coasts. PFMC manages commercial, recreational, and tribal fisheries for approximately 119 species of salmon, groundfish, coastal pelagic species, and migratory species in federal waters. Washington, Oregon, and California manage fisheries in their respective state waters; the states also manage Dungeness crab, ocean pink shrimp, and other species. PFMC works with the states to ensure that management of shared stocks is consistent.

Most fisheries in federal waters of California are managed under the Magnuson-Stevens Fishery Conservation and Management Act (16 USC 1801 et seq.) through PFMC. PFMC develops species-specific Fisheries Management Plans (FMPs) that establish fishing quotas, seasons, and closure areas, as well as protections EFH. PFMC works with NMFS to assess and predict the status of fish stocks, set catch limits, promote compliance with fisheries regulations, and reduce bycatch.

Within California state waters, state regulatory agencies regulate commercial and for-hire recreational fisheries. California has its own structure of agencies, separate from PFMC, and ocean management plans that govern fisheries. The California Legislature and California Fish and Game Commission establish policy and set regulations that are enforced by the California Department of Fish and Wildlife (CDFW) for management of the state's fisheries (consistent with and complementary to any federal FMPs). CDFW provides biological data and expertise to inform the commission's decision-making process.

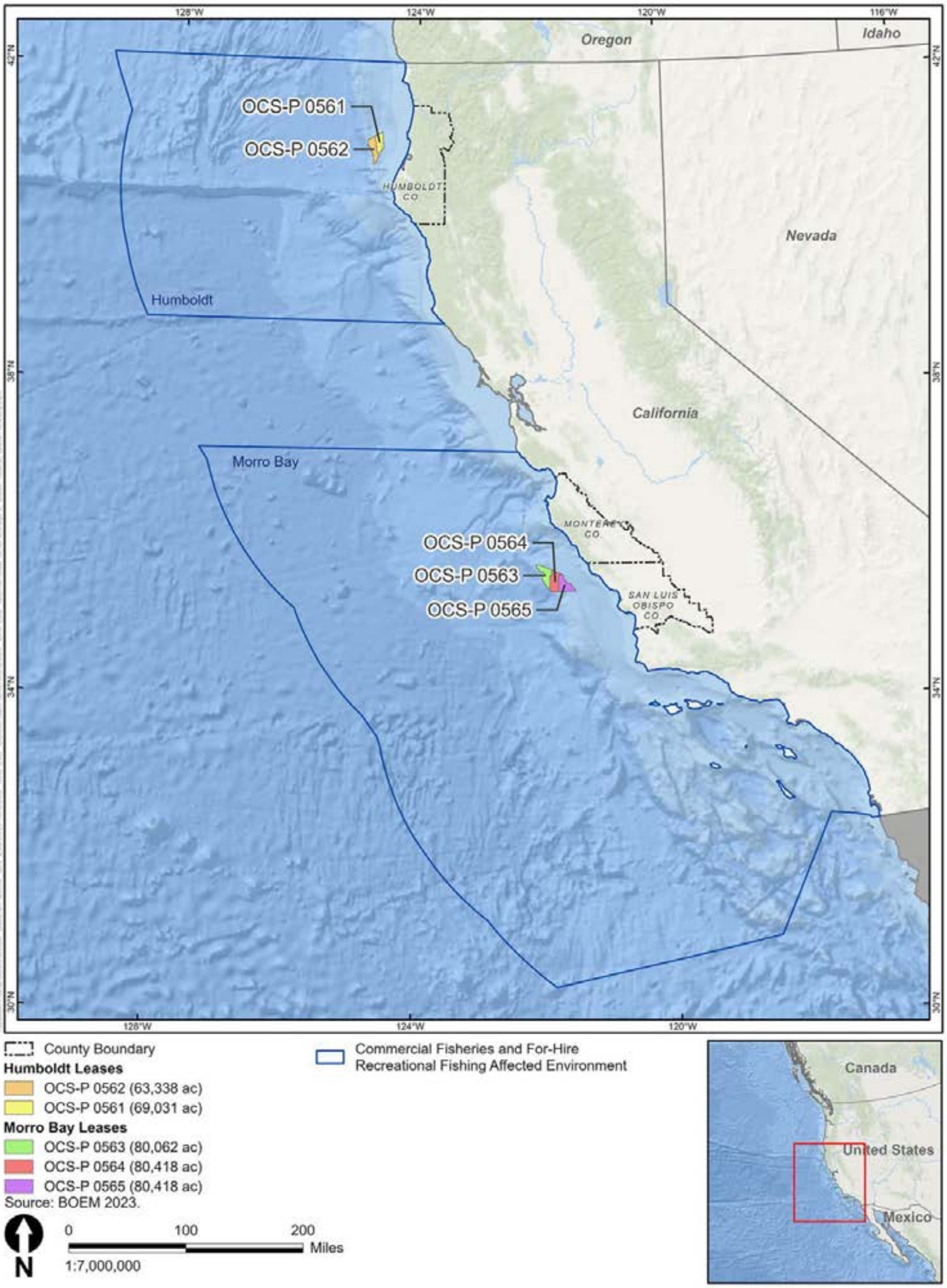

Figure 3.4.1-1. Commercial fisheries and for-hire recreational fishing Affected Environment

3.4.1.1.1 Regional Setting

Commercial fisheries offshore California are productive, valuable, and diverse (NMFS 2024). Major fisheries include trapping for Dungeness crab and California spiny lobsters, trolling offshore for Chinook salmon and albacore tuna, gillnetting for swordfish and pelagic sharks, trawling for shrimps and groundfish, hook-and line fishing for rockfishes, and diving to harvest sea urchins and sea cucumbers by hand. With such varied species, gear, and fishing methods, participants often fish for multiple species during a season depending on price, species distribution, and regulations (Richerson and Holland 2017; Frawley et al. 2020). Although the following sections focus on California-based fisheries, some vessels from southern Oregon may fish for groundfish or Dungeness crab in and around the Humboldt WEA but land their catches in Oregon ports. Such transboundary activity will not be captured by port-based landings from either state but has been demonstrated for the vessels in the Groundfish Catch Share Program (Samhouri et al. 2024).

CDFW and PFMC are the state and federal agencies responsible for managing marine species in state and federal waters. All agencies have developed FMPs for fisheries under their purview including Coastal Migratory Species (PFMC 2023a), Groundfish Species (PFMC 2022), Highly Migratory Species (PFMC 2023b), Nearshore Marine Fishes (CDFG 2002), Salmon (PFMC 2022), and selected nearshore marine invertebrates (e.g., CDFW 2016). NOAA Fisheries supports PFMC by conducting stock assessments, EFH assessments, and basic research on managed species and their habitats.

Although aquaculture may be considered a commercial fishing enterprise in marine waters of the state, it was not formerly covered in this section. Pacific oysters and other shellfish are the primary marine species being cultured over submerged, public lands leased by the operators from the state. The largest operations presently occur in Humboldt Bay, Tamales Bay, Monterey Bay, and Morro Bay (CDFW 2020).

3.4.1.1.2 Regional Fisheries Economic Value and Landings

To characterize fisheries operating in the Affected Environment, BOEM used landings and CDFW value data from 2013–2022 from port complexes (multi-port areas used for summaries) near the Humboldt and Morro Bay WEAs. BOEM downloaded commercial fishing data from CDFW Marine Fisheries Data Explorer (https://wildlife.ca.gov/Conservation/Marine/Data-Management-Research/MFDE/Custom-Queries) and made an online, custom request for landings (weight in pounds and ex-vessel values in dollars) by gear type, species, species group, port, and port complex (area) from 2013 to 2022. Ports anticipated to be affected by the Humboldt WEA include the Eureka port complex and the Fort Bragg port complex. The Eureka port complex consists of the following ports: Crescent City, Eureka, Fields Landing, Humboldt Bay, King Salmon, Orick, Shelter Cove, and Trinidad. The Fort Bragg port complex includes three ports: Fort Bragg, Albion, and Point Arena. Ports from the two complexes were combined in the analyses of landings and value relevant to the Humboldt WEA.

The most productive ports over the 2013–2022 period were Crescent City, Fort Bragg, and Eureka, which combined represented more than 90 percent of the weight landed at ports inshore of the Humboldt WEA (Table 3.4.1-1). Limited data entries for ports such as Orick, Humboldt, Albion, Fields Landing, and King Salmon were likely due to confidential data and not any pattern of fishing activity.

Over the same period, total ex-vessel values ranged from $15 to $71 million and averaged $34 million (Table 3.4.1-2). Crescent City, Fort Bragg, and Eureka collectively accounted for over 90 percent of the $34.6 million in landings for the area. Table 3.4.1-3 shows yearly totals and 10-year averages of weight (pounds) for individual species landed. For this period, total annual landings averaged over 13.5 million pounds. The top-ranked species, by descending average weight, were Dungeness crab (58.3 percent), sablefish (7.3 percent), ocean pink shrimp (6.6 percent), Dover sole (3.9 percent), and Chinook salmon (3.9 percent). Temporal patterns of landings varied for these species. For example, Dungeness crab, albacore tuna, and others were landed each year of the period; whereas, other species such as ocean pink shrimp and market squid were more sporadic, only reporting in some years (possibly due to confidential data).

Species contributing most to the ex-vessel value of landings over the 10-year period were Dungeness crab (74.8 percent), Chinook salmon (8.9 percent), sablefish (5.5 percent), ocean pink shrimp (1.8 percent), red sea urchin (1.4 percent), and albacore tuna (1.2 percent). Average landing values for Dungeness crab, Chinook salmon, and sablefish were $26 million, $3 million, and $1.9 million, respectively (Table 3.4.1-4).

Ports complexes in the Morro Bay portion of the Affected Environment include Monterey, Morro Bay, Santa Barbara, Los Angeles, and San Diego. These five port complexes contain 29 individual ports supporting a range of fisheries. Key ports in terms of average landing percentage were Ventura (22.7 percent), Terminal Island (17.4 percent), Port Hueneme (16.0 percent), Moss Landing (14.1 percent), and Monterey (13.4 percent) (Table 3.4.1-5). These five ports collectively accounted for 83.6 percent of landings for the 10-year period.

The value of Morro Bay landings averaged $93 million between 2013 and 2022. Average values at individual ports were highest at Ventura ($17.3 million), Santa Barbara Harbor ($12.2 million), Terminal Island ($11.1 million), Port Hueneme ($9.7 million), and Monterey ($8.5 million) (Table 3.4.1-6).

Table 3.4.1-1. Commercial landings (total pounds for ports in the Eureka and Fort Bragg port complexes) near the, Humboldt WEA Affected Environment, 2013–2022

Port	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Average	Percent
Crescent City[1]	11,475,633	2,622,322	6,934,228	8,790,807	1,841,519	8,206,994	6,241,343	2,845,827	4,066,946	1,041,277	5,406,690	39.9
Fort Bragg[2]	5,635,106	7,350,887	6,022,246	4,110,691	4,234,028	2,599,346	1,728,536	1,008,819	1,709,522	5,987,112	4,038,629	29.8
Eureka[1]	6,542,274	6,591,662	418,148	2,284,179	1,774,482	4,755,566	2,498,149	1,871,544	2,312,376	865,988	2,991,437	22.1
Trinidad[1]	1,677,585	737,318	74,389	791,267	447,234	863,466	577,200	542,448	582,803	78,123	637,183	4.7
Fields Landing[1]	1,087,204	--	--	--	--	1,071,816	--	--	--	--	215,902	1.6
Shelter Cove[1]	127,350	83,286	88,891	55,785	56,136	107,665	92,559	193,197	121,400	86,733	101,300	0.7
Albion[2]	903,241	1,724	6,330	--	--	--	191	--	3,471	--	91,496	0.7
Point Arena[2]	66,678	41,316	52,558	68,044	106,331	154,445	62,174	58,358	68,650	70,822	74,938	0.6
Humboldt Bay[1]	--	--	--	--	--	--	1,983	26,135	4,295	--	3,241	<0.1
Orick[1]	--	--	--	--	--	26,113	--	--	--		2,901	<0.1
King Salmon[1]	4,985	--	--	--	--	--	--	--	--	--	499	<0.1
Total	27,520,056	17,428,515	13,596,790	16,100,773	8,459,730	17,785,411	11,202,135	6,546,328	8,869,463	8,130,055	13,563,926	--

Source: CDFW 2023a, non-confidential data only.
-- = no data available.
[1] Eureka port complex.
[2] Fort Bragg port complex.

Table 3.4.1-2. Commercial landing values (total ex-vessel dollars for ports within Eureka and Fort Bragg port complexes) by year (2013–2022) in the Humboldt WEA Affected Environment

Port	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Average	Percent
Crescent City[1]	$31,021,070	$9,689,233	$6,231,931	$22,449,084	$5,587,144	$25,078,108	$20,826,127	$10,095,069	$19,267,037	$4,993,992	$15,523,880	44.4
Fort Bragg[2]	$12,692,033	$12,532,143	$10,323,052	$7,198,120	$8,225,405	$7,111,245	$4,767,903	$3,379,121	$6,639,024	$6,939,290	$7,980,734	22.8
Eureka[1]	$18,423,628	$8,537,555	$1,653,519	$6,881,146	$5,260,484	$12,552,134	$7,581,877	$4,837,856	$9,443,152	$2,538,813	$7,771,016	22.2
Trinidad[1]	$4,791,496	$3,107,244	$378,339	$2,446,561	$1,504,296	$2,892,073	$1,896,826	$1,862,722	$2,807,087	$463,677	$2,215,032	6.3
Fields Landing[1]	$2,825,859	--	--	--	--	$3,169,782	--	--	--	--	$599,564	1.7
Shelter Cove[1]	$510,459	$353,706	$433,774	$203,308	$203,887	$361,534	$316,415	$663,486	$481,680	$330,403	$385,865	1.1
Point Arena[2]	$321,399	$254,724	$320,322	$245,941	$380,492	$646,292	$277,949	$308,773	$437,247	$324,445	$351,758	1.0
Albion[2]	$766,476	$6,903	$20,167	--	--	--	$1,084		$32,449	--	$82,708	0.2
Humboldt Bay[1]	--	--	--	--	--		$13,806	$97,798	$23,510	--	$13,511	<0.1
Orick[1]	--	--	--	--	--	$83,151	--	--	--	--	$8,315	<0.1
King Salmon[1]	$30,280	--	--	--	--	--	--	--	--	--	$3,028	<0.1
Total	$71,382,700	$34,481,508	$19,361,104	$39,424,160	$21,161,708	$51,894,319	$35,681,987	$21,244,825	$39,131,186	$15,590,620	$34,935,412	--

Source: CDFW 2023a, non-confidential data only.
-- = no data available.
[1] Eureka port complex.
[2] Fort Bragg port complex.

Table 3.4.1-3. Commercial landings (total pounds) summed over all ports in the Fort Bragg and Eureka port complexes by species and year (2013–2022) for the Humboldt WEA Affected Environment

Species	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Average	Percent
Dungeness crab	21,139,100	5,102,416	901,600	10,348,067	4,780,743	15,038,687	9,310,112	4,862,765	6,563,174	1,030,977	7,907,764	58.3
Sablefish	501,977	946,334	1,309,997	1,050,065	1,268,585	936,318	941,079	488,243	863,504	1,621,903	992,801	7.3
Ocean (pink) shrimp	--	--	6,350,383	1,822,450	--	747,447	--	--	--	--	892,028	6.6
Dover sole	1,048,531	1,023,100	1,147,437	754,071	681,576	--	--	--	--	644,905	529,962	3.9
Chinook salmon	1,682,637	1,192,505	692,789	176,131	43,348	230,012	161,416	145,706	653,949	254,780	523,327	3.9
Red sea urchin	902,190	2,267,295	944,527	528,817	--	--	--	--	166,923	195,056	500,481	3.7
Market squid	--	4,770,189	--	--	--	--	--	--	--	--	477,019	3.5
Chilipepper rockfish	558,653	319,820	263,274	82,760	71,059	806	--	5,222		1,299,082	325,085	2.4
Albacore tuna	277,286	210,247	70,242	177,903	232,393	244,936	385,700	243,481	232,346	330,181	240,472	1.8
Petrale sole	220,764	358,694	448,876	154,366	242,013	--	208	1,591	3,195	959,007	238,871	1.8
Longspine thornyhead	499,882	470,376	498,724	364,225	449,569	--	--	--	--	29,273	231,205	1.7
Black rockfish	67,415	78,032	214,569	136,857	119,077	94,120	106,257	88,114	81,565	119,668	110,567	0.8
Bocaccio rockfish	17,555	33,388	61,232	58,939	88,759	852	1,778	3,831	490	668,181	93,501	0.7
Lingcod	37,259	52,951	120,718	94,052	101,432	74,645	58,638	62,552	69,779	188,647	86,067	0.6
Others	566,807	603,168	572,422	352,070	381,176	417,588	236,947	644,823	234,538	788,395	479,793	3.5
Total	27,520,056	17,428,515	13,596,790	16,100,773	8,459,730	17,785,411	11,202,135	6,546,328	8,869,463	8,130,055	13,563,926	--

Source: CDFW 2023a, non-confidential data only.
-- = no data available.

Table 3.4.1-4. Commercial landings values (total ex-vessel dollars) summed over all ports in the Fort Bragg and Eureka port complexes by species and year (2013–2022) for the Humboldt WEA Affected Environment

Species	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Average	Percent
Dungeness crab	$57,914,771	$20,181,378	$4,084,811	$31,747,947	$15,225,972	$46,220,510	$31,183,443	$17,085,200	$31,761,793	$5,998,712	$26,140,454	74.8
Chinook salmon	$9,167,341	$5,885,580	$4,608,453	$1,547,052	$404,912	$1,691,761	$953,323	$1,024,929	$4,091,543	$1,571,981	$3,094,688	8.9
Sablefish	$1,250,673	$2,234,730	$2,630,424	$2,161,531	$2,968,287	$1,672,788	$1,654,902	$867,710	$1,443,565	$2,188,023	$1,907,263	5.5
Ocean (pink) shrimp	--	--	$4,441,372	$1,309,159	--	$523,971	--	--	--	--	$627,450	1.8
Red sea urchin	$761,851	$1,910,483	$787,374	$537,600	--	--	--	--	$338,934	$415,676	$475,192	1.4
Albacore tuna	$405,222	$317,622	$119,821	$319,305	$460,737	$381,505	$499,891	$483,235	$391,258	$676,036	$405,463	1.2
Coonstriped shrimp	--	$336,892	--	$253,259	$279,604	$496,688	$616,663	$569,292	--	$591,510	$349,323	1.0
Petrale sole	$286,676	$498,761	$620,006	$218,395	$306,206	--	$284	$5,394	$1,776	$1,155,798	$309,330	0.9
Dover sole	$468,562	$455,851	$510,639	$338,698	$300,837	--	--	--	--	$259,740	$233,433	0.7
Black rockfish	$121,501	$155,377	$413,377	$269,837	$231,773	$181,735	$210,976	$170,180	$175,506	$289,626	$221,989	0.6
Lingcod	$70,546	$111,577	$226,732	$199,536	$206,704	$195,061	$157,406	$183,675	$202,772	$381,219	$193,523	0.6
Market squid	--	$1,550,311	--	--	--	--	--	--	--	--	$155,031	0.4
Chilipepper rockfish	$363,268	$218,005	$176,012	$57,344	$38,403	$927		$7,489		$620,270	$148,172	0.4
Shortspine thornyhead	$142,764	$157,987	$175,191	$137,687	$143,784	$82,729	$84,373	$53,033	$39,718	$101,383	$111,865	0.3
Longspine thornyhead	$225,370	$189,402	$199,571	$149,301	$262,256	--	--	--	--	$9,389	$103,529	0.3
Others	$204,155	$277,552	$367,321	$177,509	$332,233	$446,644	$320,726	$462,049	$684,321	$1,331,257	$460,377	1.3
Total	$71,382,700	$34,481,508	$19,361,104	$39,424,160	$21,161,708	$51,894,319	$35,681,987	$21,244,825	$39,131,186	$15,590,620	$34,935,412	--

Source: CDFW 2023a, non-confidential data only.
-- = no data available.

A range of species are landed by Morro Bay area fisheries. Market squid, northern anchovy, Pacific mackerel, red sea urchin, Pacific sardine, yellowfin tuna, and sablefish accounted for about 94 percent of landings by weight within the Morro Bay portion of the Affected Environment over the 10-year period (Table 3.4.1-7). Market squid contributed 77 percent of the average landings followed by northern anchovy (4.7 percent), Pacific mackerel (4.7 percent), red sea urchin (3.3 percent), and Pacific sardine (3.2 percent).

Among ports in the Morro Bay WEA, the species ranked highest for value of landing (in descending order were): market squid (49.1 percent), California spiny lobster (15.3 percent), red sea urchin (6.6 percent), Dungeness crab (3.8 percent), sablefish (2.8 percent), spot prawn (2.7 percent), and Chinook salmon (2.6 percent) (Table 3.4.1-8). The top-ranked 15 species accounted for 92 percent of the 2013 to 2023 average values. Of these species, eight were invertebrates with market squid ($45.6 million), California spiny lobster ($14.2 million), red sea urchin ($6.1 million), and Dungeness crab ($3.5 million) being the most valuable contributing over 77 percent of the average value. Most valuable finfish were sablefish ($2.6 million), Chinook salmon ($2.4 million), and bigeye tuna ($2.4 million) representing 8 percent of the average value of landings in the Morro Bay portion of the Affected Environment.

Table 3.4.1-5. Commercial landings (total pounds for ports within Monterey, Morro Bay, Santa Barabara, Los Angeles, and San Diego port complexes) by year (2013–2022) and port in the Morro Bay WEA Affected Environment

Port	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Average	Percent
Ventura[1]	64,741,997	37,763,255	23,166,128	18,477,149	53,160,853	16,248,814	7,084,271	4,889,677	23,387,299	58,248,030	30,716,747	22.7
Terminal Island[3]	49,535,775	30,410,795	4,755,071	25,355,628	27,829,170	22,286,051	17,762,815	11,442,525	15,934,092	30,274,644	23,558,657	17.4
Port Hueneme[1]	35,807,990	34,736,856	17,538,232	17,004,439	35,693,492	13,702,299	3,214,710	1,024,936	12,553,361	45,335,354	21,661,167	16.0
Moss Landing[2]	14,545,867	46,432,049	41,983,007	8,008,033	4,704,924	10,875,360	18,255,925	22,241,717	21,438,237	3,081,314	19,156,643	14.1
Monterey[2]	18,264,160	60,186,336	17,250,906	8,339,434	10,651,030	16,983,314	2,140,569	16,574,708	26,527,456	4,180,906	18,109,882	13.4
San Pedro[3]	65,078,929	21,654,136	5,022,179	3,989,346	8,941,466	1,958,357	541,830	1,656,667	3,335,452	493,408	11,267,177	8.3
Santa Barbara Harbor[1]	7,040,576	7,021,473	6,374,608	5,002,684	3,786,170	3,296,512	2,546,279	2,235,767	1,962,890	2,465,243	4,173,220	3.1
Morro Bay[5]	5,532,405	5,452,481	2,534,069	3,232,355	3,711,840	723,436	588,280	505,999	469,688	298,246	2,304,880	1.7
Oxnard[1]	3,053,236	2,955,993	2,201,251	1,825,325	1,364,639	1,074,239	880,419	901,252	978,608	1,201,429	1,643,639	1.2
San Diego[4]	301,201	314,221	259,616	367,567	445,264	994,548	1,962,180	2,223,191	1,366,647	1,130,835	936,527	0.7
Santa Cruz[2]	435,877	571,215	296,872	409,263	373,708	232,802	353,345	415,994	434,185	470,971	399,423	0.3
Point Loma[4]	245,675	5,554	175,386	99,815	834,116	997,102	404,458	310,918	159,258	220,671	345,295	0.3
Avila/Port San Luis[5]	387,734	401,446	318,524	851,267	687,042	210,800	199,037	144,866	133,147	97,167	343,103	0.3
Mission Bay[4]	519,420	537,300	507,153	342,869	314,054	211,937	250,241	163,593	137,927	141,613	312,611	0.2
Oceanside[4]	71,354	309,697	267,939	238,784	242,505	236,777	197,302	182,770	115,334	143,271	200,573	0.1
Dana Point[3]	146,073	164,511	166,595	58,461	62,417	138,816	118,879	93,285	72,339	198,493	121,987	0.1
Redondo Beach[3]	52,859	242,932	164,848	92,747	16,868	324,583	160,140	18,853	125,623	9,745	120,920	0.1
Newport Beach[3]	152,395	189,990	133,081	118,160	38,644	80,869	96,881	12,416	32,945	109,209	96,459	0.1
Long Beach[3]	14,460	--	15,466	29,684	18,319	23,578	19,621	23,520	11,796	23,026	17,947	<0.1
Marina Del Rey[3]	13,509	24,212	26,405	--	--	23,031	27,644	1,215	--	--	11,602	<0.1
Avalon[3]	2,231	9,832	412	--	7,720	9,790	9,879	3,148	15,032	19,967	7,801	<0.1
Big Creek[2]	4,676	9,031	9,977	5,957	--	--	--	--	--	--	2,964	<0.1
Hermosa Beach[3]	--	--	--	--	1,289	7,850	1,673	--	--	--	1,081	<0.1

Port	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Average	Percent
Huntington Beach[3]	--	--	--	--	--	--	--	--	--	7,697	770	<0.1
Los Angeles[3]	--	--	5,261	--	--	--	--	--	--	--	526	<0.1
Mill Creek[2]	1,309	1,912	345	--	--	--	--	--	--	--	357	<0.1
Gaviota Beach[1]	--	--	--	--	--	2,817	--	--	--	--	282	<0.1
La Jolla[4]	--	--	1,383	--	--	0	--	--	--	--	138	<0.1
Total	**265,949,708**	**249,395,227**	**123,174,714**	**93,848,967**	**152,885,530**	**90,643,682**	**56,816,378**	**65,067,017**	**109,191,316**	**148,151,239**	**135,512,378**	--

[1] Santa Barbara port complex.
[2] Monterey port complex.
[3] Los Angeles port complex.
[4] San Diego port complex.
[5] Morro Bay port complex.
Sources: CDFW 2023a, non-confidential data only.
-- = no data available.

Table 3.4.1-6. Commercial landings values (total ex-vessel dollars for ports within Monterey, Morro Bay, Santa Barabara, Los Angeles, and San Diego port complexes) by year (2013–2022) and port in the Morro Bay WEA Affected Environment

Port	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Average	Percent
Ventura[1]	$22,417,883	$14,938,792	$10,281,260	$12,347,505	$30,344,301	$12,110,151	$6,971,830	$6,844,866	$17,465,139	$39,201,871	$17,292,360	18.6
Santa Barbara Harbor[1]	$10,761,567	$13,120,532	$14,017,961	$13,232,730	$12,545,720	$12,528,668	$10,506,787	$10,987,977	$11,182,058	$13,537,129	$12,242,113	13.2
Terminal Island[3]	$14,098,192	$9,848,861	$3,165,729	$10,862,221	$15,238,783	$12,332,175	$8,262,748	$7,088,545	$10,735,526	$19,472,866	$11,110,565	11.9
Port Hueneme[1]	$11,473,509	$10,870,110	$4,875,452	$8,282,606	$17,749,372	$6,818,480	$1,589,431	$508,960	$7,438,659	$26,936,765	$9,654,334	10.4
Monterey[2]	$6,720,534	$19,951,532	$5,964,720	$5,631,935	$5,847,236	$8,476,566	$2,184,983	$10,428,007	$16,924,652	$3,144,949	$8,527,511	9.2
Moss Landing[2]	$6,193,845	$14,897,629	$6,932,779	$5,376,917	$3,746,704	$6,441,982	$4,793,970	$9,100,630	$11,691,893	$3,323,366	$7,249,972	7.8
San Pedro[3]	$18,535,248	$7,074,021	$1,949,577	$4,205,710	$5,007,380	$2,367,285	$1,975,124	$2,266,286	$3,043,432	$1,139,076	$4,756,314	5.1
Oxnard[1]	$3,550,440	$4,143,015	$3,121,452	$3,396,089	$3,309,774	$2,993,556	$3,124,563	$3,800,661	$4,990,482	$6,503,831	$3,893,386	4.2
Morro Bay[5]	$5,548,270	$6,099,025	$6,238,344	$5,228,861	$5,363,793	$2,614,262	$2,961,132	$1,557,921	$1,558,363	$1,259,266	$3,842,924	4.1
San Diego[4]	$1,842,194	$1,686,269	$1,418,154	$2,373,881	$2,061,177	$3,192,644	$6,252,440	$6,624,627	$5,158,114	$5,020,954	$3,563,045	3.8
Santa Cruz[2]	$1,778,175	$2,298,011	$1,575,517	$1,629,717	$1,692,787	$1,421,186	$1,923,669	$2,195,716	$3,281,252	$3,315,559	$2,111,159	2.3

Port	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Average	Percent
Mission Bay[4]	$2,682,820	$3,150,738	$2,480,028	$2,017,497	$2,356,659	$1,679,498	$1,275,844	$1,579,001	$1,557,883	$1,576,720	$2,035,669	2.2
Dana Point[3]	$1,483,794	$1,886,879	$1,506,150	$870,059	$1,061,564	$1,307,052	$1,088,920	$1,236,790	$933,116	$2,715,355	$1,408,968	1.5
Oceanside[4]	$1,117,893	$1,945,164	$1,496,271	$1,522,259	$1,624,343	$1,434,110	$952,763	$1,193,959	$1,131,196	$1,649,050	$1,406,701	1.5
Avila/Port San Luis[5]	$1,737,472	$1,932,478	$1,812,401	$2,166,791	$2,027,401	$750,698	$1,262,479	$794,689	$807,316	$483,031	$1,377,476	1.5
Point Loma[4]	$374,034	$97,882	$314,415	$380,180	$2,162,555	$2,521,309	$1,146,475	$876,069	$732,488	$905,300	$951,071	1.0
Newport Beach[3]	$804,394	$906,979	$744,847	$702,951	$366,116	$478,262	$581,383	$51,709	$173,867	$690,512	$550,102	0.6
Redondo Beach[3]	$519,982	$664,539	$490,426	$480,028	$316,450	$546,927	$408,143	$377,112	$56,672	$189,054	$404,933	0.4
Long Beach[3]	$281,568	--	$331,156	$393,666	$347,451	$394,981	$281,284	$272,766	$227,749	$332,571	$286,319	0.3
Marina Del Rey[3]	$247,091	$511,237	$592,574	--	--	$386,631	$390,993	$2,119	--	--	$213,065	0.4
Avalon[3]	$24,083	$146,998	$1,352	--	$75,534	$91,838	$79,695	$21,936	$190,724	$292,019	$102,687	0.1
Hermosa Beach[3]	--	--	--	--	$24,130	$104,263	$25,730	--	--	--	$15,412	0.1
Big Creek[2]	$12,792	$32,191	$34,520	$21,278	--	--	--	--	--	--	$10,078	0.1
Huntington Beach[3]	--	--	--	--	--	--	--	--	--	$37,094	$3,709	0.1
Los Angeles[3]	--	--	$24,578	--	--	--	--	--	--	--	$2,458	0.1
Gaviota Beach[1]	--	--	--	--	--	$11,487	--	--	--	--	$1,149	0.1
Mill Creek[2]	$3,529	$3,857	$892	--	--	--	--	--	--	--	$828	0.1
La Jolla[4]	--	--	$2,254	--	--	--	--	--	--	--	$282	0.1
Total	$112,209,309	$116,206,739	$69,372,809	$81,122,881	$113,269,230	$81,004,011	$58,040,386	$67,810,346	$99,280,581	$131,726,338	$93,004,263	--

[1] Santa Barbara port complex.
[2] Monterey port complex.
[3] Los Angeles port complex.
[4] San Diego port complex.
[5] Morro Bay port complex.
Source: CDFW 2023a, non-confidential data only.
-- = no data available.

Table 3.4.1-7. Commercial landings (total pounds for ports within Monterey, Morro Bay, Santa Barabara, Los Angeles, and San Diego port complexes) by species and year (2013–2022) for the Morro Bay WEA Affected Environment

Species	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Average	Percent
Market squid	213,921,840	201,071,871	65,353,717	68,954,335	132,480,754	69,504,088	24,267,248	38,464,684	91,902,280	137,048,173	104,296,899	77.0
Northern anchovy	11,010	--	27,717,506	6,265,623	31,421	--	14,746,293	9,264,590	5,832,910	493,967	6,436,332	4.7
Pacific mackerel	17,746,176	11,921,197	12,061,226	3,033,087	4,743,017	4,495,823	5,432,325	1,125,575	1,902,927	873,502	6,333,486	4.7
Red sea urchin	9,522,904	8,376,070	7,045,711	5,276,868	3,658,083	2,889,149	2,239,809	1,640,408	1,933,292	2,590,609	4,517,290	3.3
Pacific sardine	15,584,767	17,045,293	1,563,571	370,116	246,198	503,401	996,405	3,729,637	1,484,880	1,444,500	4,296,877	3.2
Yellowfin tuna	1,806	764,991	563,116	502,669	2,292,066	2,453,525	634,535	3,097,515	128	130,378	1,044,073	0.8
Sablefish	1,194,280	1,260,767	1,369,476	1,107,616	1,017,597	1,186,932	1,023,864	818,323	974,736	424,974	1,037,857	0.8
Dungeness crab	1,229,252	1,802,317	1,035,277	1,590,231	1,100,419	328,951	266,978	293,349	234,021	125,871	800,667	0.6
California spiny lobster	751,038	917,600	761,943	637,807	674,301	858,520	806,160	687,113	623,975	912,935	763,139	0.6
Red rock crab	565,089	968,408	1,127,032	705,635	514,986	428,395	367,749	315,930	326,565	340,364	566,015	0.4
Bigeye tuna	--	--	--	294,757	664,030	1,156,535	1,052,283	780,894	744,882	367,549	506,093	0.4
Yellow rock crab	371,524	522,342	356,470	207,572	337,802	681,463	781,854	715,747	424,656	563,900	496,333	0.4
Jack mackerel	1,964,530	1,522,030	450,822	350,520	274,923	83,923	--	53,852	19,998	2,223	472,282	0.3
Ridgeback prawn	47,993	492,837	797,393	462,733	378,312	375,451	383,682	482,989	247,121	183,404	385,192	0.3
Others	3,037,499	2,729,504	2,971,454	4,089,398	4,471,621	5,697,526	3,817,193	3,596,411	2,538,945	2,648,890	3,559,844	2.6
Total	265,949,708	249,395,227	123,174,714	93,848,967	152,885,530	90,643,682	56,816,378	65,067,017	109,191,316	148,151,239	135,512,378	--

Source: CDFW 2023a, non-confidential data only.
-- = no data available.

Table 3.4.1-8. Commercial landings values (total ex-vessel dollars for ports within Monterey, Morro Bay, Santa Barabara, Los Angeles, and San Diego port complexes) by species and year (2013–2022) for the Morro Bay WEA Affected Environment

Species	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Average	Percent
Market squid	$68,433,468	$63,703,894	$19,617,972	$33,599,933	$66,182,149	$33,978,929	$12,032,665	$22,251,962	$54,917,196	$81,867,807	$45,658,598	49.1
California spiny lobster	$13,549,411	$17,478,717	$15,691,408	$13,071,771	$12,738,414	$13,935,631	$11,097,663	$13,215,627	$14,083,551	$17,657,933	$14,252,013	15.3
Red sea urchin	$6,944,656	$6,280,843	$6,140,383	$6,632,520	$5,735,028	$5,213,043	$4,868,008	$4,071,155	$6,246,412	$9,337,334	$6,146,938	6.6
Dungeness crab	$4,155,987	$7,933,415	$6,507,548	$5,357,101	$4,705,386	$1,749,107	$1,168,897	$1,113,895	$1,595,922	$825,594	$3,511,285	3.8
Sablefish	$3,102,451	$3,090,853	$3,679,287	$2,683,509	$2,383,439	$2,970,570	$2,847,746	$2,020,927	$2,138,945	$1,200,953	$2,611,868	2.8
Spot prawn	$1,139,331	$1,842,373	$1,625,852	$4,454,962	$2,506,901	$2,849,756	$2,432,734	$4,081,320	$1,851,470	$1,917,010	$2,470,171	2.7
Chinook salmon	$2,504,364	$715,398	$1,059,245	$1,210,845	$1,492,272	$1,361,435	$5,720,924	$2,433,008	$3,755,386	$4,376,509	$2,462,939	2.6
Bigeye tuna	--	--	--	$913,241	$1,998,221	$3,425,221	$3,728,924	$2,664,363	$2,669,965	$1,540,852	$2,420,112	2.6
Shortstripe thornyhead	$1,006,207	$1,373,645	$1,347,489	$2,183,530	$2,647,119	$2,191,915	$1,786,684	$856,406	$664,592	$480,579	$1,453,817	1.6
California halibut	$867,276	$856,127	$682,753	$1,032,109	$1,234,697	$1,388,270	$1,208,054	$1,606,255	$1,675,761	$1,732,427	$1,228,373	1.3
Ridgeback prawn	$143,495	$1,347,794	$1,968,396	$1,030,162	$907,295	$1,049,344	$872,517	$1,067,023	$744,197	$718,164	$984,839	1.1
Red rock crab	$901,681	$1,504,548	$1,728,020	$1,114,874	$881,365	$744,100	$668,509	$594,252	$681,658	$755,636	$957,464	1.0
Yellow rock crab	$522,154	$667,815	$449,192	$263,625	$510,356	$1,081,839	$1,345,617	$1,280,531	$846,237	$1,370,014	$833,738	0.9
Swordfish	$463,321	$434,554	$378,897	$1,127,625	$1,093,369	$1,113,233	$1,172,755	$947,003	$796,692	$595,663	$812,311	0.9
Others	$8,475,507	$8,976,763	$8,496,367	$6,447,074	$8,253,219	$7,951,618	$7,088,689	$9,606,619	$6,612,597	$7,349,863	$7,925,832	8.5
Total	$112,209,309	$116,206,739	$69,372,809	$81,122,881	$113,269,230	$81,004,011	$58,040,386	$67,810,346	$99,280,581	$131,726,338	$93,004,263	--

Source: CDFW 2023a, non-confidential data only.
-- = no data available.

3.4.1.1.3 Commercial Fisheries in the Humboldt and Morro Bay Lease Areas

Spatial data for various commercial fisheries were examined to understand the level of fishing effort in the WEAs. Somers et al. (2020) mapped patterns and trends in commercial fishing efforts in the bottom trawl portion of the Groundfish Catch Share Program, which is part of the Groundfish FMP, along the entire coast of California. To assess the extent to which fishery activity coincided with the Humboldt and Morro Bay WEAs, the lease boundaries were superimposed onto Somers et al. (2020) spatial data for federally managed bottom trawling. Bottom trawling (bottom contact trawling) is one of the primary fisheries in the water depths found in the WEAs. Bottom trawling occurred in and around the Humboldt WEA with heavy activity just inshore of the lease boundary from 2016 to 2017. Figure 3.4.1-2 shows data plotted as status in total distance trawled (kilometers/square kilometers/year) from 2016 to 2017. Since 2015, trawl activity around the Morro Bay WEA has been limited because very few non-confidential data entries were present in that area (Somers et al 2020). However, pot fishing (also part of the Groundfish Catch Share Program) has been very active (2016–2017) in and around the Morro Bay WEA (Figure 3.4.1-2). Harvey et al. (2022) developed and reported seven indicators of fishing activity in the areas surrounding the two WEAs. These results provide a more nuanced description of bottom trawl fishing activity in the two regions across a longer historical period.

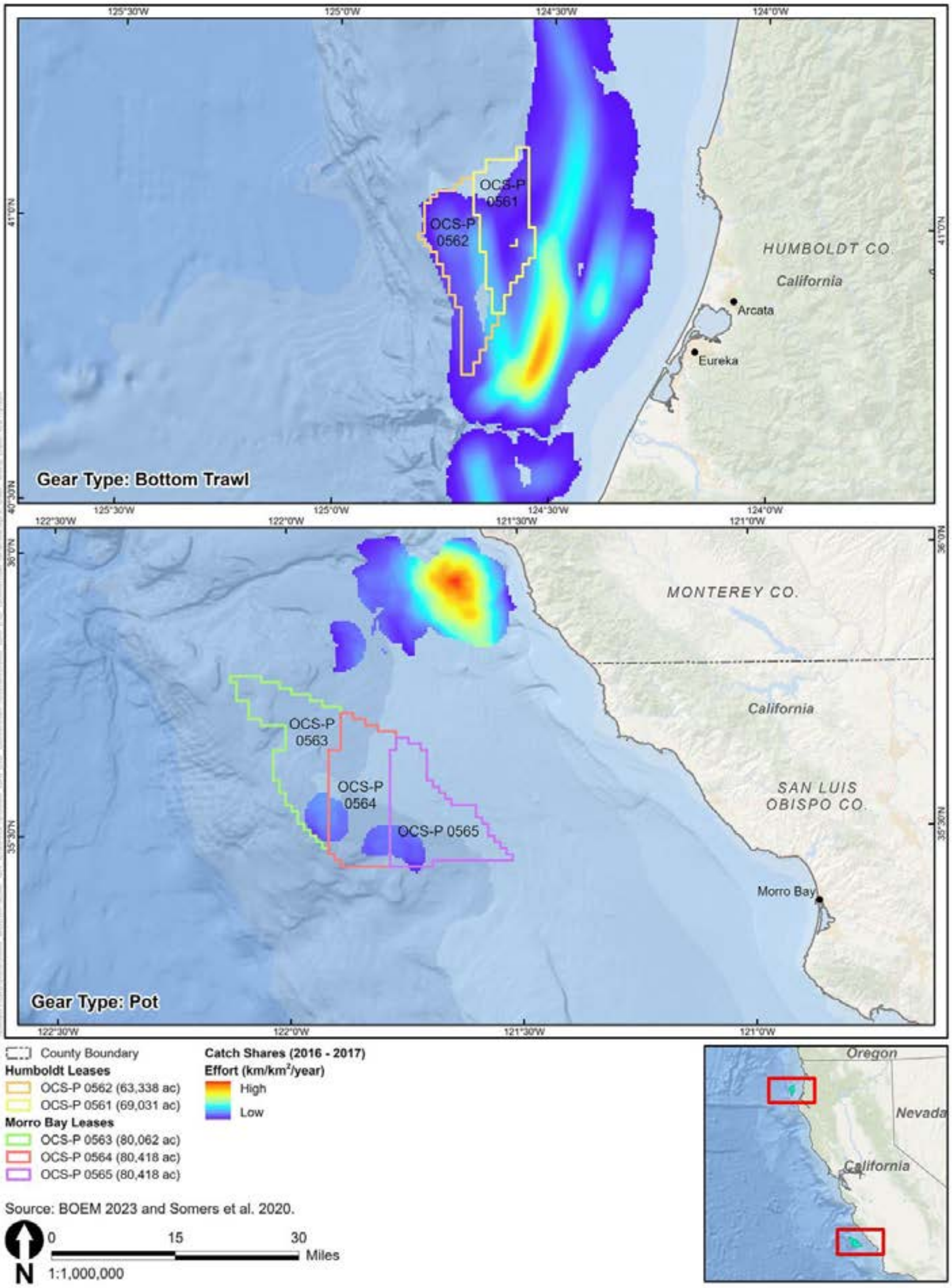

Figure 3.4.1-2. Federally managed bottom trawl (upper panel) and pot fishing (lower panel) activity relative to the Humboldt and Morro Bay WEAs

Source: Somers et al. 2020.
Note: red = high effort; blue = low effort

In another study of potential overlap of fishing effort with the WEAs, Wang et al. (2022) analyzed CDFW commercial fishing block data from 2005 to 2019 for nine species groups representing over 95 percent of the total landings for the period. The species groups include groundfish, coastal pelagic species, highly migratory species, game fishes, Dungeness crab, echinoderms, salmon, squid, and other crustaceans. Average catch for the 15-year time series by species group were mapped using the spatial grid of CDFW blocks. Wang et al (2022) analyzed blocks overlapping the Humboldt and Morro Bay lease areas relative to broader port-based fishery areas (complexes) to provide information on the level of fishing effort and type occurring in the WEAs. In the Humboldt region, Dungeness crab trapping was the most important fishery based on volume and value of landings (Table 3.4.1-4) with salmon and groundfish being second and third in landings and value, respectively. When prescribed depth limits were applied to the species groups (Miller et al. 2017), importance shifted from Dungeness crab to groundfish and salmon (Wang et al. 2022). Segregating species groups by their preferred water depths helps indicate potential overlaps between fishing activity and WEA footprints. Figure 3.4.1-3 illustrates these patterns for the two WEAs.

- The top left of the figure shows fisheries landed in ports in the Humboldt WEA (Eureka, Trinidad, Shelter Cove, Crescent City, Fields Landing, King Salmon, Klamath, and Humboldt Bay).
- The top right of the figure shows fisheries landed in ports in the Morro Bay WEA (Avila/Port San Luis, Morro Bay, and San Simeon).
- The middle left of the figure shows fisheries recorded in the blocks overlapping the Humboldt WEA.
- The middle right of the figure shows fisheries recorded in the blocks overlapping the Morro Bay WEA.
- The bottom left of the figure shows fisheries in the Humboldt WEA within the prescribed depth limit; the bottom right of the figure shows the same but for the Morro Bay WEA.

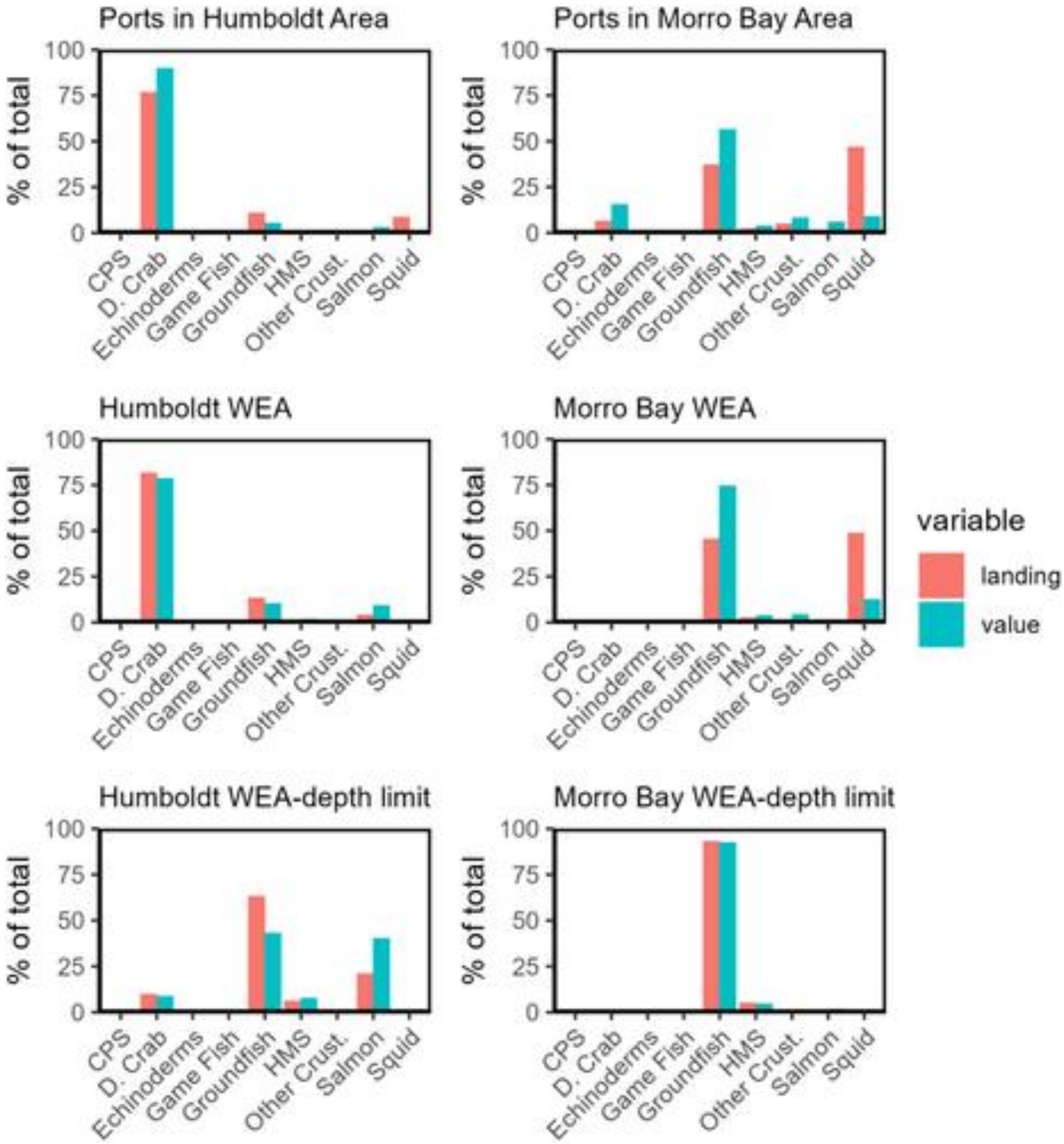

Figure 3.4.1-3. Percent of total landings and values based on fishery recorded in three-digit blocks under different conditions

Source: Wang et al. 2022.

3.4.1.1.4 *Commercial Fishing Gear Types*

Traps, trawl, hook-and-line, hand (diving), seine, and nets (other) are used in the Humboldt WEA. Traps produced 61.6 percent of the landings followed by trawls (19 percent), hook-and-line (10 percent), and hand (diving) (3 percent). Table 3.4.1-9 provides top species caught by the different gear types and typical depth range fished for the Humboldt Affected Environment.

Table 3.4.1-9. Commercial fishing gear types, primary species landed, and typical depth ranges fished in the Humboldt Affected Environment

Gear[1]	Species Sought	Areas Fished
Seine	Market squid	Shelf waters, near surface
Hand (diving)	Sea urchin, red	Shelf waters (40–110 ft [12–34 m])
Traps and pots	Hagfishes, sablefish, and Dungeness and rock crabs	Shelf and upper slope waters Crabs and hagfishes (30–600 ft [9–183 m) Sablefish (600–2,250 ft [182–686 m])
Bottom trawl	Ocean pink shrimp, sablefish, rockfish complex, flatfish complex	Outer shelf to upper slope (180–1,200 ft [55–366 m])
Hook and line (trolling)	Chinook salmon, albacore tuna	Oceanic waters
Hook and line (bottom fishing)	Sablefish, rockfish complex, lingcod, flatfish complex	Shelf to upper slope (66–2,250 ft [182–686 m])

[1] Gear types ranked in descending order of average pounds landed for the 2013–2022 period.
ft = feet; m = meters.
Sources: CDFW 2023a, non-confidential data only; CDFW 2023b; Industrial Economics Inc., 2012.

Fisheries in the Morro Bay WEA used a wider range of gear than those in the Humboldt WEA. In addition to equipment used in the Humboldt WEA, Morro Bay WEA landings also reported use of gillnet, harpoon/spear, and pelagic longline (Table 3.4.1-10). Spatial analysis by Wang et al. (2022) indicated groundfish trawling would likely overlap with the WEAs.

Table 3.4.1-10. Commercial fishing gear types, primary species landed, and typical depth ranges fished in the Morro Bay WEA Affected Environment

Gear[1]	Species Caught	Primary Fishing Areas
Seine and other nets	Market squid, northern anchovy, Pacific mackerel, yellowfin tuna	Shelf waters (near surface)
Hand (diving)	Red sea urchin	Shelf waters (40–110 ft [12–34 m])
Pelagic longline	Bigeye tuna, opah, swordfish, yellowfin tuna, albacore tuna	Oceanic waters
Traps	Dungeness crab, California spiny lobster, hagfishes, rock crabs	Crabs (30–600 ft [9–183 m]); hagfishes (200– 600 ft [60–183 m])
Trawl	Ocean pink shrimp, ridgeback prawn, longspine thornyhead, sablefish	Outer shelf to slope waters (180–1,200 ft [55–366 m])

Gear[1]	Species Caught	Primary Fishing Areas
Hook and line (trolling)	Albacore tuna, Chinook salmon, bluefin tuna, swordfish	Shelf nearshore to 600 ft (183 m) for Chinook salmon Oceanic waters (all others)
Hook and line (bottom fishing)	Opah, shortspine thornyhead, rockfish complex	Shelf and upper slope waters (66–2,250 ft [182–686 m])
Gillnet	White seabass, swordfish, California halibut, thresher shark	Oceanic waters (federal waters only)
Harpoon/spear	Swordfish	Oceanic waters

[1] Gear types ranked in descending order of average pounds landed for the 2013–2022 period.
Sources: CDFW 2023a, non-confidential data only; CDFW 2023b; Industrial Economics Inc., 2012.
ft = feet; m = meters.

In summary, the waters off the Morro Bay and Humboldt WEAs support varied commercial fisheries. Landings (pounds and values) for ports in the Humboldt WEA are led by Dungeness crab and followed distantly by groundfish and salmon. At water depths of the Humboldt WEA, groundfish, salmon, and highly migratory species are more commonly caught (Wang et al. 2022). Trapping for Dungeness crab is important in the Humboldt WEA but occurs primarily in inner shelf waters. The Morro Bay WEA produces mostly groundfish, followed by highly migratory species. The primary gear types used in the Morro Bay WEA are seines, hand (diving), pelagic longline, pots, and hook-and-line (Table 3.4.1-10).

3.4.1.1.5 For-Hire Recreational Fishing

For-hire recreational fisheries involve anglers paying to fish from licensed vessels, which travel offshore in pursuit of various target species. In California waters, for-hire vessels, called Commercial Passenger Fishing Vessels (CPFV) or party/charter vessels, seek primarily bottom fish, coastal pelagic fishes, and highly migratory pelagic fishes. Some charter vessels cater to scuba divers seeking to spearfish or catch spiny lobsters.

For-hire fleets primarily target bottom fish found in nearshore hard bottom, kelp beds, and shelf or slope hard and soft bottoms. Bottom fishes include all species listed in the Pacific Coast Groundfish FMP (PFMC 2020) except leopard shark, California skate, sand sole, and starry flounder; all species listed in the California Nearshore FMP (CDFG 2002); and unidentified bottom fish or groundfish, blacksmith, black croaker, white seabass, other flounders, sea chubs, groupers, grunts, Pacific halibut, sea basses (except spotted sand bass), kelpfishes, sculpins, wrasses, ocean whitefish, some surfperches (black, kelp, pink, rainbow, reef, sharp nose and striped), and other flatfish and sharks found in the nearshore over hard bottoms and offshore (CDFW 2022).

Coastal pelagic species may also be targeted during certain seasons by for-hire vessels based on availability. Anglers may catch all species listed in the Coastal Pelagic Species FMP (PFMC 2023a) including northern anchovy, Pacific mackerel, jack mackerel, market squid, and Pacific. Ocean-run Chinook salmon are caught aboard for-hire vessels during summer months and other species such as anchovies, Pacific barracuda, butterfish, flying fish, jacks (jack family and yellowtail), mackerels (mackerel family, bullet, sierras, and Pacific bonito), and Pacific saury are also taken during typical trips (CDFW 2022).

Fishers on for-hire vessels catch highly migratory species such as albacore tuna, yellowfin tuna, bluefin tuna, and skipjack tuna depending on seasonal availability and location. These species are listed in the PFMC FMP (2023b).

This analysis uses data obtained from the RecFIN data portal managed by the Pacific States Marine Fisheries Commission (RecFIN.org) to characterize temporal (monthly) patterns of for-hire recreational fisheries associated with the Affected Environment. The data recorded the number of angler trips per month on for-hire vessels from 2013 to 2022 and were partitioned by RecFIN into northern and southern California subregions. The northern subregion extends from the Oregon border to Point Conception and includes the Humboldt WEA and some of the Morro Bay WEA. The southern subregion extends from Point Conception to the Mexican border and includes major ports in the region. The data do not neatly overlap with the Affected Environment but provide reasonable indications of temporal patterns in participation.

Data from 2013 to 2022 indicate that for-hire recreational fishing efforts are concentrated during summer months (when seas tend to be calmer). Most efforts are focused on bottom fishing, as opposed to fishing for coastal or highly migratory pelagic species (Figure 3.4.1-4). The number of trips by for-hire vessels was lower in the northern California subregion (which includes the full extent of the Humboldt WEA Affected Environment and a portion of the Morro Bay WEA Affected Environment) than the number of trips recorded for southern California (which includes the remaining southern portion of the Morro Bay WEA Affected Environment).

Unlike effort data, yearly catch data on composition of for-hire vessels from 2013 to 2022 from RecFIN were available at finer geographical scales corresponding to the two Affected Environment areas. These data were also available for water codes (≤3 miles [4.8 kilometers] from shore and >3 miles [4.8 kilometers] from shore).

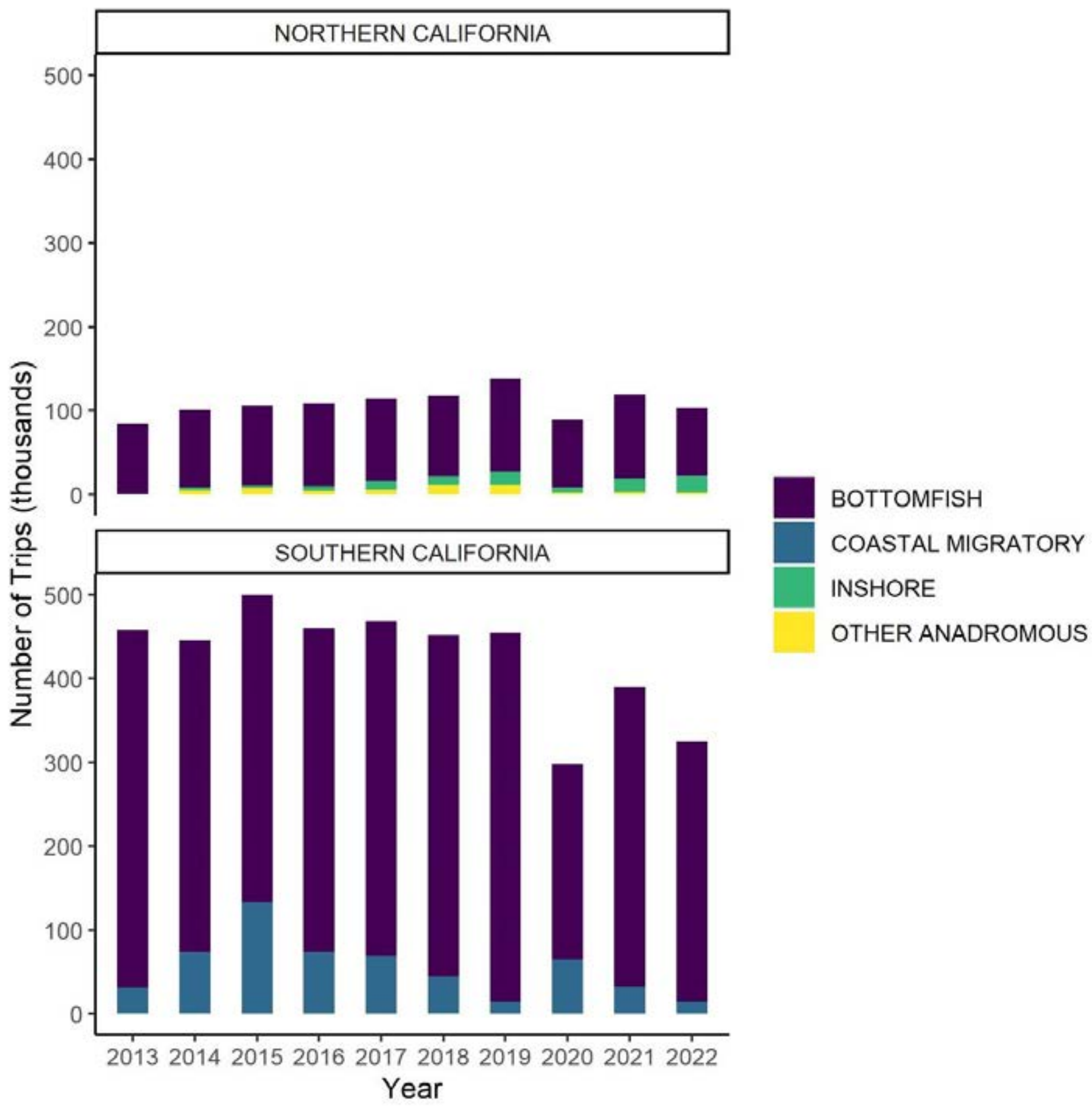

Figure 3.4.1-4. Number of trips made per year by anglers on CPFVs for northern and southern California, 2013–2022

Source: Free et al. 2022.
Note: The proportion of trips focused on different species groups (bottom fish, coastal migratory, nearshore, and other) is shown by colored segments of the bars. This partially corresponds with the Morro Bay portion of the affected environment.

Rockfishes (*Sebastes* spp.) dominated the catches made during the 2013 to 2022 period in the Humboldt portion of the Affected Environment (Table 3.4.1-11). More fish were caught ≤3 miles (4.8 kilometers) from shore than were caught >3 miles (4.8 kilometers) from shore with some difference in species composition of the catch between the two areas. Of the 19 species, which combined, represented the top 15 highest average catches for the two water codes; only lingcod, Pacific sanddab, sanddab genus (*Citharichthys* spp.), and white croaker were not rockfishes. The dominance of rockfishes in the catches indicates that most for-hire bottom fishing in the Humboldt portion of the Affected Environment is likely over natural or artificial hard bottom.

Table 3.4.1-11. Top 15 species ranked by average numbers of fish caught by anglers fishing on for-hire vessels operating <3 miles from shore, or >3 miles from shore in the Humboldt area WEA Affected Environment, 2013–2022

Species	Ocean ≤3 Miles	Rank	Ocean >3 Miles	Rank
Rockfish genus	4,594	1	2,615	1
Blue rockfish	3,347	2	653	5
Brown rockfish	2,247	4	1,271	2
Black rockfish	2,515	3	445	8
Sanddab genus	2,079	5	--	--
Yellowtail rockfish	2,031	6	845	3
Lingcod	1,296	7	268	12
Canary rockfish	1,062	8	414	9
Widow rockfish	685	9	459	7
Olive rockfish	618	11	264	13
Rosy rockfish	461	14	660	4
Starry rockfish	520	12	469	6
Vermilion rockfish	502	13	240	--
Redstripe rockfish	456	15	360	11
Pacific sanddab	623	10	255	14
Copper rockfish	429	--	248	15
White croaker	56	--	385	10

Source: RecFIN.org 2023.

In addition to bottom fishes, anglers in northern California fish from for-hire vessels for Chinook salmon generally from May to August when fish are present. Data on salmon catch from Free et al. (2022) were plotted for the following port complexes areas (i.e., Eureka, Fort Bragg, Bodega Bay, San Francisco, Monterey, and Morro Bay) (Figure 3.4.1-5). PFMC, responding to recommendations from NMFS, closed all ocean salmon fishing off Washington, Oregon, and California in 2023 (CDFW 2024).

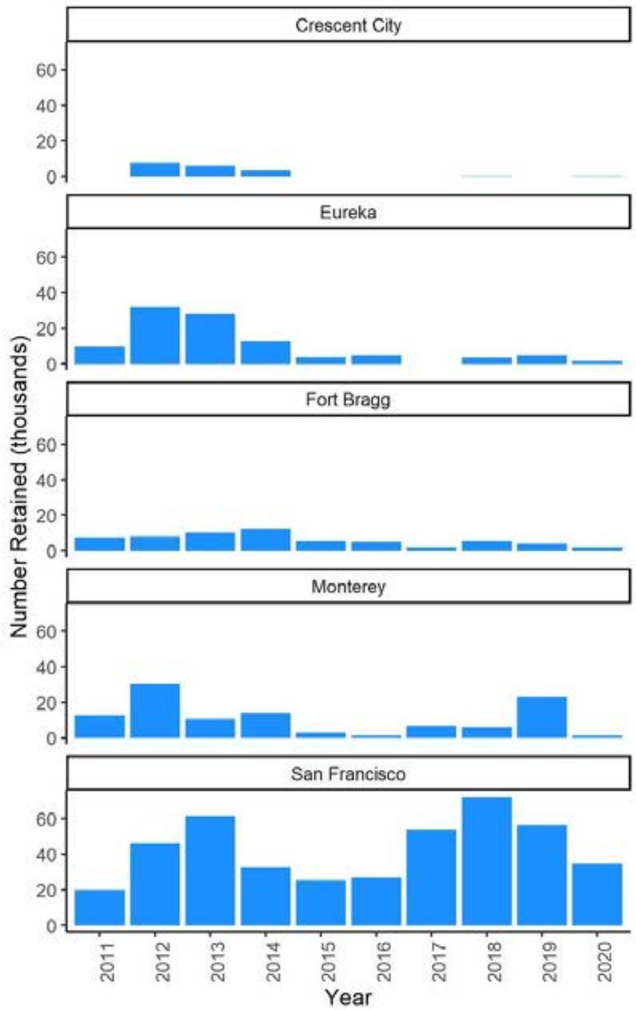

Figure 3.4.1-5. Annual catch of Chinook salmon by recreational anglers fishing from private and CPFVs for northern California port areas, 2011–2020

Source: Free et al. 2022.

Catches from the Morro Bay portion of the Affected Environment were also numerically dominated by rockfishes (Table 3.4.1-12). Of the 22 species, which represented the 15 highest average catches for the two water-codes, only kelp bass, Pacific sanddab, yellowtail, sablefish, and other sanddabs were not rockfishes. The composition of catches from the Morro Bay portion of the Affected Environment were also indicative of hard-bottom habitat being targeted by for-hire recreational fishing.

Table 3.4.1-12. Top 15 species (ranked by average numbers of fish caught) by anglers fishing on for-hire vessels operating <3 miles from shore, or >3 miles from shore in the Morro Bay WEA Affected Environment, 2013–2022

Species	Ocean ≤3 Miles	Rank	Ocean >3 Miles	Rank
California scorpionfish	1,438	12	8,383	1
Rockfish genus	3,485	3	3,188	4
Pacific sanddab	2,489	6	4,982	2
Blue rockfish	4,477	1	604	--
Ocean whitefish	3,525	2	2,846	5
Vermilion rockfish	3,484	4	2,698	7
Squarespot rockfish	1,317	13	4,325	3
Yellowtail rockfish	2,693	5	667	--
Bocaccio	1,877	8	2,703	6
Pacific bonito	1,776	9	1,624	9
Copper rockfish	1,938	7	453	--
Gopher rockfish	1,468	11	191	--
Kelp bass	1,562	10	436	--
Halfbanded rockfish	905	--	1,419	10
Yellowtail	745	--	2,051	8
Starry rockfish	1,022	14	959	15
Speckled rockfish	603	--	1,378	11
Rosy rockfish	991	15	633	--
Chilipepper	511	--	1,021	14
Other sanddabs	287	--	1,172	13
Sablefish	--	--	1,251	12

Source: RecFIN.org 2023

Free et al. (2022) aggregated data by port complexes (i.e., a geographic region with multiple ports) along the California coast. The Fort Bragg port complex (including Eureka and Crescent City) corresponds with the Humboldt portion of the Affected Environment. Monterey, Morro Bay, Port Hueneme (includes Santa Barbara, Oxnard, Ventura), Redondo, Long Beach, Newport, Oceanside, and San Diego port complexes correspond to the Morro Bay portion of the Affected Environment.

Bodega Bay and Monterey Port complexes had the lowest registered CPFV numbers, while the San Diego port complex had the highest number of CPFVs (Free et al. 2022).

Numbers of anglers fishing from CPFVs generally increased from north to south (Free et al. 2022). This trend was reflected by higher numbers of anglers for port complexes near population centers such as San Francsico, Port Hueneme (which includes Santa Barbara, Oxnard, and Ventura), Long Beach (including Seal Beach and San Pedro), and San Diego (including Mission Bay). A similar north-to-south pattern but with lower numbers of anglers was exhibited by Bodega Bay, Monterey, Morro Bay, Redondo, Newport, and Oceanside port complexes. Fort Bragg had the lowest number of anglers during the period; whereas, San Diego had the highest followed by Port Hueneme, San Francisco, and Los Angeles (Free et al 2022).

In summary, the for-hire recreational fisheries off the California coast are most prevalent from Santa Barbara to San Diego in the southern portion of the Morro Bay WEA. This area supports the most vessels and anglers, which in turn, leads to higher landings. Concentrated human populations, as well as amenable oceanic and weather conditions, contribute to these patterns. Northern ports have fewer anglers and vessels available and consequently land fewer fish. Less predictable weather patterns also affect the for-hire fishery patterns north of San Francisco (Free et al 2022). Most for-hire operators focus their efforts on hard-bottom species such as rockfishes and, to a lesser extent, coastal pelagic species. Some vessels will target highly migratory species when oceanographic conditions are favorable. Thus, for-hire activity will be higher in the Morro Bay portion of the Affected Environment and less active in the Humboldt portion.

3.4.1.2 Impact Background for Commercial Fisheries and For-Hire Recreational Fishing

Anchoring, cable installation and maintenance, noise, port utilization, presence of structures, and vessel traffic are contributing IPFs to impacts on commercial fisheries and for-hire recreational fishing. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.4.1-13. Beneficial impacts on commercial fisheries and for-hire recreational fishing are described in Section 3.1.2, *Impact Terminology*.

Table 3.4.1-13. Issues and indicators to assess impacts on commercial fisheries and for-hire recreational fishing

Issue	Impact Indicator
Port access	Vessel traffic congestion and reduced access to high-demand port services and higher costs for such services; displacement to other primary or landing ports.
Fishing access	Increased operating costs (e.g., additional fuel to arrive at more distant locations; additional crew/observer compensation and higher monitoring costs due to more days at sea; inefficient use of days-at-sea effort controls; increased search times due to reduced familiarity of accessible fishing grounds); lower revenue (e.g., less-productive area, less-valuable species, lower catch rates, lower product quality); increased conflict among fishermen; avoidance of area by fishermen because of safety concerns or noise; decreased permit value due to limited access and reduced fishery landings revenue potential; loss of fishing are due to protection measures; temporary displacement due to surveys and cable installation, maintenance, and decommissioning.
Loss of or damage to fishing gear	Costs of gear repair or replacement; lost fishing revenue while gear is being repaired or replaced.

Issue	Impact Indicator
Change in distribution and subsequent catch of target species	Change in revenue due to change in abundance, distribution, and mortality of target species resulting from habitat alteration, changes to oceanographic processes (upwelling, flow, temperature, nutrient/prey mixing), invasive species, presence of structures (reef effect), predator/prey interactions, construction and operational noise above established behavioral effects and mortality thresholds, or other quantifiable effects as noted in Section 2.5 (Tables 1–4) in the Construction and Operations Plan Modeling Guidelines.[1]
Social and cultural impacts	Assessment of impacts on the well-being of fishing communities (place-based and activity level communities, families, individuals); community dependence; increased stakeholder pressure; social stratification and change in ownership patterns; fisheries participation and employment structure; access to social capital; impacts on identity and livelihoods.
Shoreside business impacts	Impacts on shoreside support businesses (e.g., revenue, employees, displacement).

[1] https://www.boem.gov/renewable-energy/boemoffshorewindpiledrivingsoundmodelingguidance.

3.4.1.3 Impacts of Alternative A – No Action – Commercial Fisheries and For-Hire Recreational Fishing

When analyzing the impacts of the No Action Alternative on commercial fisheries and for-hire recreational fishing, BOEM considered the impacts of ongoing activities on the baseline conditions for commercial fisheries and for-hire recreational fishing.

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative on existing baseline trends, including other planned activities, which are described in Appendix C, *Planned Activities Scenario*.

3.4.1.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for commercial fisheries and for-hire recreational fishing described in Section 3.4.1.1, *Description of the Affected Environment and Baseline Conditions*, would continue to follow current regional management trends and respond to IPFs introduced by other activities. Ongoing activities in the Affected Environment that contribute to impacts on commercial fisheries and for-hire recreational fishing are generally associated with activities that limit the spatial extent of where fishing can occur. This includes tidal energy projects; military use; increased vessel congestion that can pose a risk for collisions or allisions; dredging and port improvements; marine transportation; oil and gas activities; or activities that pose a risk for gear entanglement such as undersea transmission lines, gas pipelines, and other submarine cables. Existing undersea transmission lines, gas pipelines, and other submarine cables are generally indicated on nautical charts and may also prompt commercial fishermen to avoid the areas to prevent the risk of gear entanglement. Some of these activities may also result in bottom disturbance or habitat conversion that may alter the distribution of fishery-targeted species and increase individual mortality, resulting in a less-productive fishery or causing some vessel operators to seek alternate fishing grounds, target a different species, or switch gear types. If these risks result in a decrease in catch or increase in fishing costs, the profitability of businesses engaged in commercial fisheries and for-hire recreational fishing would be adversely affected.

Activities of NMFS, CDFW, and PFMC could affect commercial and for-hire recreational fisheries through stock assessments (and potential setting of quotas) and implementation of spatial or temporal harvesting closures to protect biodiversity and preserve sustainable fisheries for future generations. The recent closure of all ocean salmon fishing off the California coast published in the *Federal Register* (88 FR 30235) is an example. Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by state, regional, or federal agencies may affect commercial fisheries and for-hire recreational fishing by modifying the nature, distribution, and intensity of fishing-related impacts. In addition to conventional regulations, spatial planning efforts such as marine protected areas (MPAs) may cause conflicts with commercial and for-hire recreational fishermen.

Commercial and for-hire recreational fisheries will also be affected by climate change primarily through ocean acidification, ocean warming, sea level rise, and increases in both the frequency and magnitude of storms, which could lead to altered habitats, altered fish migration patterns, changes in species abundance and distribution, increases in disease frequency, and safety issues for conducting fishing operations.

Cumulative Impacts of the No Action Alternative

Other planned activities like tidal energy projects, military use, dredging, port improvements, marine transportation, fishery management, oil and gas activities, and undersea transmission lines, gas pipelines, and other submarine cables can have an impact on commercial fisheries and for-hire recreational fishing (Appendix C). Each of the listed activities may result in bottom disturbance or habitat conversion that may alter the distribution of fishery-targeted species and increase individual mortality, resulting in a less-productive fishery.

Additionally, increased vessel congestion can pose a risk for collisions or allisions, and restricted areas (MPAs). The designation of the Chumash Heritage National Marine Sanctuary in fall 2024/early 2025 may yield some benefits for commercial and for-hire fishing operations such as protection of fishery resources and habitat. No restrictions to fishing above or beyond currently established MPAs are expected for the proposed sanctuary. However, discharge of sewage or graywater within the sanctuary boundaries would be prohibited, which may adversely affect vessels lacking sewage holding tanks. Commercial and for-hire vessels lacking proper holding tanks may have to travel well outside sanctuary boundaries to legally discharge sewage or graywater (NOAA 2023).

BOEM expects planned activities to affect commercial fisheries and for-hire recreational fishing through the following primary IPFs.

Anchoring: Anchoring from vessels related to ongoing commercial activities, recreational activities, oil and gas operations, and military use would continue to cause short-term to permanent impacts in the immediate area where anchors and chains contact the seafloor. Anchoring could pose a localized (within a few hundred feet of anchored vessels), temporary (hours to days) navigational hazard to fishing vessels. The footprint of each anchoring by commercial, recreational, or military activities would be relatively small and would be of short duration.

Cable installation and maintenance: Submarine cables for telecommunications and other transmissions would be installed in the Affected Environment. Submarine cable installation would produce sedimentation as would any ongoing cable maintenance activities that contact the seafloor. Localized, short-term impacts, including disrupting fishing activities, would occur during active installation and maintenance or periods during which the cable is exposed on the seabed prior to burial (if simultaneous lay and burial techniques are not used). Cable installation and maintenance would result in a disturbed footprint that is relatively small but may vary in scale and location over the course of development. Fishing vessels may not have access to affected areas, in whole or in part, over various durations during the installation period, which could lead to reduced revenue, displacement, or increased conflict over other fishing grounds. Because most construction activities would likely take place in more favorable conditions (i.e., late spring through early fall), fisheries and fishery resources most active during that period would likely be affected more than those in the winter (e.g., for-hire recreational fisheries). The localized commercial and for-hire recreational fishing industries proximal to cable routes or landing sites for cable projects would also be affected by emplacement activities.

Invasive species: Construction, military, and cargo vessels, especially those transiting from foreign ports would continue to be potential sources of invasive species. The discharge of ballast water is considered a primary pathway for introduction of invasive marine species. Additional ship-borne sources of introduction include sea chests, hulls, and anchors (Page et al. 2019). Navigational buoys, drilling platforms, submerged construction materials, and floating marine debris may also harbor invasive fouling organisms. Introduction of new invasive species or pathogens would be limited by adherence to ballast water management plans. However, should a new invasive species become established, it could reduce the abundance of target species, either through direct predation or by outcompeting them for resources, which could lead to reduced catch rates, decreased profits for fishers, and potential job losses within the industry.

Noise: Noise sources in the oceans include biological and anthropogenic sources. Biological sound sources include invertebrates, fishes, and marine mammals. Even weather conditions and geological processes may contribute to the ocean soundscape (Duarte et al. 2021). Anthropogenic noise sources include construction, pile driving, G&G survey activities, vessels, oil and gas operations, deterrents (seal bombs used by squid fishermen), and military activities that could contribute to impacts on fisheries in inshore and nearshore environments, as well as in offshore waters. Noises produced by these sources include impacts from sound pressure, particle motion, and substrate vibration.

Noise from anthropogenic sources could cause temporary impacts on commercial fisheries and for-hire recreational fishing through direct effects on species (Popper and Hastings 2009). Anthropogenic noise would also include the use of deterrents (seal bombs) to chase pinnipeds away from squid netting operations. Although small, these explosives can chase or even kill (SEL source levels between 190 and 203 dB re 1 $\mu Pa^2\ m^2$) some fishery species potentially impacting catches by other fisheries in close proximity to detonation sites (Krumpel et al. 2021). There is no available information to suggest that such noise would negatively affect fisheries on a broad scale (English et al. 2017); therefore, fishery-level impacts are unlikely in this context. Section 3.3.5, *Fishes, Invertebrates, and Essential Fish Habitat*, provides additional information on potential impacts from various noise sources on finfish.

Port utilization: Vessel visits and sizes of vessels have increased at major ports in the United States, and port utilization is expected to increase over the next 35 years. Ports are also going through continual upgrades and maintenance, including dredging. Multiple ports in California (e.g., Ports of Los Angeles, Long Beach, Hueneme, San Luis, and Humboldt) are investing in expanding and modifying their facilities to accommodate increasing demand (Appendix C). Planned port improvements proceeding independently of any specific offshore wind development include the Port of Humboldt Bay Offshore Wind Heavy Lift Multipurpose Marine Terminal and the Port of Long Beach Pier Wind and Deep Draft Navigation projects. Dredging and port improvements would allow larger vessels to use the ports and may result in increased port use and conversion of surrounding land use if the ports are expanded. Port expansion and modification could include dredging, deepening, and new berths and could have localized, temporary impacts on commercial and for-hire fishing vessels in ports used for both fishing and other projects. Some displacement of available dockage during construction activities may occur. Cumulative impacts on commercial fisheries and for-hire recreational fishing from planned activities would be expected based on the expected level of port utilization and related activities (e.g., dredging). Specific ports and expansions would be further discussed in project-specific COPs and COP NEPA analyses.

Presence of structures: Structures considered under the No Action Alternative include buoys and shoreline developments such as docks and ports and offshore oil and gas platforms. The presence of structures can lead to impacts on commercial fisheries and for-hire recreational fishing through fish aggregation, habitat conversion, allisions, displacement of certain vessels/gear types, navigation hazards (including transmission cable infrastructure), alterations on fisheries-management mechanisms, space-use conflicts, and safety-related issues (e.g., hindering search and rescue). Structures may alter the availability of targeted fish species for commercial and for-hire recreational fishers in the immediate vicinity of the structures. Structure-oriented fishes such as rockfishes, lingcod, sculpins, and sea basses may increase in areas where there was no previous structure (natural or artificial). In many cases, bottom-founded oil and gas platforms harbored higher densities of young fishes compared to natural habitats (e.g., Claisse et al. 2014; Love et al. 2019). Highly migratory and coastal pelagic species may also be attracted to floating structures such as buoys, which will likely act as FADs (Taquet 2013; Kramer et al. 2015; Price et al. 2022). These effects are not anticipated to result in stock-level impacts that would affect fisheries. Rockfishes and other bottom fishes would likely recruit to the anchors but at levels far below those seen with more complex oil and gas structures in the Santa Barbra Channel (Love et al. 2019).

Potential decommissioning of oil and gas structures would affect both commercial and for-hire recreational fishing. Removal of these structures would result in a small benefit to commercial fisheries, because removal of platforms, pipelines, and cables and clearing of seafloor obstructions such as shell mounds or other debris would reduce space use conflicts and the potential for snagging losses of commercial fishing gear in a very small area of the Affected Environment. Conversely, areas where platforms are currently located may become less desirable for recreational fishing after platform removal due to the reduced habitat structure. This would likely result in a partial shift of recreational fishing efforts to other areas, such as nearby natural reef habitats. Although the change in fishing conditions at platform locations would be essentially permanent, the Affected Environment represents a very small proportion of nearby natural reef and rocky outcrop habitat available for recreational fishing. Because of the limited number of structures in the Affected Environment, the small spatial extent of the areas where recreational fishing activities may become less desirable, and the availability of alternative recreational fishing areas, cumulative impacts are not anticipated.

Vessel traffic: Planned activities would result in a small incremental increase in vessel traffic, with a peak during surveys, construction, and decommissioning particularly if any offshore project construction activities overlap. The presence of construction vessels could restrict harvesting or other fishing activities along cable routes during installation and maintenance activities or in the vicinity of oil and gas structures during decommissioning. Vessel traffic would contribute to cumulative impacts on commercial and for-hire recreational fishing.

3.4.1.3.2 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, commercial fisheries and for-hire recreational fishing would continue to follow current regional management trends and respond to current and future environmental trends and societal activities. BOEM expects ongoing activities to have continuing temporary to long-term impacts (displacement, space-use conflicts, navigational and fishing hazards, changes in target species abundance and distribution) on commercial fisheries and for-hire recreational fishing, primarily through cable installation, noise, port expansion, presence or removal of structures, and vessel traffic. The extent of impacts on commercial fisheries and for-hire recreational fishing would vary by fishery due to different target species, gear type, and location of activity. Beneficial impacts on for-hire recreational fishing may result from ongoing offshore oil and gas operations that may bolster populations of pelagic and demersal fish species (Holland et al. 1990; Kramer et al. 2015; Snodgrass et al. 2020; Price et al. 2022).

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, commercial fisheries and for-hire recreational fishing would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on commercial fisheries and for-hire recreational fishing, particularly from increased vessel traffic and climate change. The extent of cumulative impacts would vary by fishery and fishing operation because of differences in target species, gear type, and predominant location of fishing activity. Beneficial impacts on commercial fishing could occur if oil and gas structures are decommissioned and removed.

3.4.1.4 Impacts of Alternative B – Development with No Mitigation Measures – Commercial Fisheries and For-Hire Recreational Fishing

ESA Section 7 consultation with NMFS would be conducted for each project, and it is assumed that the Letter of Authorization would include mitigation requirements that would reduce impacts.

3.4.1.4.1 Impacts of One Representative Project in Each WEA

Alternative B considers future offshore wind development in the Humboldt and Morro Bay WEAs but without the application of any mitigation measures that could avoid, minimize, mitigate, or monitor impacts associated with such development.

The analysis of Alternative B assumes that one representative project in each of the Humboldt WEA and Morro Bay WEA would be developed and considers the potential impacts of that development on the commercial and for-hire recreational fishing. As described in Chapter 2, *Proposed Action and Alternatives*, the analysis and impact conclusions are based on an RPDE, and subsequent project-specific environmental analysis and impact conclusions will be developed for individual COPs.

The Alternative B analysis considered the following IPFs: anchoring, cable installation and maintenance, noise, port utilization, presence of structures, and vessel traffic.

Anchoring: Vessel stabilization during construction and possibly during decommissioning is likely use vessels equipped with dynamic positioning; therefore, only minimal anchoring would occur. However, vessel anchoring could occur in shallow waters or where other non-anchoring alternatives are not feasible. Vessel anchoring would cause temporary impacts on fishing vessels and fishing activities. Anchored vessels would pose a navigational hazard to fishing vessels and disturb seafloor habitats.

Haberlin et al. (2023) suggested that mooring structures and floating interarray cables would affect all fishing with mobile gear due to difficulties with navigation, safety, physical obstruction, and snagging gear. WTG anchoring would depend on the type of configuration used, but seafloor contact area would range from 0.05 to 75 acres (200 to 300,000 square meters) per WTG or OSS. A contact area of that size, coupled with a network of floating interarray cables would preclude commercial anglers from using any mobile gear permanently from those areas due to risks of gear entanglement. For-hire recreational anglers fishing with any type of weighted trolling or drifting hook-and-line gear would also be excluded from fishing around the structures and their floating interarray cables. The anticipated impacts from anchoring on commercial fisheries and for-hire recreational fishing in the Affected Environment for one representative project in each WEA would vary depending on the type of moored WTG selected.

Cable installation and maintenance: Offshore export cable installation would result in seafloor disturbance. Cable installation could prevent deployment of fixed and mobile fishing gear in limited parts of the Affected Environment from 1 day up to several months (if simultaneous lay and burial techniques are not used), which may result in the loss of revenue if alternative fishing locations are not available. Activities from cable installation would require communications with fixed-gear fisheries stakeholders to ensure no gear is deployed along the installation route. Though many of the impacts from cable installation would be temporary, some of the offshore export cable would require cable protection, which would permanently affect the seafloor and present a hazard for bottom tending gear that could result in damage or loss, if bottom trawling vessels do not adjust their tracks to avoid the cables. Additionally, small areas along the cable routes could be temporarily closed throughout the duration of the representative project due to routine or emergency maintenance. If cable repairs are needed, support vessels would temporarily affect commercially important fish and invertebrate species, as well as exclude fishing vessels, but only in a localized area immediately adjacent to the repair location. Interarray cables are expected to be floating, creating a navigation hazard and potentially precluding commercial and recreational for-hire vessels using hook-and-line fishing among or close to the WTGs. Commercial and recreational fishing vessels would also be excluded from small areas during routine cable surveys, which would likely occur throughout the duration of the representative project's lifetime. Overall, cable installation and maintenance would not restrict large areas, and navigational impacts on commercial or for-hire recreational fishing vessels would be on the scale of hours to days. Cable installation and maintenance because of one representative project per WEA would result in localized and permanent impacts on commercial fisheries and for-hire recreational fishing. This finding assumes cables are buried without a raised profile on the seafloor, which could snag or damage bottom-tending gear and requiring fishermen to alter their normal activity. Impacts are anticipated to be more severe in areas where cables are on the seafloor and present potential snags capable of damaging bottom-tending gear.

Invasive species: The risk of invasive species introduction into harbors within the Humboldt or Morro Bay WEA Affected Environment would increase with increasing numbers of vessels entering the harbors (see *Vessel traffic* IPF section). In addition to potentially introducing nonnative plants, invertebrates, or fishes, support vessel ballast water may also harbor pathogens capable of negatively affecting aquaculture operations.

Noise: Noise from G&G surveys, construction (including pile driving for TLP foundation types), trenching, operations, and maintenance may occur. Noise can temporarily disturb fish and invertebrates in the immediate vicinity of the source, causing a temporary behavior change, including leaving the area affected by the sound source. Section 3.3.5 and Appendix H contain details about fish hearing and specific sound impacts on fish and invertebrates. Impacts on commercial fisheries and for-hire recreational fishing would depend on the duration of the noise-producing activity and corresponding impacts on managed fish species, but, as detailed in Section 3.3.5, most impacts on fish from sound are behavioral based and would not result in mortality. Impacts are anticipated since targeted species have the potential to leave a localized area, which may overlap with fishing effort.

Port utilization: Port usage may result in a decrease in available dockage for commercial or recreational fishing vessels. There could be a decrease in available dockage for transient fishing vessels needing a place to sell catches, refuel, reprovision, and wait out bad weather. The additional vessels due to the representative project could cause delays or reduced access to port services such as fueling and provisioning, potentially causing fishing vessels to use alternative ports. The California Coastal Act (Section 30703) may protect fishermen from such effects. Several of the productive ports in terms of landings (Table 3.4.1-5 and Table 3.4.1-6) and values (Table 3.4.1-5 and Table 3.4.1-6) are not being considered as shore bases during construction or O&M. Examples of such ports in the Humboldt portion of the Affected Environment are Fort Bragg and Trinidad. For the Morro Bay portion of the Affected Environment, important non-industrialized ports were included: Ventura, Santa Barbara, Terminal Island, and Morro Bay. Therefore, one representative project would be expected to generate impacts on commercial fisheries and for-hire recreational fishing associated with port utilization.

Presence of structures: Installing components, as well as the presence of construction vessels and permanent structures, could restrict harvesting and fishing activities in the Affected Environment. Section 3.4.1.3.2, *Cumulative Impacts of the No Action Alternative*, describes anticipated types of impacts on commercial fisheries and for-hire recreational fishing that could result from the presence of structures, including fish aggregation, habitat conversion, allisions, displacement of certain vessels/gear types, entanglement or gear loss/damage, navigation hazards (including transmission cable infrastructure), alterations on fisheries-management mechanisms, space-use conflicts, and safety-related issues (e.g., hindering search and rescue). The structures and related impacts associated with one representative project per WEA would remain at least until decommissioning is complete and could pose long-term impacts on commercial fisheries and for-hire recreational fishing.

The exact location of the proposed infrastructure in the individual lease areas could affect transit corridors and access to preferred or traditional fishing locations. Transiting through a developed wind farm area could also create challenges associated with using navigational radar when many radar targets obscure smaller vessels and where radar returns may be duplicated under certain meteorological conditions like heavy fog (National Academies of Sciences, Engineering, and Medicine 2022). Larger vessels may find it necessary to travel around wind farms to avoid maneuvering among the WTGs.

Chapter 2, Table 2-2 provides information relative to the number of structures (WTGs, OSSs, mooring lines, array cables, and export cables) that will be installed. Additionally, Table 2-2 shows the extent of seafloor contact for each structure and provides information relative to the spacing of the structures offshore.

Overall, impacts from the presence of structures on commercial fisheries and for-hire recreational fishing are anticipated to be greater than under the No Action Alternative. The magnitude of impact would also vary depending on the individual fishery or fishing grounds, distance from the wind farm, vessel size, and type of gear used. In the Humboldt WEA, bottom trawling and hook-and-line fishing (including trolling), would be most affected. In the Morro Bay WEA, traps (pots) and hook-and-line fisheries would be most susceptible to exclusion by the presence of structures. Large floating structures are known to attract a wide variety of large mobile fauna and their ability to create a habitat with permanent, semi-permanent and transient fauna suggests they can be a net ecosystem benefit (Gooding and Magnuson 1967; Roberts et al. 2012; Kramer et al. 2015). These structures, also known as FADs, create shade and provide shelter for small fishes, as well as provide orientation points for larger mobile species (Helfman 1981; Taquet 2013). Floating FADs are generally distinguished from bottom-founded artificial reefs by the kinds of fishes and other biota they attract. In the Gulf of Mexico, floating (but moored) oil and gas structures (spars, TLPs, and catenary moored) have been documented to attract various pelagic fish species (Franks 2000; Continental Shelf Associates, Inc. 2002; Snodgrass et al. 2020; Price et al. 2022). The numbers and kinds of fishes expected to associate with the floating offshore wind structures in the Humboldt and Morro Bay WEAs would depend on various factors including the local species pool, available life stages, and environmental conditions (Kramer et al. 2015). Nevertheless, benefits of floating offshore wind structure placement may be realized as increased fish production or diversity from the FAD effect, as well as the creation of no-take or reduced-take fishery zones, all of which have been identified as topics in need of research (Wilson et al. 2010; Wilson and Elliot 2009).

Vessel traffic: Increased vessel traffic would occur compared to the No Action Alternative, with a peak during project construction and decommissioning. Specific vessels are required for habitat monitoring and site-characterization surveys, floating foundation installation, OSS installation, cable installation, WTG installation, and support activities. Because this PEIS precedes any project-specific COP submittal and no detailed vessel information specific to West Coast floating offshore wind installation is available, this analysis proceeds with using known details from offshore wind projects on the Atlantic OCS as a proxy. Based on the estimated number of vessels planned to operate during construction of other offshore wind projects,[1] construction of one representative project in each WEA is estimated to result in up to 51 project vessels operating in the project area at any given time during construction, and traffic would decrease thereafter to just a few vessels during O&M. Offshore construction and installation of one project would temporarily restrict access to offshore export cable corridors and the WEA during construction. Construction-support vessels, including vessels carrying assembled WTGs or WTG and OSS components, would be present in waterways between the lease areas in the development area and the ports used during construction, installation, and decommissioning.

Fishing vessels transiting near the lease areas or ports being used by construction and installation vessels would be required to avoid project vessels and restricted safety zones through routine adjustments to navigation. Although fishing vessels may experience increased transit times in some situations, these situations would be spatially and temporally limited.

3.4.1.4.2 Impacts of Five Representative Projects

Alternative B also analyzes the impacts of five representative projects to evaluate the overall impacts of a full offshore wind buildout in the Humboldt and Morro Bay WEAs. While lessees may elect a phased development approach, for purposes of analysis, this PEIS assumes one project per lease area. The same types of design parameters described for one project in each WEA would apply to development in all lease areas, except that the number and length of each parameter would be scaled for five projects. The analysis of five representative projects would include up to 1,000 WTGs, up to 30 OSSs, up to 40 offshore export cables totaling 8,639 nautical miles (16,000 kilometers), and up to approximately 2,700 nm (5,000 kilometers) of interarray cables.

The same impact types and mechanisms described under one representative project apply to five representative projects for anchoring, cable installation and maintenance, noise, port utilization, presence of structures, and vessel traffic. However, there would be a greater potential for impacts due to the larger number of projects affecting a larger geographic area.

Impacts from anchoring would increase because anchoring arrays of five representative projects would increase the seafloor contact area from which commercial fisheries and for-hire recreational fishing would be excluded fivefold (effectively excluding the entirety of each WEA from fishing activities). Impacts from noise would remain the same under five representative projects because the impacts

[1] Empire Wind (OCS-A 0512), Ocean Wind 1 (OCS-A 0498), and Atlantic Shores South (OCS-A 0499).

would remain so small that they would be difficult or impossible to measure and temporally limited to the duration of high-noise activities such as pile-driving or G&G activities.

Impacts from cable installation and maintenance under five representative projects would increase due to multiple cable installation areas potentially occurring simultaneously, substantially increasing the exclusion area for commercial or recreational fishing vessels during installation, and substantially increasing the probability of cable breaks and subsequent vessel exclusion during repair activities. However, the area used by installation vessels would still be small relative to the size of available fishing grounds for commercial and for-hire recreational fishermen. It is unlikely that all five projects would be installed simultaneously.

Impacts of invasive species may occur if invasive species were to cause habitat degradation, competition, or predation on target fish or invertebrate stocks, which then lead to reduced catches and revenues for fishers. Some invasive species occur in marine and coastal waters; however, none have yet caused declines in fishery stocks (CDFW 2024). Because large vessels act as vectors of invasive species, the increase in vessel traffic expected would also increase the risk of invasive species introduction in the broader area. Also, the addition of submerged surfaces on floating turbines, anchors, mooring lines, interarray cables and other structures would provide more opportunities for attachment by sessile or motile invasive species.

Impacts from port utilization would increase for five representative projects. If the components under five projects were constructed, the number of required project-associated vessels would substantially increase, resulting in a subsequent increase in demand for port dockage and other services, which could cause commercial or recreational fishing vessels to make considerable alterations to their normal port usage.

The range of impacts from the presence of structures would increase under five representative projects as compared to one project per WEA. Similar to one representative project, exact impacts would depend on project-specific timing, location, and spacing of project-related structures.

Impacts from vessel traffic would increase under five projects due to the substantially higher number of vessels that would be required during installation, O&M, and decommissioning as compared to one representative project. The number of vessels would increase the likelihood of vessels changing their travel routes, times, or other routines that could negatively affect their catch or result in increased expenses.

3.4.1.4.3 Cumulative Impacts of Alternative B

The construction, O&M, and decommissioning of both onshore and offshore infrastructure across the Affected Environment would also contribute to the IPFs of anchoring, cable installation and maintenance, invasive species, noise, port utilization, presence of structures, and vessel traffic. The presence of MPAs may also affect commercial and for-hire anglers. Localized impacts on commercial fisheries and for-hire recreational fishing would likely be greater as a result of cumulative impacts.

BOEM anticipates that the cumulative impacts associated with five projects, when combined with planned activities, could alter the overall state of commercial fisheries and for-hire recreational fishing.

3.4.1.4.4 Conclusions

Impacts of Alternative B. Activities associated with the construction and installation, O&M, and decommissioning of Alternative B, whether one representative project per WEA or five representative projects, would result in impacts for most IPFs, with the most severe impact anticipated from the presence of structures. Beneficial impacts on for-hire recreational fishing may also occur based on the potential bolstering of for-hire recreational fishing opportunities due to fish aggregation around structures. Such benefits would depend on the ability of fore-hire vessels to safely fish around structures and would be limited to for-hire vessels capable of making longer trips that would be required to reach the WEAs. Localized impacts on commercial fisheries and for-hire recreational fishing would likely be greater. Impacts of five representative projects for some IPFs would be greater than impacts for one representative project per WEA.

Cumulative Impacts of Alternative B. In the context of reasonably foreseeable environmental trends, the incremental impacts from Alternative B to the cumulative impacts on commercial fisheries and for-hire recreational fishing would potentially alter the overall state of commercial fisheries and for-hire recreational fishing. The occurrence/severity of impacts would vary by fishery and fishing operation because of differences in target species, gear type, and predominant location of fishing activity. The presence of structures is also expected to yield a beneficial impact, particularly on for-hire recreational fishing.

3.4.1.5 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Commercial Fisheries and For-Hire Recreational Fishing

Alternative C, the Proposed Action, is the prospective adoption of mitigation measures intended to avoid or reduce Alternative B's potential impacts. Accordingly, the analysis considers the change in impacts relative to Alternative B. Appendix E, *Mitigation*, identifies the mitigation measures that would be included in the Proposed Action. Table 3.4.1-14 summarizes mitigation measures relevant to commercial fisheries and for-hire recreational fisheries.

Table 3.4.1-14. Summary of mitigation measures for commercial fisheries and for-hire recreational fishing

Measure ID	Measure Summary
MM-19	This measure requires lessees to submit an Anchoring Plan that identifies and maps locations of interest, including hard-bottom, sensitive habitats, potential shipwrecks, potential hazards, and existing and planned infrastructure. The plan will require all vessels deploying anchors to use, whenever feasible and safe, mid-line anchor buoys to reduce the amount of anchor chain or line that touches the seafloor.
MM-20	This measure requires lessees to submit a Sensitive Marine Species Characterization and Monitoring Plan for biological species and habitats in the water column or on the seafloor that may be affected by a project's activities. Species and habitats that are particularly sensitive to impacts will be identified, avoided, and require monitoring, allowing for the identification of adverse effects and evaluation of mitigation efforts. Consolidated seafloor sediments are equivalent to sensitive habitats and species and shall be avoided from direct and indirect impacts unless data exist to demonstrate no harm to sensitive species and habitats. If, during the conduct of lessee's approved activities, the lessee or BOEM finds that sensitive seafloor habitats, EFH, or habitat areas of particular concern may be adversely affected by lessee's activities, BOEM must consult with the NFMS (30 CFR 585.703).
MM-21	This measure proposes that the lessee must prepare a Scour and Cable Protection Plan that includes descriptions and specifications for all scour and cable protection materials. All materials used for scour and cable protection measures should consist of natural or engineered stone that provides three-dimensional complexity in height and in interstitial spaces, as practicable and feasible. These methods would also ensure that the lessee avoid the use of engineered stone or concrete mattresses in complex habitat, use tapered or sloped edges for trawled areas, use materials that do not inhibit epibenthic growth, avoid use of plastics/recycled polyesters/net material, and submit the plan for review and approval.
MM-22	This measure states that lessees should consider establishing a compensation process if a project is likely to result in lost income to commercial and recreational fisheries; compensation can include gear loss and damage and lost fishing income.
MM-23	This measure states that lessees should prepare a Fisheries Communication Plan, outlining the specific methods for engaging with and disseminating project information to the local fishing community, as well as other associated stakeholders, throughout each phase of the project describing how the lessee intends to engage with the various fishing constituencies that are active within a project area.
MM-24	This measure states that lessees should work cooperatively with commercial/recreational fishing entities and interests to minimize potential disruptions to commercial and recreational fishing interests during construction, operation, and decommissioning of a project to prevent unreasonable fishing gear loss or damage.
MM-27	This measure recommends static cable design elements, including burial below the seabed where feasible, avoidance of methods that raise the profile of the seabed, and removal of large marine objects and decommissioning instrumentation and/or anchors as soon as practicable and within required regulations and permits. This measure should reduce possible damage to fishing gear. Future mitigations may include gear identification and or lost survey gear monitoring and reporting.
MM-32	This measure encourages lessees to coordinate transmission infrastructure among projects by using, for example, shared intra- and interregional connections, meshed infrastructure, or parallel routing, which may minimize potential impacts from offshore export cables.

Measure ID	Measure Summary
MM-33	This measure requires monitoring of cables periodically after installation to determine cable location, burial depths, and site conditions to determine if burial conditions have changed and whether remedial action or additional mitigation measures are warranted.
MM-36	This measure requires the lessee to develop an Oceanographic Monitoring Plan. Monitoring reports will be used to determine the need for adjustments to the monitoring approach, consideration of new monitoring technologies, and/or changes to the frequency of monitoring. Components of the plan include coordination with relevant regulatory agencies and neighboring lessees, monitoring strategies for all phases of a project, comparisons with available model outputs, technologies, and appropriate physical and biochemical measurements.
MM-40	This measure encourages lessees to incorporate technologies for detecting tagged fish in their projects to monitor the effect of increases in habitat use and residency around WTG foundations and share monitoring results/ propose new or additional mitigation measures and/or monitoring methods if appropriate.

3.4.1.5.1 Impacts of One Representative Project in Each WEA

Mitigation measures would reduce some impacts on commercial fisheries and for-hire recreational relative to Alternative B, as described below. For the impacts not listed below, mitigation measures did not reduce the impacts. Consequently, the impact level under Alternative C remains the same as under Alternative B.

Anchoring: MM-19 and MM-20 would mitigate the impacts associated with placing anchors, equipment, or installation of facilities (e.g., buoys, export cable installation, WTG or OSS installation and interarray cable installation) or decommissioning. MM-19 would require detailed anchoring plans outlining the avoidance of sensitive benthic habitats and require implementation of measures to minimize sediment disturbance resulting in avoidance of impact for the species that rely on the sensitive habitats. MM-20 would require lessees to reduce or avoid impacts on important environmental resources such as sensitive habitats and species to the extent feasible. MM-22 could establish a compensation process if a project is likely to result in lost income to commercial and recreational fisheries. These measures would lessen impacts on habitats used by certain commercially important fish and could reduce negative impacts by providing monetary compensation for lost income and gear loss or damage, if a compensatory process is established.

Cable installation and maintenance: MM-19 and MM-20 are designed to mitigate the impacts associated with placing anchors, equipment, or installation of facilities (e.g., buoys, export cable installation, WTG or OSS installation and interarray cable installation) or decommissioning through avoidance of sensitive habitats that are used by certain commercially important fish. MM-21 and MM-27 would require a Scour and Cable Protection Plan, including descriptions of materials to be used for cable protection and that such materials reflect pre-existing conditions as much as possible, which would reduce the risk of fishery gear snags. Further, MM-27 would discourage any raising of the seabed and cable placement in unfavorable areas, while encourage vessel traffic separation and fairways. Collectively, such efforts would further reduce the risk of fishery gear snags. MM-22 could establish a compensation process if a project is likely to result in lost income to commercial and recreational fisheries. If a compensation process is established, this measure would reduce negative impacts by providing monetary compensation to account for displacement for fishing operations or gear lost. MM-33 would require cable monitoring programs to gather to data assist in adaptive management potentially including new mitigation measures. These measures would lessen impacts on fisheries.

Presence of structures: MM-36 would require the development of an Oceanographic Monitoring Plan. While monitoring would not directly reduce hydrodynamic effects of wind farms on fishery resources, the information gathered could be evaluated for efficacy and potentially lead to changes in or additions to existing mitigation measures. Also, MM-21 and MM-27 may reduce impacts from the presence of structures through several methods, reducing the risks of fishery gear snags to reduce impacts. However, the long-term reef impacts from the presence of structures would remain the same and would exist for any structure post-construction.

Other measures: MM-23 recommends preparation of a Fisheries Communication Plan outlining the specific methods for engaging with and disseminating project information to the local fishing community, as well as other associated stakeholders, throughout each phase of the project. MM-24 recommends lessees work cooperatively with commercial/recreational fishing entities and interests to minimize potential disruptions to commercial and recreational fishing interests during construction, operation, and decommissioning of a project.

Overall, these measures, if adopted, could reduce impacts but the extent to which they would do so would depend on project-specific actions since impacts on commercial and for-hire recreational fishing are driven by the areal extent of space taken by multiple anchored structures (WTGs/OSSs and associated mooring systems and interarray cables), which would affect the bottom contact area from which fishers would be displaced.

3.4.1.5.2 Impacts of Five Representative Projects

Five representative projects would pose a greater likelihood for impacts under certain IPFs due to the increased amount of offshore development. However, Alternative C's mitigation measures would scale up accordingly, such that impact levels for five projects would be substantially similar as for one project in each WEA.

In addition to the measures identified for one representative project, MM-32 proposes coordination among the lessees to use shared transmission infrastructure where practical. Implementation of this measure could result in a reduction of the overall amount of cable placed on the seafloor and a subsequent reduction of impacts on commercial fisheries and for-hire recreational fishing from cable installation and maintenance. MM-36 would require the development of an Oceanographic Monitoring Plan, and MM-40 encourages lessees to coordinate monitoring and survey efforts across lease areas to standardize approaches, understand potential impacts on resources at a regional scale, and maximize efficiencies in monitoring and survey efforts. While monitoring would not directly reduce impacts on commercial fisheries or for-hire recreational fishing, the information gathered could be evaluated for efficacy and potentially lead to changes in or additions to existing mitigation measures.

Impacts from anchoring, cable installation and maintenance, noise (including pile driving), port utilization, presence of structures, invasive species, and vessel traffic are expected to be the same as discussed in Section 3.4.1.5.1, *Impacts of One Representative Project in Each WEA*, for one project in each WEA, though over the broader geographic and temporal scale covered by the five representative projects.

3.4.1.5.3 Cumulative Impacts of Alternative C

Similar to Alternative B, under Alternative C, the same ongoing and planned activities would continue to contribute to the primary IPFs of anchoring, cable installation and maintenance, noise, port utilization, presence of structures, invasive species, and vessel traffic. BOEM anticipates that the cumulative impacts on commercial fisheries and for-hire recreational fishing associated with five representative projects when combined with impacts from ongoing and planned activities would be unchanged because some commercial and for-hire recreational fisheries and fishing operations could experience substantial disruptions indefinitely, even with project-specific mitigation measures.

3.4.1.5.4 Conclusions

Impacts of Alternative C. The implementation of mitigation measures would reduce the severity of impacts from Alternative B on commercial fisheries and for-hire recreational fishing across most IPFs. Under Alternative C, beneficial impacts on for-hire recreational fishing may also occur based on the potential bolstering of for-hire recreational fishing opportunities due to the reef effect.

Cumulative Impacts of Alternative C. Even with the application of recommended mitigation measures, BOEM anticipates cumulative impacts because some commercial and for-hire recreational fisheries and fishing operations could experience substantial disruptions indefinitely. Impacts would vary by fishery and fishing operation because of differences in target species, gear type, and predominant location of fishing activity. The presence of structures is also expected to yield a beneficial impact, particularly on for-hire recreational fishing.

3.4 Socioeconomic Conditions and Cultural Resources

3.4.2 Cultural Resources

Federal, state, and local regulations recognize Tribal Nations' significant cultural ties to, and the public's interest in, cultural resources. Many of these regulations, including NEPA and the NHPA, require the consideration of potential impacts on cultural resources and historic properties. This section discusses the presence of cultural resources in the Affected Environment, potential impacts from the alternatives and ongoing and planned activities, and analysis of mitigation measures to avoid or reduce adverse effects on cultural resources.

In 2019, BOEM entered into a programmatic agreement that outlines how renewable energy plans off the coast of California will comply with NHPA Section 106. Recognizing that there are some differences in how NEPA and NHPA Section 106 require consideration of cultural resources, many of the Section 106 definitions and procedures outlined in this section and discussed further in Appendix G, *NHPA Section 106 Summary*, are informed by the *Programmatic Agreement Among the U.S. Department of the Interior, Bureau of Ocean Energy Management, The State Historic Preservation Office of California, The Advisory Council on Historic Preservation Regarding Review of Outer Continental Shelf Renewable Energy Activities Offshore California Under Section 106 of the National Historic Preservation Act* (California PA) (BOEM 2019).

This section programmatically analyzes effects that may occur in the Affected Environment, which encompasses knowable or potential areas where cultural resources, if they are determined to be present, could be affected by the alternatives. The Affected Environment for cultural resources encompasses the Humboldt and Morro Bay programmatic area of potential effects (Programmatic APE) (Figure 3.4.2-1). In 36 CFR 800.16(d), an APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alteration in the character or use of historic properties, if any such properties exist." The California PA further defines the APE as "the depth and breadth of the seabed that could potentially be impacted by seafloor/bottom-disturbing activities associated with the undertakings; the offshore and onshore viewshed from which renewable energy structures would be visible; and, if applicable, the depth, breadth, and viewshed of onshore locations where transmission cables or pipelines come ashore until they connect to existing power grid structures" (Stipulation II.A).

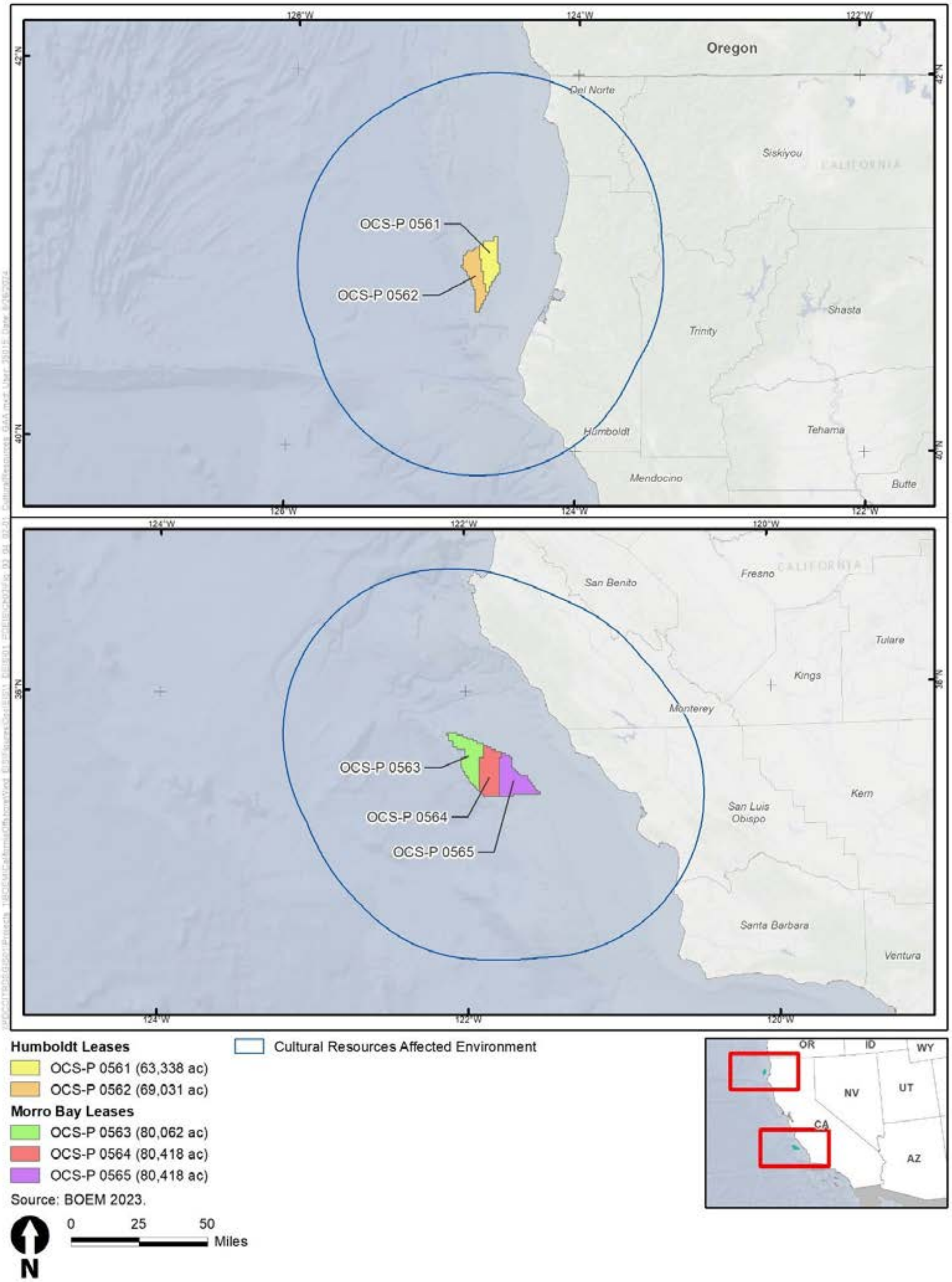

Figure 3.4.2-1. Cultural resources Affected Environment and Programmatic APE

In accordance with Stipulation II.A of the California PA, the Programmatic APE includes three parts:

- **Programmatic Marine APE**: The *Programmatic Marine APE* is the marine portion of the Programmatic APE, which includes areas potentially affected by seabed-disturbing activities.
- **Programmatic Visual APE**: The *Programmatic Visual APE* is the visual portion of the Programmatic APE, which includes the maximum viewshed from which offshore renewable energy structures constructed in the Humboldt and Morro Bay lease areas would be visible from landside locations.
- **Programmatic Terrestrial APE**: The terrestrial portion of the Programmatic APE includes onshore locations where transmission cables or pipelines would come ashore until they connect to existing power grid structures. However, because specific cable routes, landfall locations, and onshore transmission routes are not available at this time, BOEM has defined a broadly expansive *Programmatic Terrestrial APE* based on general information obtained from the lessees and other consulting parties.

Analysis of the Programmatic APE will inform each lessee during completion of cultural resource assessments[1] as part of their COP preparation. COP submittal will enable BOEM to conduct more specific cultural resources analysis. These assessments must follow historic property identification guidelines (BOEM 2020) starting with the delineation of a preliminary APE (PAPE) per the PDE defined in each project's COP. *Please note that the project-specific PAPE is not the same as the Programmatic APE used for the current programmatic NEPA analysis of five projects.*

The COP submittal will include assessments of marine archaeology, terrestrial archaeology, and onshore aboveground historic properties located within the PAPE, along with documentation of the identification of historic properties, analysis of potential effects, and development of potential mitigation measures for adversely affected historic properties. Once these COP appendices are deemed sufficient, BOEM will delineate the COP APE and assess the specific impacts on historic properties as part of the COP-specific NEPA and NHPA reviews and consultations. BOEM acknowledges that Tribal Nations may have cultural, religious, archaeological, and traditional practices that may be adversely affected by a project and will consider those under the NHPA and NEPA reviews.

3.4.2.1 Description of the Affected Environment and Baseline Conditions

This section identifies cultural contexts and associated resources that may occur in the Programmatic APE, drawing from the baseline cultural resources analysis of the Pacific OCS (BOEM 2013). This section also identifies representative examples of these contexts and types that are known to occur in the Programmatic APE. Finally, this section discusses the environmental trends occurring in the Programmatic APE that affect cultural resources and historic properties.

Marine cultural resources in the Programmatic APE may include physical remnants and ASLFs associated with human habitation patterns dating to as early as 14,000 before present (BP). Based on known

[1] The three required cultural resources assessment appendices to the COP are the Marine Archaeological Resources Assessment, Terrestrial Archaeological Resources Assessment, and Historic Resources Visual Effects Assessment.

historical and recent maritime activity in the region, the Humboldt and Morro Bay lease areas have a high probability for containing shipwrecks, downed aircraft, and related debris fields that may be subject to potential impacts by seabed-disturbing activities from offshore wind development (BOEM 2013). ASLFs have a moderate (Humboldt WEA) to low (Morro Bay WEA) probability of occurrence on the OCS (BOEM 2013).

As evidenced by the extent of known human occupation in the region, onshore areas potentially subject to ground-disturbing activities from offshore wind development are likely to contain terrestrial archaeological resources dating from any of the periods of habitation, exploration, settlement, and development. Marine cultural resources in the Programmatic APE may include maritime cultural landscapes or individual buildings or structures associated with pre-contact and historic-period use and settlement of coastal California. Maritime cultural landscapes, such as Tribal landscapes, coastal military installations, or historic port facilities, and intangible resources are especially likely to be affected by California offshore wind project development. These resources can be affected by the physical disturbance of marine and terrestrial components of the maritime cultural landscape, as well as by visual changes that can affect the historical integrity of feeling, setting, and association or intangible qualities of the resource.

For the purposes of the discussion of cultural contexts and property types that follow, cultural resources are divided into several types and subtypes as defined in Table 3.4.2-1.

Table 3.4.2-1. Definitions of cultural resource types used in the analysis

Term	Definition
Ancient submerged landform feature (ASLF)	A type of marine cultural resource, ASLFs are landforms that have the potential to contain Native American archaeological resources inundated and buried as sea levels rose at the end of the Last Glacial Maximum. Additionally, Native American Tribes in the region may consider ASLFs to be independent or contributing elements to previously subaerial traditional cultural places, representing places where their ancestors once lived.
Cultural landscape and maritime cultural landscape	The National Park Service (2006) defines a *cultural landscape* as a "geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person, or exhibiting other cultural or aesthetic values." In this analysis, cultural landscapes are considered a type of historic aboveground resource. NOAA (2024) defines a maritime cultural landscape as "a geographic area where the combination and interrelationships of human activity and the marine environment is expressed in significant ways, such as the distribution of heritage resources, traditions and cultural practices, or culturally important locations. Every maritime cultural landscape captures a unique combination of both material and intangible heritage, and includes meaning attached to a given location by different stakeholder groups."
Cultural resource	The phrase *cultural resource* refers to a physical resource valued by a group of people such as an archaeological resource, building, structure, object, district, landscape, or TCP. Cultural resources can date to the pre-contact or post-contact periods (e.g., respectively, the time prior to the arrival of Europeans in North America and thereafter) and may be listed on national, state, or local historic registers or be identified as important to a particular group during consultation, including any of those with cultural or religious significance to Native American Tribes. Cultural resources in this analysis are divided into several types and

Term	Definition
	subtypes: marine cultural resources, terrestrial archaeological resources, historic aboveground resources, and TCPs.
Marine archaeological resource	*Marine archaeological resources* are the physical remnants of past human activity that occurred at least 50 years ago and are submerged underwater. They may date to the pre-contact period (e.g., those inundated and buried as sea levels rose at the end of the Last Glacial Maximum) or post-contact period (e.g., shipwrecks, downed aircraft, and related debris fields).
Historic aboveground resource	*Historic aboveground resources* are subaerial features or structures of cultural significance at least 50 years in age and include those that date to the pre-contact or post-contact periods. Example types that are or may have historic aboveground components include standing buildings, bridges, dams, historic districts, cultural landscapes, and TCPs.
Historic district	A *historic district* is an area composed of a collection of either or both archaeological and aboveground resources.
Historic property	As defined in 36 CFR 800.16(l)(1), the phrase *historic property* refers to any "prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the [NRHP] maintained by the Secretary of the Interior." Historic property also includes National Historic Landmarks, as well as properties of religious and cultural significance to Native American Tribal Nations that meet NRHP criteria.
Terrestrial archaeological resource	*Terrestrial archaeological resources* are the physical remnants of past human activity that occurred at least 50 years ago and are located on or within lands not submerged underwater. They may date to the pre-contact period (e.g., have associations with Native American populations dating to before European colonization of the Americas) or post-contact period (e.g., have associations with African American, European American, or Native American populations dating to after European colonization of the Americas).
Traditional cultural place	National Register Bulletin 38 (Parker and King 1990, revised 1992 and 1998; and NPS 2023) defines a *traditional cultural place* as a "building, structure, object, site, or district that may be listed or eligible for listing in the National Register for its significance to a living community because of its association with cultural beliefs, customs, or practices that are rooted in the community's history and that are important in maintaining the community's cultural identity" (NPS 2023:12). TCPs may be locations, places, or cultural landscapes and have either or both archaeological and aboveground elements.
Intangible resources	Intangible heritage (UNESCO 2024) is inherited from ancestors and passed on to descendants. It includes oral traditions, performing arts, social practices, rituals and festive events, knowledge and practices concerning nature and the universe, and the knowledge and skills related to craftsmanship. It is continuously changing, evolving, and being re-created as it is transmitted from generation to generation and evolves in response to our environment.

3.4.2.1.1 Habitation Areas in the Marine Environment

The following discussion of habitation areas in the marine environment associated with the Programmatic APE is drawn from the 2013 inventory and analysis of coastal and submerged archaeological resources along the Pacific OCS (BOEM 2013).

Formerly habitable lands, also referred to as ASLFs, inundated over thousands of years by rising sea levels may occur in the Programmatic Marine APE. Prehistoric coastal foragers likely used a range of natural resources latitudinally distributed across the marine environment and into areas of the modern North American coast. As sea levels rose, landward compression of the OCS coastal landscape forced prehistoric foragers to move farther inland to stay above shifting shorelines and to access shifting resource areas. Prehistoric sites on or below the seabed may hold evidence of foraging activities related to the proximal location of different kinds of environmental zones at different points in time. Where site-formation processes promote the development of stratified geological records and where prehistoric peoples continued using the same sites through time, it can be expected that there would be archaeological components related to inland terrestrial and riverine resource use buried by younger deposits bearing evidence of people using estuarine or littoral ecosystems at the same location.

Historic properties may occur in the Programmatic APE that relate to human habitation dating back as early as 14,000 BP (Terminal Pleistocene/Early Holocene). Some of these properties may have been submerged due to rising seas. Maritime cultural landscapes may be identified through consultation with California Native American Tribes who have knowledge of the interrelationships of human activity, traditions and cultural practices, or culturally important locations in or near the lease areas dating from the earliest times through the present day. Archaeological sites from different time periods may be important for their ability to provide information about how lifeways changed over time. For example, assemblages from 14,000 BP may include abundant flaked-stone tool types and distinctive lithic technology, pitted stones, asphaltum, shell spoons and ornaments, and pointed-bone objects. However, artifacts related to intensive nearshore fishing and shellfish gathering may represent habitation closer to 12,000 BP. The appearance of groundstone at mainland coastal sites as early as 10,000 BP most likely reflects some form of seed, nut, or root exploitation not typically conducted in earlier eras.

Historic properties in the PAPE may be associated with trends toward significant technological innovation and overall population increase starting around 8,000 BP and stretching to 3,000 BP (Middle Holocene). Mainland coastal sites from this period are associated with the Millingstone Culture and increase in number and diversity of sites throughout the period. Although shellfish continued to be the dietary staple in most areas of the coast, terrestrial mammals, birds, and estuarine and pelagic fish became more important. Subsistence strategies became increasingly focused on fish and large sea mammals, seen in the first widespread appearance of the circular shell fishhook, stone sinkers/net weights, harpoon tips, and wood-stake fishing weirs dating to as early as 4,500 BP on the Northern California coast. Plant foods increased in importance, reflected by the widespread appearance of the mortar and pestle, which may reflect the first systematic use of acorns along the coast. Flaked-stone technology is marked by an overall increase in the number of projectile points and the introduction of smaller side-notched types. These developments in projectile point technology and frequency coincided with the increase in marine mammal exploitation. Olivella beads became more numerous, elaborate, and widely distributed; this may be associated with the development of, and increase in, social complexity. This, along with the presence of fired ceramics, suggests that regional interaction between Indigenous groups was extensive by 5,000 BP.

During the era between 3,000 BP and the 15th or 16th century, when contact was made between Indigenous people and Europeans (Late Holocene), the entire California coast was subject to substantial human occupation with increasing cultural complexity and population size. The overall settlement pattern is toward larger year-round villages, large formal cemeteries, and ephemeral satellite camps. Sites are more abundant and display a wide range of cultural and technological developments, suggesting shifts in the region's social organization and complexity.

3.4.2.1.2 Historic Coastal Habitation

The following discussion of historic coastal habitation areas associated with the Programmatic APE is drawn from the 2013 inventory and analysis of coastal and submerged archaeological resources along the Pacific OCS (BOEM 2013). BOEM understands Tribal cultural and historic use in areas onshore and offshore prior to European contact are not often represented in the archaeological record. The evidence of past Tribal use of these areas exists in their present-day cultural practice, through ceremony, in their stories, and their knowledge of the landscape. This information is often sacred and is held only by Tribal members. This section seeks only to capture a broad history of coastal habitation on the landscape, while acknowledging there are equally important periods of history represented by intangible resources connected to places.

Indigenous lifeways post-contact have continued despite European incursions, both within and outside of Spanish missions and associated rancherias. By the American Period (after 1848), archaeological evidence supports the continuing practice of Indigenous lifeways throughout California. However, Indigenous people were often relegated to refugia such as pre-contact village sites, reservation communities, hinterlands, or marginal areas. Indigenous cultures and peoples were obliterated because of European colonization, large numbers of descendants continue to reside throughout California and maintain their cultural identity today. The existence of living members and shared cultural knowledge and traditions attest to the perseverance of Indigenous peoples despite overwhelming odds. Refer to Section 3.4.5, *Tribal Values and Concerns*, for further analysis of relevant Tribal resources.

Some of the earliest non-Indigenous cultural resources on the California coast relate to European exploration that began in the 16th century, introducing new types of settlements to a Native American landscape. Archaeological resources and the increasingly rare building or structure dating to the Spanish, Russian, or British explorers may include landing sites, trading posts, military forts, presidios, missions, and pueblos. Spain established 21 missions and transportation networks connecting them as far north as Sonoma to convert the region's Native Americans to Christianity and assimilate them into European modes of economic production and social structure. With declining Indigenous populations (due to disease and colonization) and minimal settlement by Spain, much of California remained sparsely populated until Mexico won independence from Spain in 1821. By 1834, Mexican authorities had undertaken to secularize the mission system and began granting mission lands—which had originally been promised to Indigenous Californians—to former Spanish colonists and other newcomers to the region. Trade and settlement grew rapidly following Mexican independence, introducing large ranchos for cattle ranching, vernacular and designed adobe residences, and more abundant commercial trading centers also largely built from local materials.

Historic properties from the 19th century that may be in the APE reflect the transition from Mexico's Alta California to the American state of California. With the signing of the Treaty of Guadalupe Hidalgo in

1848, Mexico ceded a vast northern territory to the United States; California was granted statehood in 1850. The discovery of gold on the American River in California's Sierra Nevada foothills in 1848 inaugurated the California Gold Rush and associated population boom that transformed San Francisco into one of the major urban centers and ports of the United States and dramatically increased maritime traffic and associated port and harbor development along the California coast. The U.S. War Department assumed responsibility for protecting the increasingly populous new state and its growing maritime trade, dotting California's coastal population centers with military camps, forts, and barracks. Logging activity flourished during the second half of the 19th century along the Humboldt coastline with shipping of redwood from natural harbors and coves dictating the location of towns along the Northern California coast. The fishing industry also expanded during the latter part of the century and fostered a large degree of ethnic diversity in many coastal areas. Although most of California's missionized Native Americans never received mission lands, Indigenous groups continued to practice traditional fishing and procurement activities for both sustenance and ceremonial purposes. Victorian-era coastal homes and lighthouses built to improve maritime safety also became prevalent structures on the Pacific Coast. Although arable land remained limited along much of the coastline, with the establishment of settlements and towns farmers began agricultural enterprises in coastal valleys and on coastal plains.

In the Programmatic APE, there may be historic properties associated with industrialization and globalization trends that the United States experienced around the turn of the 19th and 20th centuries, and also with social movements that formed in protest to these trends. California's major coastal cities and ports grew rapidly during this period as the federal government invested heavily in defense, maritime transportation, and trade. Expanding maritime trade and the introduction and growth of automobile travel increased demand for oil. By the 1920s, California distinguished itself as the leading oil-producing region in the world, which led to a new type of infrastructure for related processing, storage, and shipping. Industrialized logging and fishing continued along the Northern California coast. New railroad lines developed in these regions to facilitate travel and overland shipping. During the first quarter of the 20th century, multiple social movements associated with Progressive-era reform shaped aspects of the coastal built and natural environments by encouraging new responses to problems posed by natural resource extraction and commodification.

In 1901, the California legislature created the first of its state's parks, California Redwood Park, and within a decade, executive orders issued by President Theodore Roosevelt established numerous land conservation areas. Intensified logging during World War I led to the creation of organizations that advocated for further natural landscape preservation. In the wake of late-19th century commercial overfishing, the scientific element of the conservation impulse joined with Progressivist philanthropy in the creation of new marine science institutions. The reform ethos also fostered a new level of sociopolitical engagement and institutional development that included efforts to assimilate new immigrant populations by encouraging more civic engagement among women. Reformers and women's clubs constructed several important buildings and complexes along the California coast. Coastal cities became preferred destinations for affluent residents and tourists, leading to the development of celebrity getaways like Hearst Castle and estates dotting the hills of Santa Barbara, as well as more modest beach-front homes and hotels. Increased tourism led to development of coastal scenic highways with vista point pullouts, campgrounds, motor courts, and public beaches to provide tourists physical and visual access to the scenic and natural qualities of the Pacific coastline.

During and after World War II, military development continued to shape areas of the West Coast. World War II and Cold War military development introduced training camps and military installations to the central coast and led to the fortification and expansion of most port facilities in California. The U.S. Navy based its West Coast construction corps (the Seabees) at Port Hueneme. Santa Monica became a densely populated area with a commercial core and an industrial base increasingly geared to defense. During the post-war period, wealth gravitated to the coasts and California coastal living became a sign of elite status, leading to conservation-minded residential developments for the affluent, such as Sea Ranch on the north coast. Overall, the major urban areas of Los Angeles and San Francisco became increasingly densely developed throughout the 20th century, but the areas around Humboldt and Morro Bay retained their early to mid-century character because they were less accessible, already dedicated military reserves, or protected by environmental conservation and historic preservation efforts.

3.4.2.2 Trends Affecting Cultural Resources

Climate change effects include increases in temperature and increased disturbance to ecological systems that are affecting the physical qualities of cultural resources, as well as the intangible qualities of cultural resources and intangible heritage resources (Flanigan et al. 2018; Wright 2016). Likewise, ongoing and planned activities in the Affected Environment have the potential to affect cultural resources. Such effects would continue and result in similar impacts regardless of any offshore wind development. The rate and continuation of these activities are uncertain, but their effects on cultural resources would be detectable, either qualitatively or quantitatively. Table 3.4.2-2 summarizes known environmental trends and ongoing and planned activities with the potential to affect cultural resources.

Table 3.4.2-2. Trends affecting cultural resources in the Affected Environment

Trend Category	Individual Trend	Potential Effects on Cultural Resources
Environmental Trends or Natural Processes		
Sea level rise	Erosion, submersion, inundation, saturation	Impacts may occur due to the ongoing trend or individual events and affect archaeological sites, buildings and structures, cultural landscapes, and intangible heritage through physical damage or forced changes in how people are able to experience the resource (such as intangible heritage).
Ocean acidification	Corrosion, deterioration, destruction	Increased corrosion of submerged archaeological resources possessing acid-soluble metals. Increased deterioration of organic cultural materials and shell middens. Reduced calcium carbonate-based marine biota that protect cultural resources.

Trend Category	Individual Trend	Potential Effects on Cultural Resources
Precipitation variation and flooding	Deterioration, destruction	Increased precipitation and associated flooding along the coast can lead to landslides (destroying buildings/structures or buried resources), coastal scour that physically damages buried resources, inundation, damage to components of maritime cultural landscapes, or changes in the accessibility or associations with intangible resources.
Increased atmospheric moisture	Oxidation	Increases in the ambient atmospheric moisture can affect the physical/chemical stability of building materials, resulting in loss of buildings or structures.
Temperature variation	Corrosion, deterioration, conflagration, desiccation	Rising ocean temperatures can lead to increased corrosion or increased decomposition caused by marine organisms, affecting marine archaeological resources. Fires and extreme heat can lead to destruction or damage to all types of cultural resources that are exposed to these conditions.
Climate change effects on species	Disruption, invasive species	Changing environmental conditions can lead to introduction of invasive species of animals or plants that may disturb buried resources or destabilize aboveground resources; disruption of species can affect intangible heritage that relies on relationships to the natural world.
Ongoing and Planned Activities		
New marine sanctuary	Chumash Heritage National Marine Sanctuary, resulting in managed use of the area, intended to balance compatible ocean uses and cultural heritage considerations while protecting natural and cultural resources in the area	Where permitted activities are allowed, potential disturbance of the seabed and potential damage or destruction to the marine environment could occur for archaeological resources, ASLFs, and maritime cultural landscapes.
Undersea transmission lines, gas pipelines, and other submarine cables	Increase in seafloor and littoral zone disturbance	Physical destruction or damage to marine archaeological resources, ASLFs, and maritime cultural landscapes could occur.
Dredging and port improvement projects	Gradual increase in dredging activities as new offshore infrastructure is built, such as gas pipelines and electrical lines, and as ports and harbors are expanded or maintained	Impacts could occur on cultural resources through physical destruction or damage resulting from seabed, littoral zone, and terrestrial disturbance; changes in the setting; or the introduction of visual, atmospheric, or audible elements.
Marine minerals use and ocean-dredged material disposal	No foreseeable marine minerals use area in the Affected Environment; three active disposal sites in the vicinity of the Affected Environment	Activities associated with dredged materials disposal could damage marine archaeological resources and ASLFs.

Trend Category	Individual Trend	Potential Effects on Cultural Resources
National security and military use	Continued military testing and training activities within and in the vicinity of the Morro Bay WEA	Impacts on cultural resources could occur through physical destruction or damage resulting from seabed, littoral zone, and terrestrial disturbance; changes in the setting; or the introduction of visual, atmospheric, or audible elements.
Marine transportation	Gradually increasing vessel traffic, including vessel use for recreational, fisheries, marine transportation, military, and other ongoing activities	Potential for increased release of fluids, trash and debris, and cleanup activities that require the removal of contaminated soils or seafloor sediments could cause impacts on cultural resources through effects from the released chemicals as well as the ensuing cleanup activities.
Fisheries use and management	Continued level of fisheries use and management with the potential for accidental releases; impacts from anchoring and dredging	This activity could continue to physically damage marine archaeological resources such as shipwrecks, debris fields, and ASLFs. Temporary intrusive lighting from vessels could alter setting of aboveground cultural resources and cultural landscapes.
Oil and gas activities	Continuation at current rates in BOEM lease oversight areas from offshore Lompoc to offshore Long Beach, with the potential for pipeline or cable installation and maintenance, anchoring, dredging, and lighting.	These activities could physically damage marine archaeological resources such as shipwrecks, debris fields, and ASLFs. Temporary intrusive lighting from vessels could alter setting of aboveground cultural resources and cultural landscapes.
Onshore development activities (unrelated to offshore wind)	Continuation of onshore residential, commercial, industrial, and military development activities resulting in terrestrial land disturbance; introduction of additional lighting and structures into the viewshed	These activities could cause physical destruction or damage to terrestrial archaeological resources, aboveground resources, and cultural landscapes; changes in the setting; or the introduction of visual, atmospheric, or audible elements.
Other		
Global climate change	Increases in global atmospheric and oceanic temperature, increased extreme weather, rising sea levels, and changes in atmospheric and oceanic chemistry (Blunden and Arndt 2020)	Global climate change could cause physical damage to or deterioration of cultural resources through altered atmospheric and oceanic chemistry; impacts on littoral and terrestrial cultural resources resulting from extreme weather and coastal erosion; and changes to the setting of cultural resources.

Sources: Rockman 2015; Wright 2016.

3.4.2.3 Impact Background for Cultural Resources

This analysis uses general terms to describe impacts on cultural resources (e.g., alteration, disturbance, diminishment, destruction) with more specific scenarios described for each IPF. Impact determinations would depend on the degree to which a project may impair the resource’s historical integrity or characteristics that qualify it for listing in the NRHP.

- For marine and terrestrial archaeological resources, this may be related to physical disturbance of cultural materials that diminishes or destroys the information of scientific or intangible value embodied in that resource.
- For aboveground historic resources, this may be related to physical harm to the materials, design, or workmanship of a building, structure, or landscape element.
- For historic buildings, districts, or maritime cultural landscapes whose significance relies on associations with or views of the marine environment, this may be related to the introduction of offshore wind infrastructure that industrializes a previously unspoiled ocean setting.

Temporary activities may permanently affect cultural resources. For example, disturbing an archaeological site resulting in the loss of irreplaceable information would constitute a permanent impact regardless of whether the disturbance is caused by an isolated, temporary, or short-term activity. Table 3.4.2-3 defines potential impacts on cultural resources (including historic properties per Section 106 of the NHPA).

Table 3.4.2-3. Adverse impact definitions for cultural resources by type

Definition for Historic Properties under Section 106 of the NHPA	Definition for Archaeological Resources and ASLFs	Definition for Historic Aboveground Resources and Intangible Heritage
No historic properties affected, as defined at 36 CFR 800.4(d)(1).	A. No cultural resources subject to potential impacts from ground- or seabed-disturbing activities; or B. All disturbances to cultural resources are fully avoided, resulting in no potential damage to or loss of scientific or cultural value from the resources.	A. No discernible impacts; or B. No physical impacts and no change to the integrity of resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance; or C. All physical impacts and disruptions are fully avoided.
No adverse effects on historic properties could occur, as defined at 36 CFR 800.5(b). This can include avoidance measures.	A. Some damage to cultural resources from ground- or seabed-disturbing activities, but there is no loss of scientific or cultural value from the resources; or B. Disturbances to cultural resources are avoided or limited to areas lacking scientific or cultural value.	A. No physical impacts (e.g., alteration or demolition of resources) and some limited sensory disruptions (e.g., sound from construction or visual perception of construction lighting) to the historic or aesthetic settings from which resources derive their significance; or B. Disruptions to historic or aesthetic settings are short term and expected to return to an original or comparable condition (e.g., temporary vegetation clearing and construction vessel lighting).

Definition for Historic Properties under Section 106 of the NHPA	Definition for Archaeological Resources and ASLFs	Definition for Historic Aboveground Resources and Intangible Heritage
Adverse effects on historic properties as defined at 36 CFR 800.5(a)(1) could occur. Characteristics of historic properties would be altered in a way that diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association, but the adversely affected property would remain eligible for the NRHP.	A. Greater extent of damage to cultural resources from ground- or seabed-disturbing activities, including some loss of scientific or cultural data; or B. Disturbances to cultural resources are minimized or mitigated to a lesser extent, resulting in some damage to and loss of scientific or cultural value from the resources.	A. No or limited physical impacts and greater extent of changes to the integrity of cultural resources or sensory disruptions to the historic or aesthetic settings from which resources derive their significance; or B. Disruptions to settings are minimized or mitigated; or C. Historic or aesthetic settings may experience some long-term or permanent impacts.
Adverse effects on historic properties as defined at 36 CFR 800.5(a)(1) could occur. Characteristics of historic properties would be affected in a way that diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association to the extent that the property is no longer eligible for listing in the NRHP.	A. Destruction of or greater extent of damage to cultural resources from ground- or seabed-disturbing activities; or B. Disturbances are minimized or mitigated but do not reduce or avoid the destruction or loss of scientific or cultural value from the cultural resources; or C. Disturbances are not minimized or mitigated resulting in the destruction or loss of scientific or cultural value from the resources.	A. Physical impacts on cultural resources (for example, demolition of a cultural resource onshore); or B. Greater extent of changes to the integrity of cultural resources or sensory disruptions to the historic or aesthetic settings from which resources derive their significance, including long-term or permanent impacts; or C. Disruptions to settings are not minimized or mitigated.

As shown in Table 3.4.2-4, contributing IPFs on cultural resources include accidental releases, anchoring, cable installation and maintenance, gear utilization, land disturbance, lighting, and presence of structures.

Table 3.4.2-4. Issues and indicators for assessing impacts on cultural resources

Issue	Impact Indicator	Relevant IPFs
Offshore seabed disturbance: potential physical destruction of, damage to, or entanglement with marine cultural resources	Qualitative analysis of impacts on marine archaeological resources and ASLFs subject to physical impacts from activities occurring in offshore areas.	Accidental releases, anchoring, cable installation, gear utilization
Onshore and nearshore ground disturbance: potential physical destruction of or damage to terrestrial archaeological and other cultural resources	Qualitative discussion of potential for impacts on terrestrial archaeological resources or any other resources subject to physical impacts from activities occurring in onshore or nearshore areas, inclusive of the littoral zone.	Land disturbance

Issue	Impact Indicator	Relevant IPFs
Visual disturbance: potential visual impact on identified historic properties	Qualitative assessment of maritime settings/ocean views of aboveground historic properties subject to visual impacts from components constructed or activities occurring offshore. Qualitative assessment of settings/views of aboveground historic properties subject to visual impacts from components constructed or activities occurring onshore.	Lighting, presence of structures
Nighttime lighting: potential impact on identified historic properties	Qualitative assessment of dark nighttime settings of aboveground historic properties subject to visual lighting impacts from components constructed or activities occurring offshore or onshore.	Lighting

3.4.2.4 Impacts of Alternative A – No Action – Cultural Resources

When analyzing the No Action Alternative's potential impacts on cultural resources, BOEM considered the impacts of ongoing activities against the existing conditions for cultural resources. Under the No Action Alternative, baseline conditions for cultural resources would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. Ongoing activities within the Affected Environment that are likely to contribute to impacts on cultural resources include residential, commercial, and industrial development; commercial, recreational, and military vessel traffic; and environmental changes resulting from climate change (refer to Appendix C, *Planned Activities Scenario*).

Accidental releases: Accidental releases have the potential to cause permanent, adverse impacts on marine or terrestrial cultural resources. Potential sources of accidental releases include undersea transmission lines and other submarine cables, dredging and port improvement projects, potential marine minerals extraction and ocean-dredged material disposal, marine transportation, and oil and gas activities. Small accidental releases with an anticipated small volume of released material, and associated need for cleanup activities, would have limited impacts due to the low probability of occurrence, low volumes of material released in individual incidents, low persistence time, standard BMPs to prevent releases, and localized nature of such events.

Large-scale accidental spills, like oil spills, can severely affect marine and terrestrial cultural resources. Even minor spills can cause significant damage if cleanup efforts are extensive relative to the size of the affected resource. Cleanup activities following a large-scale spill could harm coastal, nearshore, and marine cultural resources by removing contaminated soil or sediment. This could also alter the setting of coastal historic resources and TCPs. Materials released in deep water could settle on marine cultural resources, such as shipwrecks, downed aircraft, and debris fields, and this may accelerate their decomposition or cover them and make them inaccessible or unrecognizable to researchers, resulting in a significant loss of historic information (Hamdan Lab n.d.). Therefore, large-scale spills can cause permanent and widespread impacts.

Anchoring: Anchoring can disturb marine cultural resources, potentially causing permanent harm. This can occur during commercial and recreational activities, dredging, port improvements, marine transportation, and oil and gas operations. The placement and movement of anchors and seafloor gear like wire ropes, cables, and anchor chains can affect the seafloor by sweeping, dragging, or installation, potentially damaging or destroying marine cultural resources (where present). The loss of marine archaeological resources or ASLFs from these activities would be irreversible, leading to a significant loss of scientific or cultural value.

The scale of anchoring impacts on marine cultural resources would depend on the number of such resources and ASLFs in disturbed areas, or the extent of impact on individual cultural resources. Physical impacts that may damage or disturb marine archaeological resources due to anchoring can typically be avoided through including avoidance buffers or exclusion zones in project design. The number, extent, orientation, and dispersed character of ASLFs make avoidance difficult in water depths below 130 meters (Clark et al. 2014), while the depth of these resources hinders the efficacy of mitigation measures.

Cable installation and maintenance: Submarine cable installation can involve dredging, trenching, sediment displacement, or concrete or rock placement on the seafloor, each of which can cause permanent, adverse impacts (disturbance or destruction) on marine cultural resources. Such damage would likely result in permanent and irreversible loss of scientific or cultural value.

Gear utilization: Gear utilization, which involves the capture or entanglement of marine species during surveys, can disturb, dislodge, damage, or destroy marine archaeological resources (BOEM 2013). Use of survey gear by commercial, recreational, or military vessel traffic, or as part of cable installation, could cause impacts.

Land disturbance: Land disturbance can adversely affect cultural resources. Ongoing activities could cause adverse impacts on both known and undiscovered cultural resources; grading or excavating disturbs or destroys undiscovered archaeological resources and TCPs. The number of affected cultural resources and the severity of impacts would depend on the location of land disturbance relative to these resources and the proportion of the resource affected. Many of these activities would be subject to state and federal requirements to identify cultural resources, assess impacts, and develop plans to avoid, minimize, or mitigate adverse impacts. Therefore, any adverse impacts from these activities would likely be permanent but localized.

Lighting: Ongoing activities involving offshore vessels may produce light above or below the water both onshore and offshore. These lighting variations have the potential to affect cultural resources in the short and long terms. Ongoing offshore activities may result in impacts related to anthropogenic light from vessels but are less likely to introduce lighting impacts from operations because such activities are below the surface of the ocean. Activity duration and atmospheric and environmental conditions (such as clouds, fog, and waves that could partially or completely obscure or diffuse light sources) would further reduce lighting intensity from the planned ongoing non-offshore-wind activity.

Presence of structures: The introduction of intrusive visual elements into the viewshed has the potential to cause impacts on cultural resources. The extent of visual-related cultural resource impacts would be limited to historic properties from which the presence of structures would be visible, typically historic aboveground resources such as buildings, structures, objects, and districts, and could include significant cultural landscapes relatively close to shorelines and on elevated landforms. Ongoing onshore activities may introduce modern structures in the viewshed of cultural resources with the potential for impacts depending on a variety of factors including atmospheric conditions, vegetation, and distance from cultural resources.

3.4.2.4.1 Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative on existing trends and potential impacts from other planned activities. While the planned activities have the potential to increase the number of resources affected by the IPFs, or the variety of ways that the same resource might be affected, overall, the impacts themselves would not be different from or substantially more severe than those caused by ongoing activities under the No Action Alternative. Planned activities that could affect cultural resources include NOAA's late 2024/early 2025 designation of the Chumash Heritage National Marine Sanctuary (NOAA 2023:viii) as well as port and onshore developments.

3.4.2.4.2 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, cultural resources would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing temporary, long-term, and permanent impacts (marine, terrestrial, and visual) on cultural resources in the Affected Environment through seabed, terrestrial, and visual disturbance.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and cultural resources would continue to be subject to impacts by natural processes (such as coastal erosion, sea level rise, or atmospheric conditions that lead to deterioration of cultural materials) and human-caused IPFs. Planned activities would contribute to impacts on cultural resources due to the disturbance, damage, disruption, and destruction of individual cultural resources onshore and offshore.

3.4.2.5 Impacts of Alternative B – Development with No Mitigation Measures – Cultural Resources

Alternative B considers the potential cultural resources impacts of future offshore wind development in the Humboldt and Morro Bay lease areas without inclusion of mitigation measures. As previously noted, BOEM has defined a broadly expansive Programmatic APE intended to include, as much as possible, future COP-specific APEs when that information becomes available. BOEM is, therefore, analyzing potential impacts on cultural resource types that may be present in the Programmatic APE. However, other cultural resources and cultural resource types subject to potential impacts are possible; these are discussed generally throughout this section.

3.4.2.5.1 Impacts of One Representative Project in Each WEA

Overall, development of one representative project in each WEA would result in similar types of impacts as those described for the No Action Alternative. Accordingly, the discussion does not repeat the analyses of impact types supplied above but describes differences in scale, severity, or location. Similarly, for most of the IPFs more substantial impacts could occur if final project designs could not avoid known resources or if previously undiscovered resources are discovered or damaged during construction.

Accidental releases: Development of one representative project in each WEA would increase offshore activity and its geographic extent and thus slightly increase the probability of accidental releases. Overall, BOEM anticipates accidental releases impacts would be localized and short term in most cases, but potentially greater if the release is geographically extensive or permanent depending on the number and scale of accidental releases and the number and size of affected cultural resources.

Anchoring: The anchoring of WTGs, OSSs, or vessels could result in slightly increased impacts on marine cultural resources, with the severity of impacts depending on the type, location, and duration of impacts on cultural resources. For example, anchoring in an area with more or more valued cultural resources would have a greater likelihood for impacts than locations without such resources.

Cable installation and maintenance: Cable-related activities could disturb the seabed as well as any cultural resources that may be present (including any discovered). While subject to NHPA and NEPA compliance and review from the State Historic Preservation Office (SHPO) and BOEM, final project design may or may not be able to avoid all cultural resources. For these reasons, similar to the *Anchoring* IPF for Alternative B, BOEM anticipates these activities may have localized and permanent impacts on marine cultural resources.

Gear utilization: As part of compliance with the NHPA and as part of COP submittals, the SHPO and BOEM, respectively, would require project applicants to conduct extensive geophysical surveys of lease areas and export cable corridors to identify submerged marine cultural resources. The adverse impacts of gear utilization on marine archaeological resources would be infrequent and isolated, particularly in the case of an entanglement, due to the permanent, irreversible nature of such impacts.

Land disturbance: Land disturbance from onshore construction could affect cultural resources, depending on the locations of onshore project components. Ground-disturbing activities like site clearing, grading, excavation, and filling could affect cultural resources (historic properties and terrestrial archaeological resources). Impacts would be localized, temporary to permanent, and would be more severe if known resources could not be avoided or if undiscovered resources were found during construction.

Lighting: Onshore lighting during all project phases could introduce new sources of light into historic viewsheds. Onshore component locations remain undefined but impacts could be temporary to long term. Due to the extent of existing development where onshore components are most likely, their lighting is not expected to contribute significantly to sky glow and is unlikely to have measurable impacts on historic aboveground resources for which a dark nighttime sky is a character-defining feature or otherwise supports NHPA eligibility.

Similarly, offshore lighting during all project phases could also cause impacts, the severity of which would vary with the number of WTGs and OSSs their proximity to shore. BOEM prepared visual simulations to illustrate the prospective visibility of wind development offshore Humboldt and Morro Bay. The simulations of nighttime conditions produced a wide range of results, including prominent nighttime views of WTGs from Sue-meg State Park (formerly Patrick's Point State Park) in Humboldt County (ESS Group 2019a, 2019b). Each individual project would be subject to NHPA Section 106 agency consultation, which could include mitigation enforceable by other federal and state agencies. The FAA has regulatory requirements for the lighting of offshore structures under 14 CFR part 77. This analysis assumes that one such requirement would be the implementation of ADLS, which would reduce nighttime lighting impacts from Aviation Warning Lights (BOEM 2021c). Overall, BOEM anticipates impacts on cultural resources from lighting from one representative project in each WEA would range from localized to widespread, and temporary to long term, depending on the locations and types of lighting sources and their proximity to historic aboveground resources and their significant historic contexts.

Presence of structures: One representative project in each WEA would introduce new infrastructure within a setting that historically consisted of ocean and horizon views, thus potentially affecting cultural resources by changing the visual context. As with the lighting IPF, the severity of impacts from the presence of structures could vary based on the height and proximity to shore of WTGs and OSSs, as illustrated by the above-referenced 2019 visual simulations. The visual simulations from Julia Pfeiffer Burns State Park, Limekiln State Park, Piedras Blancas Lighthouse, Piedras Blancas in Morro Bay, and Valencia Peak show that simulated WTGs more than 40 miles away (in the Morro Bay WEA) would appear small and indistinguishable.

In contrast, visual simulations from Sue-meg State Park and Montaña de Oro State Park show that WTGs closer to shore relative to the location of the visual simulation would disrupt the visual experience of the maritime setting of the respective resources. COP-related analysis will include visual simulations better representative of actual anticipated lease area development. At this programmatic stage, BOEM anticipates that visual impacts from the presence of structures would range from localized to widespread, and from temporary to long term, depending on the locations and heights of WTGs, their proximity to historic aboveground resources and their significant historic contexts, and final project design specifications.

3.4.2.5.2 Impacts of Five Representative Projects

Overall, IPFs from the development of five representative projects would affect cultural resources in the same manner as described for the corresponding IPFs for one representative project in each WEA but would be of greater likelihood, intensity, or extent. The increased amount of development from five projects would increase the amount of activities as well as the geographic range of impacts, which would proportionately increase potential for impacts over a single project.

3.4.2.5.3 Cumulative Impacts of Alternative B

Overall, potential cumulative impacts on cultural resources under Alternative B would occur in the same manner as described for Alternative A. However, additive impacts of further representative projects would increase the overall likelihood, intensity, or extent of impacts on cultural resources. Additionally, the increased intensity or extent of the contributions would be dependent on whether cultural resources exist in the expanded area of development such that impact determinations for individual IPFs would not change from the No Action Alternative cumulative scenario.

3.4.2.5.4 Conclusions

Impacts of Alternative B. Projects in lease areas closer to the shoreline with large areas of ground or seabed disturbance are more likely to have greater impacts on cultural resources than projects developed farther from the shoreline, which may have smaller areas of disturbance, dependent on the final project designs. Five representative projects would likely have increased impacts because the increased amount of development increases the likelihood that impacts would be physically damaging or cause permanent setting changes, and that such impacts would occur on a greater number of cultural resources. Impacts of one or five representative projects would be due to the extent of onshore and offshore development that could introduce physical and visual impacts on cultural resources.

Cumulative Impacts of Alternative B. BOEM anticipates cumulative impacts on cultural resources from representative projects due to the extent of onshore and offshore development and extent of known cultural resources in the region subject to impacts. In the context of other reasonably foreseeable environmental trends, the incremental impacts on cultural resources contributed by Alternative B would be noticeable.

3.4.2.6 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Cultural Resources

The analysis of the Proposed Action considers how BOEM's adoption of mitigation measures may avoid or decrease the potential impacts described for Alternative B. The analysis for this alternative is presented as the change in impacts from those discussed under Alternative B. Refer to Appendix E, *Mitigation*, for the list of mitigation measures that make up the Proposed Action. Table 3.4.2.5 summarizes relevant mitigation measures.

Table 3.4.2-5. Summary of mitigation measures for cultural resources

Measure ID	Description
MM-28	The lessee must provide the methods and results of an archaeological survey with its COPs. The lessee will conduct HRG surveys prior to conducting bottom disturbing activities such as geotechnical/sediment sampling and avoid all potentially eligible cultural resources or historic properties. The lessee may only conduct geotechnical exploration activities, including geotechnical sampling or other direct sampling or investigation techniques, in areas of the leasehold in which an analysis of the results of geophysical surveys have been completed for that area by a qualified marine archaeologist. BOEM will establish and lessees must comply with requirements for all protective buffers recommended by BOEM for each marine cultural resource (i.e., archaeological resource and ASLFs) based on the size and dimension of the resource. Protective buffers must extend outward from the maximum discernible limit of each resource and are intended to minimize the risk of disturbance during construction. If an adverse effect cannot be avoided, the lessee will be required to conduct further investigations to minimize or resolve effects on these historic properties, per 36 CFR 800.6.
MM-29	BOEM will establish avoidance criteria for any historic property or any unevaluated terrestrial archaeological resource. Lessees must avoid impacts on all historic properties and unevaluated archaeological resources. If avoidance is not feasible, the lessee must develop a plan to be submitted to BOEM that addresses the adverse effect on the terrestrial archaeological resource. The lessee may submit this plan with the Terrestrial Archaeological Resources Assessment appendix to the COP or may develop this plan in the course of BOEM's project-level NEPA review and Section 106 consultation on terrestrial archaeological resources. Avoidance would entail the development and implementation of avoidance buffers around each historic property and unevaluated resource. If avoidance of an unevaluated resource is not feasible, additional investigations must be conducted for the purpose of determining eligibility for listing in the NRHP.
MM-30	Through consultation, BOEM may request that the lessee financially contributes to a third-party managed compensatory mitigation fund to address visual impacts on aboveground historic properties related to OCS offshore wind activities.
MM-31	BOEM will establish, and the lessees must comply with, monitoring and post-review discovery plans outlining processes to document and review impacts of construction or any seabed-disturbing activities on marine cultural resources. Such plans may be developed in the course of BOEM's project-level NEPA review and Section 106 consultation on marine archaeological resources. A post-review discovery plan approved by BOEM is also required in the event that an unanticipated discovery and/or inadvertent impact of a marine archaeological resource occurs.
MM-32	Lessees should coordinate transmission infrastructure among projects. Where practicable, transmission infrastructure should use shared intra- and interregional connections, have requirements for meshed infrastructure, apply parallel routing with existing and proposed linear infrastructure (including export cables and other existing infrastructure such as power and telecommunication cables, pipelines), and limit the combined footprint to minimize impacts and maximize potential capacity.
MM-39	In coordination with BOEM, the lessee must prepare and implement a scenic and visual resource monitoring plan that monitors and compares the visual effects of the wind farm during construction and operations/maintenance (daytime and nighttime) to the findings in the COP Visual Impact Assessment and verifies the accuracy of the visual simulations (photo and video). The monitoring plan must include monitoring and documenting the meteorological influences on actual wind turbine visibility over a duration of time from selected onshore key observation points, as determined by BOEM and the lessee.

3.4.2.6.1 Impacts of One Representative Project in Each WEA

Overall, programmatic impacts of one representative project on cultural resources under Alternative C would be the same or similar to those for one representative project under Alternative B. At the project level, informed by greater resource and impact information, it may be possible to show changes in impact degree/severity as a result of mitigation measures.

- MM-28 and MM-29 may lead to greater assurances that physical impacts on cultural resources resulting from seabed- or ground-disturbing activities could be avoided by identifying the location of resources and establishing protective buffers.
- MM-30 involves the use of a compensatory mitigation fund, which may mitigate some visual impacts.
- MM-31 may lead to greater assurances that physical impacts on cultural resources resulting seabed-disturbing activities could be minimized by planning the documentation and treatment of any unanticipated discoveries.
- MM-32 involves the use of shared transmission infrastructure among lessees, which could lessen impacts relative to cable installation.
- MM-39 involves the development and implementation of a scenic and visual monitoring plan

As part of compliance with federal and state requirements and the conditions of the leases, offshore wind project applicants are required to conduct requisite cultural resource and historic property identification studies and commit to measures for avoiding, minimizing, or mitigating impacts on identified resources. These are considered standard processes for preconstruction activities. In general, due to the types, extent, and specificity of measures necessary to avoid, minimize, or mitigate impacts on cultural resources and effects on historic properties per Sections 106 and 110 of the NHPA, Alternative C serves to analyze the potential programmatic-level impacts. In addition, COP-specific NEPA and NHPA reviews and consultation are necessary to develop project-specific mitigation measures. These COP reviews would fully determine the extent to which measures listed in Table 3.4.2-5 would be applicable to or could be adopted for addressing impacts on specific cultural resources from specific projects.

Accidental releases: Impacts of accidental releases on cultural resources under Alternative C would be the same as or similar to those under Alternative B. The majority of potential impacts, if any, would be localized and short term in the majority of cases but could be geographically extensive and permanent depending on the number and scale of accidental releases and the proximity to marine archaeological resources, cultural landscapes, TCPs, or ASLFs. Mitigation measures are not likely to change the degree of impact because protective buffers are not feasible for activities that are accidental in nature, and work is unlikely to stop for unanticipated discoveries that occur in the course of cleanup of accidental releases.

Anchoring, cable installation and maintenance, and gear utilization: The impacts of anchoring, cable installation and maintenance, and gear utilization on marine archaeological resources in the course of developing any one of the Humboldt or Morro Bay lease areas under Alternative C would be decreased compared to those under Alternative B depending on the specific protective buffer parameters BOEM establishes in MM-28. At BOEM's discretion, MM-28 could avoid marine cultural resources.

Land disturbance: Impacts of land disturbance on terrestrial archaeological resources and historic aboveground resources from development of any one of the five lease areas would be decreased under Alternative C compared to those under Alternative B. Sufficient development and implementation of COP-specific avoidance measures per MM-29 would reduce impacts on terrestrial archaeological resources.

Lighting: Impacts of lighting on historic aboveground resources from the development of any one of the five lease areas would be similar under Alternative C compared to Alternative B.

3.4.2.6.2 Impacts of Five Representative Projects

Overall, the cultural impacts of five projects would be the same as or similar to those under the single-project scenario. With the exception of MM-32, the extent to which measures listed in Table 3.4.2-5 would or are able to reduce impacts of five projects on cultural resources—both at this and the COP stage—would be the same as described for one project. These and other measures identified in the California PA would avoid or reduce impacts on cultural resources if adopted at the COP stage.

MM-32 could further reduce impacts on cultural resources by having lessees use shared transmission infrastructure or follow parallel routing with existing and proposed infrastructure, where practicable. This would result in the consolidation of export cables from the five projects into a reduced number of cable corridors. Impacts from anchoring, cable installation and maintenance, gear utilization, and land disturbance would be most pronounced if cables from the five representative projects all follow different corridors to different landfalls, requiring seabed disturbance within multiple different cable routes and affecting a larger geographic area. Coordinated offshore transmission infrastructure and cable corridors among the two adjacent Humboldt lease areas or the three adjacent Morro Bay lease areas may reduce the area of seabed disturbance required for cable installation. Any related trenching, vessel anchoring, and survey activities would be conducted in a more localized area. Anchoring, cable installation and maintenance, and gear utilization activities would, therefore, potentially affect fewer marine cultural resources. Consolidation of transmission infrastructure and cable corridors among five representative projects may also reduce the number of landfalls, thereby decreasing potential onshore land-disturbance impacts on cultural resources. However, it cannot be known at this time to what extent lessees would adopt a shared transmission system, and impacts related to shared transmission infrastructure would need to be evaluated once project-specific information is known for each of the five representative projects.

3.4.2.6.3 Cumulative Impacts of Alternative C

Overall, the cumulative impacts of the five representative projects on cultural resources under Alternative C would be the same as or similar to the cumulative impacts described under Alternative B. The extent to which measures listed in Table 3.4.2-5 would or are able to reduce cumulative impacts on cultural resources—both at this and the COP stage—would be the same as described for one representative project.

3.4.2.6.4 Conclusions

Impacts of Alternative C. The construction, O&M, and decommissioning of one representative project, depending on the particular lease area selected for development, would likely result in impacts. The development of a lease area entailing ground or seabed disturbances to a larger area would likely have greater impacts on cultural resources than development of a lease area entailing ground or seabed disturbances within a smaller area. Likewise, the taller the WTG chosen for each lease area, the more likely that project is to result in visual impacts on historic aboveground resources. Impacts of one or five representative projects would be due to the extent of onshore and offshore development that could introduce physical and visual impacts on cultural resources. Adoption of mitigation measures could enable a more consistent process, allowing the future COP-specific NEPA and NHPA reviews, consultations, and plans to be focused on project-specific impacts not considered in the PEIS, or those impacts that warrant further consideration, and may enable greater assurances that impacts on cultural resources could be avoided, reduced, or resolved through measures agreed to by federally recognized Tribes, ACHP, SHPOs, lessees, and other consulting parties. However, at this programmatic stage, more conclusive determinations of the effectiveness of mitigation are not possible, as specific locations of project components—and therefore their impact on cultural resources—have yet to be determined.

Cumulative Impacts of Alternative C. BOEM anticipates cumulative impacts on cultural resources from five representative projects would likely be associated with the extent of onshore and offshore development and extent of known cultural resources in the region subject to impacts. Adoption of mitigation measures could enable a more consistent process, allowing the future COP-specific NEPA and NHPA reviews, consultations, and plans to be focused on project-specific impacts not considered in the PEIS, or those impacts that warrant further consideration, and may enable greater assurances that impacts on cultural resources could be avoided, reduced, or resolved through measures agreed to by federally recognized Tribes, ACHP, SHPOs, lessees, and other consulting parties.

3.4 Socioeconomic Conditions and Cultural Resources

3.4.3 Demographics, Employment, and Economics

This section describes the Affected Environment for demographics, employment, and economics and the relative impacts from the Proposed Action, alternatives, and ongoing and planned activities in the region. The Affected Environment was determined by overlaying the counties where onshore infrastructure and potential ports are likely to be located, as well as the counties closest to the WEAs that may be affected by construction, O&M, and decommissioning of wind energy projects in the Humboldt and Morro Bay lease areas (Figure 3.4.3-1). These counties include Humboldt, Monterey, San Luis Obispo, Santa Barbara, Ventura, Los Angeles, and Orange and are the most likely to experience demographic, employment, and economic impacts, such as beneficial or adverse employment or workforce impacts. Although this section focuses specifically on California, vessels from southern Oregon may fish in and around the Humboldt WEA but land their catch at an Oregon port. Transboundary activity will not be captured. See Section 3.4.1, *Commercial Fisheries and For-Hire Recreational Fishing*, for more information.

This PEIS uses county-level data to provide an approximation of background demographics, employment, and economics in the Affected Environment. While site-specific information about landfalls and onshore facilities is not available at this stage, this PEIS also examines census data around five ports (Humboldt Bay, San Luis, Hueneme, Los Angeles, and Long Beach) anticipated to be used in various stages of construction, O&M, and decommissioning. At the COP-level NEPA analysis, where landfalls, support facilities, and ports are identified, census block–level analyses may be more appropriate.

Contributing IPFs for demographics, employment, and economics are air emissions (impacts anticipated to be highest near port communities), anchoring (vessel anchoring and mooring of wind turbines), cable installation and maintenance (submarine cable installation and onshore connection), land disturbance (due to onshore construction activities); lighting (from vessels or offshore structures), noise (from onshore and offshore construction activities and noise from turbines once installed), port utilization (due to activities associated with ongoing port operations and upgrades); presence of structures (onshore and floating offshore structures), and vessel traffic (including towed arrays/equipment).

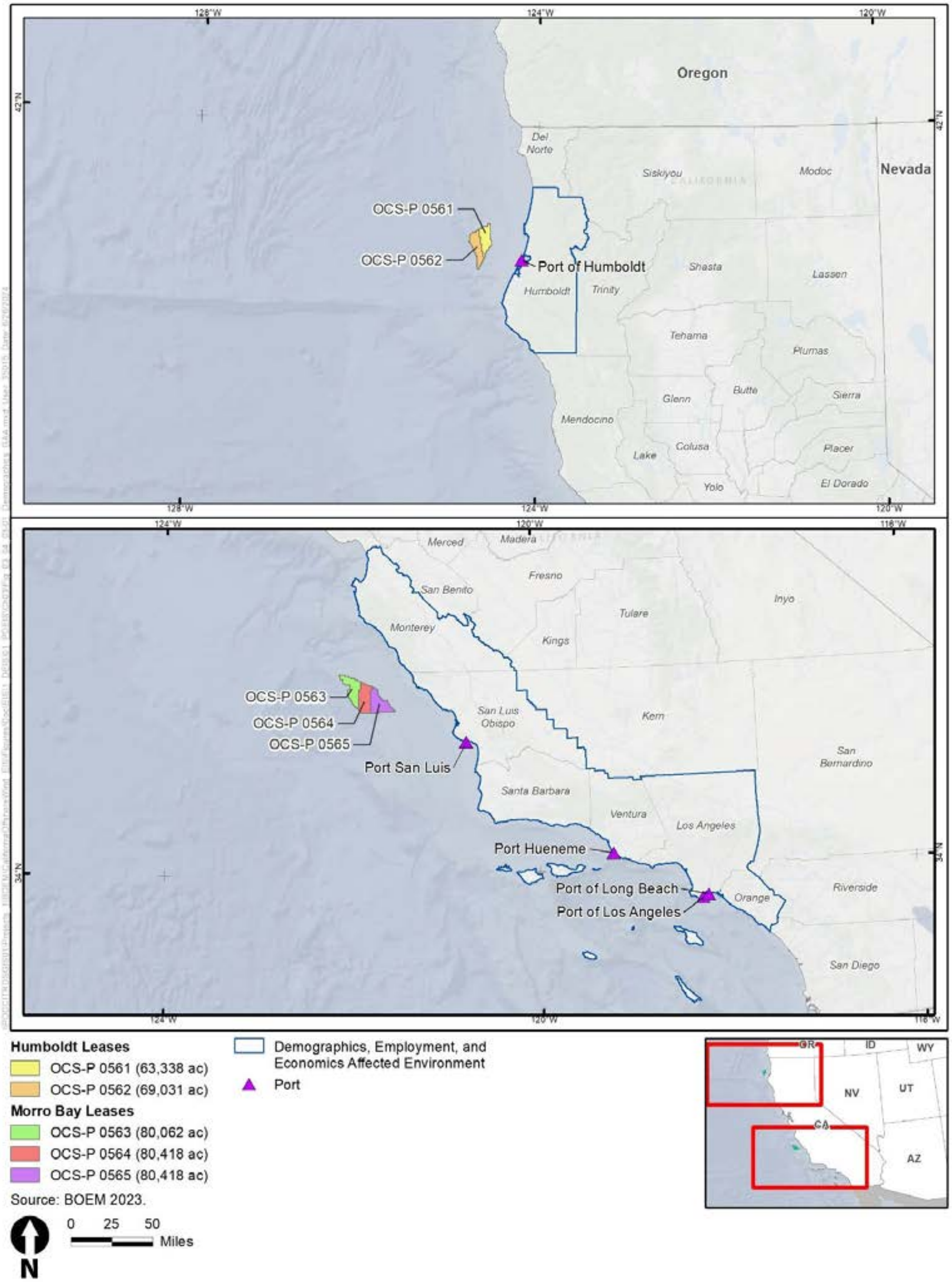

Figure 3.4.3-1. Demographics, employment, and economics Affected Environment

3.4.3.1 Description of the Affected Environment and Baseline Conditions

Table 3.4.3-1 describes the counties in the Affected Environment, including any associated ports.

Table 3.4.3-1. Affected Environment regions, leases, counties, and ports

<table>
<tr><th>Region</th><th>Lease</th><th>County</th><th>Port</th></tr>
<tr><td>Northern California</td><td>0561
0562</td><td>Humboldt</td><td>Port of Humboldt Bay</td></tr>
<tr><td rowspan="3">Central California</td><td>--</td><td>Monterey</td><td>--</td></tr>
<tr><td>0563
0564
0565</td><td>San Luis Obispo</td><td>Port of San Luis</td></tr>
<tr><td>--</td><td>Santa Barbara</td><td>--</td></tr>
<tr><td rowspan="3">Southern California</td><td rowspan="3">--</td><td>Ventura</td><td>Port Hueneme</td></tr>
<tr><td>Los Angeles</td><td>Port of Los Angeles
Port of Long Beach</td></tr>
<tr><td>Orange</td><td>--</td></tr>
</table>

Source: RPDE, Chapter 2.

All seven counties have existing demographic and economic conditions (i.e. population, housing, and employment) potentially affected by the Proposed Action. Monterey, Santa Barbara, and Orange Counties do not have local ports, but are considered home to work forces of counties with ports (San Luis Obispo, Ventura, and Los Angeles). Refer to Appendix C, *Planned Activities Scenario,* for more detailed information regarding ports.

3.4.3.1.1 Employment and Economics

The National Ocean Economics Program provides a tool called Ocean Economy Data that identifies the number of related businesses, employees, wages, and gross domestic product (GDP) per ocean industry sector. For the purposes of this analysis, the percent of employees within each sector for the WEA counties that may be affected by offshore activities are described. The National Ocean Economics Program defines the ocean economy as economic activity that indirectly or directly uses the ocean as an input (NOEP 2007).

Table 3.4.3-2 provides ocean economy employment by county and sector for the year 2020. In the Northern and Central California portions of the Affected Environment, the vast majority of ocean industry employment relates to tourism and recreation. In the Southern California portion of the Affected Environment, ocean industry employment is somewhat more dispersed among sectors, although tourism and recreation also dominate in Ventura and Orange Counties. In Los Angeles County, more than half of all ocean industry employment is in the marine transportation sector. General ocean industry employment in Los Angeles County accounts for over 20 percent of the ocean industry employment statewide.

Table 3.4.3-2. Ocean economy employment (by sector) for selected California counties (2020)[1,2]

Jurisdiction	Marine Construction	Living Resources	Offshore Mineral Extraction	Ship and Boat Building	Tourism and Recreation	Marine Transportation	Compared to State
California	2%	2%	1%	2%	67%	26%	N/A
Humboldt County	-	7%	-	-	87%	1%	1%
Monterey County	-	0%	-	-	95%	2%	3%
San Luis Obispo County	1%	1%	0%	-	94%	1%	2%
Santa Barbara County	0%	1%	0%	-	82%	1%	3%
Ventura County	0%	1%	2%	-	87%	4%	3%
Los Angeles County	3%	4%	1%	0%	38%	51%	21%
Orange County	2%	1%	0%	0%	79%	16%	10%

Source: NOEP 2023.
[1] Employment is based on establishments (defined as places of work). Federal law prohibits the publication of any economic data that could reveal the characteristics of a single establishment. A dash indicates where data failed to screen as confidential or where there are no establishments in the county for that sector. Zero percent indicates a number smaller than 1%.
[2] Percentages for each county do not total 100% due to rounding and the excluded data described in note 1.

Table 3.4.3-3 presents the number of establishments attributed to the ocean industry sector (NOAA 2023) for the counties across the Affected Environment. The number of ocean industry establishments in the counties in the Affected Environment is important in order to understand the number of businesses that may be affected by offshore wind development. Two ocean industry sectors—tourism and recreation and marine transportation—account for the highest number of establishments and employment in the Affected Environment.

Affected Environment port activity is inherent to ocean economy subsector data. For example, vessels providing marine transportation to the lease areas are likely to be docked at a port facility until dispatched to provide transport. Also, in the Affected Environment, activities (financing and permitting) related to port infrastructure expansion are part of the baseline economic landscape.[1] Section 3.4.7, *Navigation and Vessel Traffic*, provides additional information about how potential future port infrastructure enhancements could also be linked to offshore wind development.

[1] See Appendix C, Section C.2.6.1 for additional details on port improvement projects in the Affected Environment. In addition, California State Polytechnical University, Humboldt is laying the groundwork for training an offshore wind workforce (https://now.humboldt.edu/news/offshore-wind-workforce-be-trained-cal-poly-humboldt-yurok-tribe-and-college-redwoods), which is relevant to demographics (education) and employment.

Table 3.4.3-3. Total number of establishments and employment for the ocean industry economy of California and Affected Environment counties (2020)[1]

Geography	Ocean Industry Sector					
	Marine Construction	Living Resources	Offshore Mineral Extraction	Ship and Boat Building	Tourism and Recreation	Marine Transportation
California	301	1,035	408	154	22,160	1,946
Humboldt County	Suppressed	58	Suppressed	Suppressed	307	7
Monterey County	Suppressed	18	Suppressed	0	675	25
San Luis Obispo County	4	14	11	Suppressed	547	13
Santa Barbara County	5	12	31	Suppressed	774	30
Ventura County	5	22	43	Suppressed	860	62
Los Angeles County	71	335	105	14	2,567	693
Orange County	35	50	37	9	2,148	153

Source: NOAA 2023.
[1] Ocean industry employment estimates by NOAA 2023 vary slightly from those of NOEP 2023 (Table 3.4.3-2). Suppressed entries did not contain information from the source.

3.4.3.1.2 Regional Employment

Table 3.4.3-4 summarizes Affected Environment employment data. Employment data were analyzed because offshore wind development is anticipated to bring new jobs, workers, and associated income and tax revenue to the Affected Environment. More than 6 million of the total 18 million jobs in the Affected Environment are in three southern California counties (Ventura, Los Angeles, and Orange), with the remainder distributed among the remaining four counties (State of California Employment Development Department 2023). Per capita annual income in 2022 ranged from $54,043 in Humboldt County to $83,553 in Orange County. The median per capita annual income across the Affected Environment is $70,987, compared to the statewide per capita income of $77,036 (Bureau of Economic Analysis 2022). The counties with the lowest unemployment rate were San Luis Obispo (3.5 percent), Santa Barbara (4.1 percent), and Orange County (3.6 percent). The highest unemployment rate was in Monterey County (7 percent). Additional employment and income data, such as the percent of the population living under the poverty level, are discussed in Section 3.4.4, *Environmental Justice*.

Table 3.4.3-4. Employment (2023), per capita income (2022), and unemployment rate (2023) for California and the Affected Environment counties

Jurisdiction	Total Employment (number of persons)	Per Capita Annual Income ($)	Unemployment Rate (%)
California	18,388,300	$77,036	4.8%
Humboldt County	57,200	$ 54,043	4.6%
Monterey County	202,400	$ 65,123	7%
San Luis Obispo County	131,600	$ 67,951	3.5%

Jurisdiction	Total Employment (number of persons)	Per Capita Annual Income ($)	Unemployment Rate (%)
Santa Barbara County	209,300	$ 75,720	4.1%
Ventura County	395,300	$ 76,375	4.3%
Los Angeles County	4,763,600	$ 74,142	5%
Orange County	1,532,400	$ 83,553	3.6%

Source: State of California Employment Development Department 2023; Bureau of Economic Analysis 2022.

Table 3.4.3-5 summarizes Affected Environment employment rates by workforce sector. The current proportion of employment by sector provides insight into which sectors and workforce may be affected by offshore wind development. Government services hold the highest proportion of workers in Humboldt (25.9 percent), San Luis Obispo (17.6), and Santa Barbara Counties (16.9 percent); farming holds the highest proportion in Monterey County (27.2 percent); private health and education hold the highest proportion in Ventura (13.6 percent) and Los Angeles (19.3 percent) Counties; and professional and business services holds the highest proportion in Orange County (21 percent). Relative to the state as a whole, the Northern and Central California counties in the Affected Environment have higher rates of employment in some key sectors, such as farming (which includes fishing), and leisure and hospitality (which includes recreation). Development and construction of offshore wind facilities may temporarily adversely affect the farming and leisure and hospitality sectors.

Table 3.4.3-5. Percent of California and county employment contribution by sector (2023)

Commercial Sector	California	Humboldt County	Monterey County	San Luis Obispo County	Santa Barbara County	Ventura County	Los Angeles County	Orange County
Farming	2.2%	1.6%	27.2%	4.2%	13.9%	6.1%	0.1%	0.1%
Mining, logging and construction	5.1%	5.1%	3.7%	6.6%	5.0%	4.8%	3.2%	6.8%
Manufacturing	7.3%	4.2%	2.5%	6.5%	6.1%	6.8%	6.7%	10.2%
Wholesale trade	3.6%	1.9%	2.9%	1.8%	2.3%	3.0%	4.2%	5.3%
Retail trade	8.8%	11%	8%	10.3%	8.8%	9.2%	8.5%	9.5%
Transportation and warehousing, and utilities	4.5%	1/9%	1.7%	3%	1.7%	2.1%	4.6%	2.3%
Information	3.0%	0.5%	0.4%	0.9%	2.2%	0.9%	4.1%	1.5%
Financial activities	4.4%	3.0%	2.0%	3.0%	3.3%	3.9%	4.4%	6.8%
Professional and business services	15.1%	5.1%	7.4%	8.5%	13.0%	11.0%	13.7%	21.0%
Private Education and Health Services	16.9%	15.9%	10.8%	14.1%	14.8%	13.6%	19.3%	17.2%
Leisure and Hospitality	10.9%	9.4%	12.6%	15.2%	13.7%	9.7%	11.2%	15.0%
Other services,	3.2%	3.8%	2.7%	2.9%	3.2%	2.5%	3.3%	3.6%
Government	14.2%	25.9%	17.2%	17.6%	16.9%	11.9%	12.2%	10.5%

Source: State of California Employment Development Department 2023.

3.4.3.1.3 Demographics

Population

Table 3.4.3-6 summarizes Affected Environment population data. County population is relevant insofar as understanding relative sizes of county workforces and housing stock and thus better context for the prospective addition of offshore wind development. The most recent total population estimate in the Affected Environment counties is approximately 14.9 million (USCB 2022). Population by county varies widely, from under 150,000 (Humboldt) to over 10 million (Los Angeles) (USCB 2022). Between 2019 and 2022, population growth varied for Affected Environmental counties. Humboldt, Monterey, Santa Barbara, and Orange Counties increased from 2019 to 2020 and slowly declined in 2021 and 2022; San Luis Obispo County decreased from 2019 to 2020, increased slightly in 2021, and decreased again in 2022; and Ventura and Los Angeles Counties decreased between 2019 and 2022 (USCB 2019, 2020, 2021, 2022).

Table 3.4.3-6. Population and trends in the demographics, employment, and economic Affected Environment (2019, 2020, 2021, and 2022)

Jurisdiction	Population (2019)	Population (2020)	Population (2021)	Population (2022)
Affected Environment – State and Counties				
California	39,512,223	39,538,223	39,237,836	39,029,342
Humboldt County	135,558	136,463	136,310	135,010
Monterey County	434,061	439,035	437,325	432,858
San Luis Obispo County	283,111	282,424	283,159	282,013
Santa Barbara County	446,499	448,229	446,475	443,837
Ventura County	846,006	843,843	839,784	832,605
Los Angeles County	10,039,107	10,014,009	9,829,544	9,721,138
Orange County	3,175,692	3,186,989	3,167,809	3,151,184

Sources: USCB 2019, 2020, 2021, 2022

Housing

Table 3.4.3-7 summarizes housing data for the Affected Environment counties. The data indicates some variability in vacancy rates across regions and wide disparity in house values and rents. As of 2020, occupancy rates were 90 percent or greater, except for San Luis Obispo County (87 percent). Vacancy rates in California have been steadily declining over the last decade (USCB 2022), correlating with the steadily increasing population. Median owner-occupied value per unit ranged from $331,300 in Humboldt County to $703,800 in Orange County. Median monthly rents were lowest in Humboldt County ($1,002); all other counties saw median monthly rents at least 50 percent higher, with rents in Orange County ($1,928) nearly twice the rate in Humboldt County (USCB 2020e). Seasonal vacancy rates varied from a low of 14 percent (Los Angeles County) to 61 percent (San Luis Obispo County).

The housing characteristics in Table 3.4.3-7 are important to understand the housing market conditions of Affected Environmental counties. High occupancy rates, and availability or lack thereof of housing near work locations, may have impacts on demographics, such as the development of worker camps as discussed in Section 3.4.3.4.3.

Table 3.4.3-7. Housing characteristics in the demographics, employment, and economic Affected Environment (2020)

Jurisdiction	Housing Units	Occupied (%)	Vacant (%)	Seasonal Vacancy Rate (%)[1]	Median Value (Owner-Occupied)	Median Monthly Rent (Renter Occupied)
Affected Environment – State and Counties						
California	14,392,140	94%	6%	34%	$538,500	$1,586
Humboldt County	62,120	91%	9%	35%	$331,300	$1,002
Monterey County	143,631	92%	8%	48%	$559,400	$1,600
San Luis Obispo County	123,715	87%	13%	61%	$605,200	$1,535
Santa Barbara County	158,279	94%	6%	36%	$610,300	$1,697
Ventura County	293,080	95%	5%	34%	$609,200	$1,854
Los Angeles County	3,591,981	95%	5%	14%	$615,500	$1,534
Orange County	1,129,785	95%	5%	27%	$703,800	$1,928

Sources: USCB 2020b, 2020c, 2020d, 2020e.
[1] Seasonal vacancy rate captures the amount of seasonally vacant homes out of total vacant homes.

3.4.3.2 Impact Background for Demographics, Employment, and Economics

Activities that generate economic activity, such as port maintenance and channel dredging, would generally benefit a local economy by providing job opportunities and generating indirect economic activity from suppliers and other businesses that support activity along coastal areas. Conversely, ongoing activities that disrupt economic activity, such as climate change, may adversely affect businesses, resulting in impacts on employment and wages. Coastal development that leads to gentrification of coastal communities may create space-use conflicts and reduce access to coastal areas and working waterfronts that communities rely on for Tribal, recreation, employment, and commercial or subsistence fishing.

Refer to Table 3.1-1 for definitions of potential beneficial impacts.

3.4.3.3 Impacts of Alternative A – No Action – Demographics, Employment, and Economics

3.4.3.3.1 Impacts of the No Action Alternative

The socioeconomic impact of ongoing activities varies depending on each activity described in Appendix C.

Under the No Action Alternative, baseline conditions (without the Humboldt and Morro Bay lease areas) for demographics, employment, and economics described in Section 3.4.3.1, *Description of the Affected Environment and Baseline Conditions*, are anticipated to continue to follow regional trends at current proportions and respond to IPFs introduced by other ongoing activities.

Ongoing activities, such as oil and gas platform decommissioning, contribute to numerous IPFs, including cable installation and maintenance, which potentially employs local workers but could disrupt vessel traffic patterns; land disturbance, which supports local population growth, employment, and economies but affects the landscape; lighting and noise, which can affect residential and other sensitive populations; port utilization, which can affect jobs, populations, and economies; and vessel traffic, which can affect commercial fishing/shipping and recreation and tourism economies.

Activities that generate economic expansion, such as port maintenance and channel dredging, would generally benefit the Affected Environment economies by providing job opportunities and generating indirect economic activity from suppliers, such as marine transportation companies. Metrics that represent activity along coastal areas, such as number of establishments and employment for ocean industry economy, would likely increase under these baseline conditions. The California Energy Commission released the *Final Commission Report: Assembly Bill 535 Offshore Wind Energy Strategic Plan* (2024) that outlines potential economic and workforce benefits related to the development of offshore wind, such as a $124 million investment at the Port of Humboldt, a $20 million training center, and workforce development that could create 500 annual short-term jobs and 14,000 annual long-term jobs. The report also states that by 2045, upward of $5 billion in state-level GDP could be generated. The Department of Energy describes that wind energy can generate local revenue by reviewing permit applications and preparing the community for construction workers (DOE n.d.). The Department of Energy also asserts that after construction, the revenue can be used to build schools, roads, bridges, and other infrastructure (DOE n.d.).

Conversely, the ongoing process of climate change may adversely affect businesses (e.g., from coping with extreme climate disaster damages or loss of customers due to population migration) and the workforce, affecting employment (Barnard et al. 2021). Over time, the impacts of climate change are likely to worsen problems that coastal areas already face, such as flooding, coastal erosion, and shifts in coastal economies. Coasts are sensitive to sea level rise, changes in the frequency and intensity of storms, increases in precipitation, and warmer ocean temperatures. Sea level rise and increased storm frequency and severity could result in property or infrastructure damage, increased insurance cost, and reduction in the economic viability of coastal communities (Barnard et al. 2021). Impacts on marine life due to ocean acidification, altered habitats and migration patterns, and disease frequency could also affect industries such as tourism and recreation within the total ocean economy that relies on these species.

Under the No Action Alternative, there are no ongoing offshore wind projects in the Affected Environment.

3.4.3.3.2 Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative on existing baseline trends, including other planned activities (without the Humboldt and Morro Bay lease areas).

Planned activities that may contribute to demographics, employment, and economic impacts (further described in Appendix C, Section C.2), are port improvement projects, dredging, and onshore development activities. Ports in the Affected Environment would continue to serve marine traffic and industries and experience periodic dredging and improvement projects to meet ongoing needs. Dredging and port improvements would allow larger vessels to use the ports and may result in increased port use and conversion of surrounding land use if the ports are expanded. Planned onshore development such as commercial and industrial development would contribute to ongoing construction activities and development in the region. Planned onshore infrastructure would be developed in conformance with existing land use regulations. Specific planned development is discussed in Appendix C.

Oil and gas platform decommissioning is another planned activity that will likely occur in the next 5 to 10 years, as described in Appendix C, and may contribute to marine transportation and port utilization impacts.

3.4.3.3.3 Conclusions

Impacts of the No Action Alternative. BOEM anticipates that the No Action Alternative would likely have limited impacts on demographics, employment, and economics in the Affected Environment and beneficial impacts on demographics, employment, and economics from the continued operation of existing sectors in the ocean economy. Under the No Action Alternative, the demographic and economic trends from ongoing activities in the Affected Environment would continue. Tourism, recreation, and ocean-based industries such as marine transportation would continue to be important components of the regional economies.

Cumulative impacts of the No Action Alternative. BOEM concludes there are no other planned offshore wind activities in the region, and that the cumulative impact of ongoing and planned non-offshore wind and onshore activities would likely have limited impacts and beneficial impacts on demographics, employment, and economics under the No Action Alternative. Ongoing and planned non-offshore wind and onshore activities may affect ocean-based employment and economics, primarily because of the continued operation of existing marine industries.

3.4.3.4 Impacts of Alternative B – Development with No Mitigation Measures – Demographics, Employment, and Economics

3.4.3.4.1 Impacts of One Representative Project in Each WEA

Under Alternative B, the development of one representative project in each WEA, without mitigation measures, would result in impacts on demographics, employment, and economics similar to those described in Section 3.4.3.3.2, *Cumulative Impacts of the No Action Alternative*. The discussion below does not repeat the analyses in Section 3.4.3.3.2 but describes where impacts may differ and reiterates the conclusions of those analyses.

Air emissions: Air quality impacts from one representative project in each WEA and emissions from raw material extraction, materials processing, and manufacturing of components (i.e., full life-cycle analysis) have not been quantified. As explained in Section 3.2.1, *Air Quality and Greenhouse Gas Emissions*, one representative project in each WEA would provide long-term minor beneficial impacts on regional air quality to the anticipated extent that wind energy would displace energy produced by fossil-fueled power plants. These beneficial impacts would consist of reductions in air pollutant concentrations, which would lead to reductions in effects on human health in the region. Most emissions would occur temporarily during construction, offshore in the lease area, onshore at the landfall sites, along the offshore and onshore export cable routes, at the onshore substation/converter station, and at construction staging areas. These emissions would be distributed offshore and potentially across regions closest to the lease area and around one or more involved ports. While permitting authorities, including USEPA and states, are responsible for ensuring regulated pollutants do not exceed standards in place to protect human health, construction activities for one representative project in each WEA could nonetheless result in brief periods of intense activity around one or more involved ports, resulting in impacts.

Anchoring: Mooring between 30 and 200 floating offshore wind structures and between 1 and 6 OSSs in each WEA would likely result in impacts. Development of one representative project in each WEA would include the presence of specialized anchor handling vessels to install floating turbine mooring gear (Maritime Executive 2022). If the construction of the offshore wind structures in each WEA were staggered, there would potentially be one vessel conducting anchoring activities in a representative lease area at a time, resulting in a minimal impact on baseline vessel traffic (related to the ocean economy subsectors of Living Resources and Tourism and Recreation). Once the anchor gear is installed, it is unlikely that smaller vessels that home port in the Affected Environment would be displaced from anchoring within or near the array due to extreme water depths (Section 3.4.7), although some impacts of mooring lines suspended in the water column are possible for commercial and for-hire recreational fishing (Section 3.4.1).

Cable installation and maintenance: Installation and maintenance of submarine cable from one representative project in each WEA would likely result in minor impacts, primarily due to the presence of slow-moving vessels (cable-laying vessels) to and from ports in the vicinity of other vessel traffic related to living resources, tourism and recreation, and marine transportation.

Minor beneficial impacts would include potential employment opportunities associated with landside electrical transmission made possible by the Proposed Action cable.[2] Although unlikely, cable installation and maintenance could also affect demographics, employment, and economics through anchoring,

[2] According to the Berkeley Center for Labor Research and Education (Collier et al. 2019), the northern coast region lacks crucial transmission interconnection to the state grid and closing this gap could be an important early source of jobs in the California offshore wind sector.

depending upon the cable route, as there are over 80 anchorage areas along the coastal counties in the Affected Environment, some offshore and many near shore, potentially near potential cable landing sites. Some of these anchorage areas are near small marinas where vessels associated with Living Resources or Tourism and Recreation may typically dock.[3] For a discussion of cable installation and seabed disturbance impacts see Section 3.3.6, *Marine Mammals*. Cable installation could also prevent deployment of fixed and mobile fishing gear from one day up to several months (if simultaneous lay and burial techniques are not used) as addressed in Section 3.4.1.

Land disturbance: Onshore construction activities would likely have a moderate impact on demographics, employment, and coastal California economies, likely lowering the impact during operations. Construction-related impacts associated with land disturbance, such as road construction related to project components, could cause traffic congestion and delays and inconveniences to local businesses, residents, and existing infrastructure. Temporary blockage of roads during construction activities may restrict access to local areas, though it is unlikely that access to specific establishments would be completely obstructed. Decommissioning is not anticipated to create additional land disturbance. Onshore activities could also have the potential for beneficial impacts, such as increased local business employment in construction and related sectors, leading to increased spending in local communities.

Lighting: One representative project in each WEA would result in long-term, minor impacts, primarily as a result of offshore lighting on WTGs and OSSs. Lighting on the WTGs and OSSs is not expected to have a substantial effect on views because of the distance between the WEAs and the shore—the WEA nearest to the Humboldt Bay shore (northern region) is 21 miles (34 kilometers), and the WEA nearest to the Morro Bay shore (central region) is 20 miles (32 kilometers) (Figure 3.4.3-1). One representative project in each WEA would add new sources of light to onshore and offshore areas, including from fixed lighting at onshore substations/converter stations, nighttime vessel lighting during construction and decommissioning, and between 30 and 195 WTGs and between 1 and 6 OSSs (Chapter 2) (BOEM 2021).

As described in Section 3.4.10, *Scenic and Visual Resources*, in the absence of an ADLS system, there would be new, constant sources of nighttime lighting in view of the coastline for one representative California offshore wind project. Nighttime lighting could have long-term impacts on demographics, employment, and economics if the lighting influences resident and visitor housing decisions or participation in marine or coastal activities and, thereby, could influence the ocean economy (e.g., in the Recreation subsector).

Noise: Offshore noise impacts from vessel traffic during construction and maintenance, and from pile-driving, on demographics, employment, and economics would likely be short term and minor. Onshore construction noise could temporarily affect economic activity for businesses near construction sites. The magnitude of onshore noise impacts from the project would be localized but impacts on demographics,

[3] Section 3.4.7 identifies existing vessel anchorages (Figure 3.4.7-4). Lessees would need to consult with the USCG and maritime stakeholders in the event of a cable route bordering or intersecting any anchorage area. This is an unlikely scenario because cable landfalls can be selected to avoid affecting existing anchorages and prevent any impacts on the ocean economy related to this IPF.

employment, and economics would be similar to those of other onshore utility construction activities and would be intermittent, short term impacts.

Port utilization: Port utilization, such as improvements, expansions, or construction activities (e.g., port improvements for the Port of Humboldt Bay Offshore Wind Heavy Lift Multipurpose Marine Terminal and the Port of Long Beach Pier Wind and Deep Draft Navigation projects) could result in short- to long-term impacts on marine transportation. Port utilization during construction and decommissioning is expected to result in short-term, beneficial impacts on demographics, employment, and economics, and long-term, beneficial impacts during O&M.

One representative project's activities would support port investment and employment in the ocean economy and would also support businesses and jobs in the broader commercial sector (Table 3.4.3-2). Multiple port sites would be needed to support one representative project during construction and O&M, including the five ports anticipated in the RPDE (Figure 3.4.3-1). These ports would require a trained/skilled workforce to support offshore wind development, including additional shore-based and marine workers who would contribute to local and regional economic activity (Stefek et al. 2022).

The economic benefits would be greatest during construction and decommissioning when the most jobs and economic activity at ports supporting one representative project would occur.[4] Also, the ocean sector economy would benefit from marine construction and, potentially, ship and boat building preceding the offshore construction activities. During operations, activities would be concentrated at the single representative project's onshore O&M facility and in other ports that may support one representative project-related vessel traffic.

Presence of structures: Offshore structures would likely have impacts on demographics, employment, and economics. One representative project would add between 30 and 195 floating, moored offshore wind structures and between 1 and 6 OSSs, which could, in the short term, affect marine-based businesses (i.e., commercial and for-hire recreational fishing businesses, offshore recreational businesses, and related businesses) through area avoidance due to impacts associated with navigational complexity and marine-based radar limitations near the turbines. Over the long term, local businesses would benefit from fish-aggregation and reef effects and tourism as local operators gain familiarity with safe transit practices through the offshore array (Section 3.4.4).

Vessel traffic: Offshore wind traffic would likely result in short-term, impacts and long-term, beneficial impacts on demographics, employment, and economics in the Affected Environment. Vessel traffic from one representative project could adversely affect marine transportation, commercial/for-hire fishing, and recreational traffic due to associated increased vessel traffic congestion, delays at ports, and a risk of collisions between vessels. Increased traffic would support increased employment and economic activity for marine transportation, which already has the second-highest level of employment in the

[4] Nationwide, the number of projected offshore wind jobs (FTE-year) is pegged to national targets of installed offshore wind capacity (in gigawatts). Average employment levels (FTE-year) from 2024 to 2030 are estimated at 800 and 3,200 based on 25 percent and 100 percent domestic content scenarios, respectively. The domestic content range refers to estimates of labor and materials sourced from the United States (Stefek et al. 2022).

ocean industry sector. Investment in supporting businesses (e.g., shipyards if vessels are built and maintained locally) would generate beneficial impacts in the Affected Environment economy.[5] The highest activity level would occur during the construction phase, lower activity would occur during the decommissioning phase, and the lowest activity would be during the much longer O&M phase.

3.4.3.4.2 Impacts of Five Representative Projects

The types of impacts and mechanisms that affect the demographics, employment, and economics of the Affected Environment (Figure 3.4.3-1) as described for one representative project would be similar for five representative projects but would be distributed across more of the Affected Environment and include a higher level of activity because more projects would be constructed, operated, and decommissioned.

The development of five representative projects, two in the Humboldt WEA and three in the Morro Bay WEA, without mitigation measures, would result in impacts greater than those from one representative project (Shields et al. 2023). Shields et al. (2023) describes that impacts from five representative projects would create a higher level of activity and require more onshore development[6] in the Affected Environment, potentially affecting more establishments and employees within the ocean economy and possibly residents. As such, impacts and beneficial impacts on demographics, employment, and economics may occur.

Impacts may increase directly proportionate to the amount of construction; for example, seabed disturbance associated with cable installation relates directly to the total miles of cable installed for each of the five representative projects. Other impacts may be dependent on the specific construction details of each representative project. For example, the impacts from port utilization for the five representative projects would be highly dependent on the specific ports proposed to be used, their need for improvements, and whether a specific port may be used to serve multiple projects. In addition, if multiple projects are being constructed simultaneously, temporary impacts, such as those associated with traffic and port utilization, could be greater than those identified for one project. If projects are staggered over a longer period, the intensity of the impacts could be less than if multiple projects were constructed at the same time, but the overall duration of the impacts could be longer. Impacts and benefits may increase, but the magnitude of specific impacts would not be known until COPs are developed for each individual project.

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[5] According to an NREL study (Shields et al. 2023) “many of the vessels that could be required for floating wind energy installation and maintenance, such as anchor handling tug supply tugboats, and semi-submersible barges, could be subject to the Jones Act, which requires vessels that transport merchandise between U.S. ports to be U.S.-flagged.” According to this same study, the investment required to build new vessels is significant and closely linked to constraints such as available shipbuilding capacity in the United States and port design to accommodate the new vessel types.

[6] This study uses two deployment scenarios (25 gigawatts and 55 gigawatts) to gauge impacts on jobs and facility investments as wind farm output increases.

3.4.3.4.3 Cumulative Impacts of Alternative B

The construction, O&M, and decommissioning of five representative projects would contribute to impacts on demographics, employment, and economics from ongoing and planned activities in the Affected Environment. Construction and decommissioning of five representative projects that overlap with similar activities for other ongoing and planned projects would result in temporary impacts from increased vessel traffic and offshore construction that may disrupt maritime businesses. It is not likely that onshore export cables, onshore substations/converter stations, and other project-specific onshore facilities associated with the five representative projects would overlap spatially with other projects.

Prospective economic benefits deriving from Alternative B are reasonably foreseeable in coastal California where representative ports and associated commercial sectors (construction, manufacturing, transportation and warehousing and utilities) could provide key employment opportunities as well as explosive community growth as a result of economic expansion. However, high housing costs and low availability are well documented in coastal California communities, resulting in potential adverse effects. Humboldt and San Luis Obispo Counties (northern and central regions, respectively) have relatively low numbers of workers in marine construction and marine transportation, sectors of vital importance to both construction and O&M (Table 3.4.3-2). During the construction phase, it is reasonably foreseeable that in such places, large numbers of workers may need to be brought in from other regions to facilitate construction and O&M activities. To the extent such workers could not find (or afford) temporary lodging in apartments, hotels, etc., the prospect of temporary camps to house workers may be necessary, as has been a frequent practice in extractive industries (e.g., oil, gas, coal) in areas with scarce or no temporary lodging options. Temporary housing camps may pose potential safety risks, particularly to Tribal communities. Concerns regarding these risks derive from the DOI Not Invisible Commission's recommendations to address the disproportionate rate of violence, murder, or missing persons that Tribal communities experience (DOI n.d.). BOEM will ensure safe temporary camps for all users.

The five representative projects and other ongoing and planned projects may rely on the same manufacturing sites and staging and integration sites in the northern, central, and southern regions. It is possible that a particular port, manufacturing site, or staging and integration site capacity may have sufficient flexibility to accommodate more than one project's requirements. Similar efficiencies may be possible at O&M sites. Cumulative impacts would occur if the five representative projects overlap in the use of ports, leading to greater port congestion and greater economic use and employment opportunities.

3.4.3.4.4 Conclusions

Impacts of Alternative B. One representative project and five representative projects would likely have impacts on demographics, employment, and economics and beneficial impacts through job creation and increased business revenue.

Overall, impacts on employment overall are expected to be short term, with potentially short-term impacts due to land disturbance. Effects could be offset by the beneficial effects on the regional economies from increased economic activity and employment associated with the development of offshore wind energy in the regions of greatest port and manufacturing activity. For example, tradeoffs between negative impacts from land disturbance and positive impacts from port utilization would result in an overall beneficial impact on the county economies where lessees conduct activities.

Investments in wind energy could benefit the county and regional economies through the ocean economy subsectors of marine construction, ship and boat building, and marine transportation, whereas adverse impacts on individual businesses and communities would also potentially occur from living resources, tourism and recreation, and marine transportation (due to waterway use conflicts). Short-term increases in noise during construction and decommissioning and the long-term presence of offshore lighting would have impacts on demographics, employment, and economics.

Further quantification and qualification of impacts on demographic, employment, and economics in the Affected Environment due to the development of West Coast offshore wind capacity will be possible when certain variables (e.g., port selection, cable routes, source and types of specialized vessels) become evident.

Cumulative impacts of Alternative B. BOEM anticipates that demographics, employment, and economics from five representative projects would likely have cumulative impacts and beneficial impacts when combined with other ongoing and planned activities. The beneficial impacts are primarily associated with job creation and workforce development, income and tax revenue, and infrastructure improvements generated from five representative projects. Impacts would result from aviation hazard lighting on WTGs, noise, and vessel traffic during construction and decommissioning. Additional effects would result from new cable installation and maintenance and land disturbance such as roadway congestion. However, the prospective need to temporarily house workers who may need to be brought into a region where housing opportunities are scarce could result in adverse effects in certain counties.

3.4.3.5 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Demographics, Employment, and Economics

Alternative C, the Proposed Action, is the prospective adoption of mitigation measures such that the potential impacts described in Alternative B may be avoided or reduced.

While no specific mitigation measures are identified at this time, certain aspects of BOEM's lease process offers mitigative elements relative to demographics, employment, and economics. Specifically, BOEM's lease process for the Humboldt and Morro Bay WEAs includes three types of relevant bidding credits. These bidding credits are for workforce training or supply chain development, a Community Benefit Agreement for lease area use, and a general Community Benefit Agreement for groups expected to be affected by the potential impacts of lease area development that are not otherwise addressed by the lease area use Community Benefit Agreement.

3.4.3.5.1 Impacts of One Representative Project in Each WEA

Although there are no proposed measures specific to demographics, employment, and economics, and BOEM's authority to impose mitigation does not extend beyond the OCS, measures proposed for particular resources may indirectly affect demographics, employment, and economics, such as those measures that reduce onshore noise and land disturbance associated with construction of onshore support facilities or the presence of structure impacts. However, the dynamics of such interactions are complex and not easily quantifiable without project-specific data. For example, onshore construction can have negative impacts on a local community (e.g., noise and additional vehicular traffic from landside construction activities), but may use local labor, supplies, or services that positively affect the same community. Thus, the net impact of any proposed measure on demographics, employment, and economics needs to be assessed when project-specific data are available. Impacts associated with noise and land disturbance would likely be reduced, while all other impacts would remain the same as described under Alternative B.

Because there are no mitigation measures specific to demographics, employment, and economics at this time, impacts would remain the same as described under Alternative B.

3.4.3.5.2 Impacts of Five Representative Projects

Impacts of five representative projects under Alternative C would be the same as those described above for one representative project because there are no mitigation measures specific to demographics, employment, and economics at this time.

3.4.3.5.3 Cumulative Impacts of Alternative C

Under Alternative C, cumulative impacts on demographics, employment, and economics are anticipated to be the same as described for Alternative B.

3.4.3.5.4 Conclusions

Impacts of Alternative C. Under Alternative C, impacts on demographics, employment, and economics would likely remain the same as Alternative B from one representative project and five representative projects.

Cumulative impacts of Alternative C. In the context of reasonably foreseeable environmental trends, the incremental impacts on demographics, employment, and economics contributed by Alternative C would be noticeable. The combination of Alternative C and other ongoing and planned activities would likely result in the same impacts and beneficial impacts on demographics, employment, and economics as Alternative B.

3.4 Socioeconomic Conditions and Cultural Resources

3.4.4 Environmental Justice

This section describes the Affected Environment for environmental justice impacts from the Proposed Action, alternatives, and ongoing and planned activities in the region. The Affected Environment for environmental justice is informed by mapping the counties where onshore infrastructure and potential ports would be located, as well as the counties closest to the lease areas that may be affected by construction, O&M, and decommissioning of wind energy projects in the Humboldt and Morro Bay lease areas (Figure 3.4.4-1). These counties are the most likely to experience environmental justice impacts from these projects, such as beneficial or adverse air quality or employment impacts. Potentially affected counties include Del Norte, Humboldt, Monterey, San Luis Obispo, Ventura, Santa Barbara, Los Angeles, and Orange Counties, California.

Because the locations of onshore components and ports used for prospective projects are not known at this time, precise analysis of environmental justice impacts onshore cannot be conducted. Instead, this programmatic analysis considers the potential for broad impacts on a larger geographical scale.

3.4.4.1 Description of the Affected Environment and Baseline Conditions

Executive Order (EO) 14096, Revitalizing Our Nation's Commitment to Environmental Justice for All, defines *environmental justice* as the just treatment and meaningful involvement of all people, regardless of income, race, color, national origin, Tribal affiliation, or disability, in decision-making that affects human health and the environment. EO 14096 states that environmental justice must be advanced by implementing and enforcing the Nation's environmental and civil rights laws, preventing pollution, addressing climate change and its effects, and working to clean up legacy pollution that is harming human health and the environment. The EO intends to protect individuals from disproportionate adverse human health and environmental impacts and hazards, including climate change, cumulative impacts, and structural or systematic barriers. When determining whether environmental effects are disproportionately adverse, agencies are to consider whether there is or will be an impact on the natural or physical environment that significantly and adversely affects a minority population, low-income population, or Native American Tribe, including ecological, cultural, human health, economic, or social impacts; and whether the effects appreciably exceed those on the general population or other appropriate comparison group (CEQ 1997). By definition, beneficial impacts are not environmental justice impacts; however, this section identifies beneficial effects on environmental justice communities, where appropriate, for informational purposes.

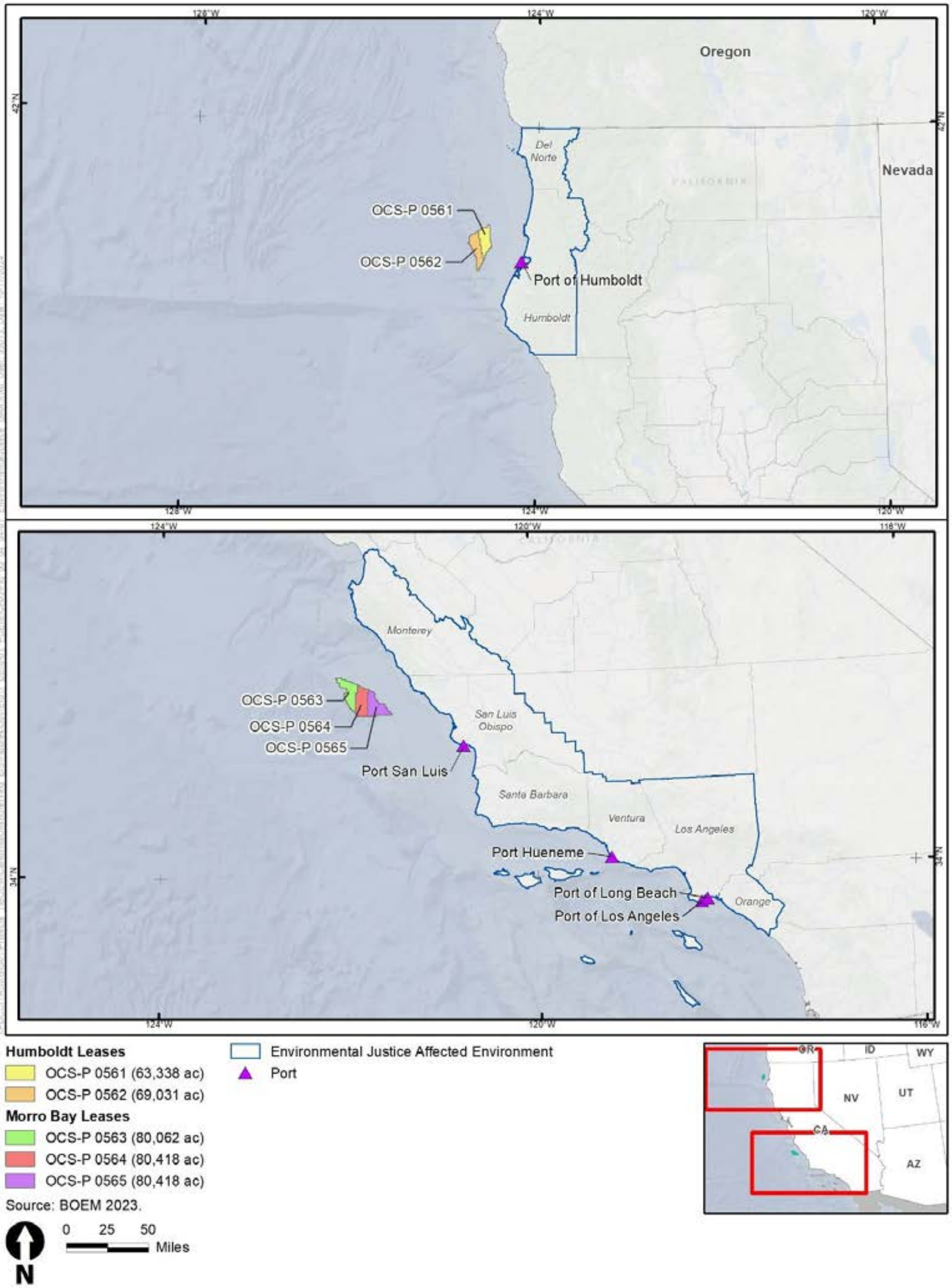

Figure 3.4.4-1. Environmental justice Affected Environment

3.4.4.1.1 USEPA Environmental Justice Community Definition

According to USEPA guidance, environmental justice analyses must address disproportionate adverse impacts on minority populations (i.e., residents who are not single-race white, or not Hispanic) when minority populations comprise over 50 percent of an affected area. Environmental justice analyses must also address affected areas where minority or low-income populations[1] are "meaningfully greater" than the minority percentage in the "reference population"—defined as the population of a larger area in which the affected population resides (i.e., a county, state, or region depending on the geographic extent of the analysis area). CEQ and USEPA guidance do not define *meaningfully greater* in terms of a specific percentage or other quantitative measure. However, for the purposes of this analysis, an environmental justice community is identified and defined under EO 14096 Section 2(b).

This PEIS uses county-level data to provide a first-order approximation of where environmental justice communities are located. While site-specific information about landfalls and onshore facilities is not available at this stage, this PEIS also examines census data around the five ports (Humboldt Bay, San Luis, Hueneme, Los Angeles, and Long Beach) anticipated to be used in various stages of construction, O&M, and decommissioning. At the COP-level NEPA analysis, where landfalls, support facilities, and ports are identified, census block-level analyses may be more appropriate.

3.4.4.1.2 California State Environmental Justice Demographics

Potential effects of this federal action on minority and low-income populations are considered here in accordance with the following EOs:

- EO 12898 (Federal Register 59, no. 32, February 16, 1994), Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, focused federal attention on the environmental and human health effects that federal actions have on minority and low-income populations.
- EO 14008 (*Federal Register* 86, no. 19, February 1, 2021), Executive Order on Tackling the Climate Crisis at Home and Abroad, strived to ensure agencies make achieving environmental justice part of their missions by developing programs, policies, and actions to address the disproportionally high and adverse effects on disadvantaged communities.
- EO 14096 (*Federal Register* 88, no. 80, April 26, 2023), Revitalizing Our Nation's Commitment to Environmental Justice for All, endeavored to advance environmental justice by requiring investing in and supporting communities so that each individual has equitable, safe, and clean access to housing, energy, and transportation.

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[1] Low-income populations are those that fall within the annual statistical poverty thresholds from the U.S. Department of Commerce, Bureau of the Census Population Reports, Series P-60 on Income and Poverty (USEPA 2016a).

CEQ Environmental Justice Guidance Under NEPA (CEQ 1997) has oversight of EO 12898 and NEPA. This guidance was developed to assist federal agencies with their NEPA procedures so that environmental justice concerns are effectively identified and addressed.

Table 3.4.4-1 shows the demographics of Affected Environment counties compared to those of the state of California to determine if such counties may have environmental justice communities. First, U.S. Census data were used to determine the number of persons in environmental justice communities. To better identify more localized, smaller environmental justice communities, USEPA's Environmental Justice Mapping and Screening Tool (EJScreen) was used to construct Table 3.4.4-2 to determine if there are concentrated pockets of minority or low-income populations near specific locations; for this PEIS, the five anticipated ports are used as a proxy for such communities.

Table 3.4.4-1. Low-income and minority populations in the Affected Environment

Jurisdiction	Percentage of Population Below the Federal Poverty Line[1]		Minority Population Percentage[2]	
	2010	2020	2010	2020
State of California	31.6%	25.2%	60.0%	63.5%
Del Norte County	43.0%[3]	34.2%	28.4%[3]	34.0%
Humboldt County	35.4%	39.4%	22.4%	26.0%
Monterey County	34.2%	24.0%	67.4%	70.5%
San Luis Obispo County	28.8%	22.2%	27.4%	30.6%
Santa Barbara County	36.0%	25.8%	51.9%	55.7%
Ventura County	21.4%	17.8%	51.3%	55.0%
Los Angeles County	35.0%	28.4%	72.5%	74.2%
Orange County	24.4%	20.2%	56.0%	60.1%

Source: U.S. Census Bureau 2010, 2020.

[1] California is a high-cost state and therefore uses twice the federal poverty line to determine individuals living below the federal poverty line.

[2] The definition used for minority includes persons who are Black or African American, Asian, American Indian and Alaska Native, Native Hawaiian and Other Pacific Islander, Other, and Hispanic or Latino.

[3] 2012 American Community Survey Census Bureau data were used for Del Norte County; 2010 data were not available, likely due to the county's rural nature.

Table 3.4.4-1 shows that in 2020, 25.2 percent of the population in the state of California was living below the federal poverty line, meaning an income at or below $25,520 (the federal poverty level in 2020 was $12,760, but the poverty threshold in California is twice that); 63.5 percent of the state's population is made up of people meeting one or more minority classifications for the 2020 decennial census. County poverty rates for Del Norte, Humboldt, Santa Barbara, and Los Angeles Counties exceed those of the state in 2020. Monterey and Los Angeles Counties show higher percentages of minority residents than the state. This does not rule out the potential for environmental justice communities to exist in all involved counties.

The communities immediately surrounding each port were analyzed using respective area zip codes within USEPA's EJScreen. The data reveal that Port Hueneme, the Port of Long Beach, and the Port of Los Angeles all have a Hispanic majority population surrounding their respective port. The highest rates of linguistic isolation are found in the port communities where the population has a larger Hispanic population in comparison to other ports. Among the counties where ports are located, the highest rate of poverty is found within Humboldt County, although all port counties' poverty rates are approximately 20 to 40 percent (Table 3.4.4-2).

Table 3.4.4-2. Demographic analysis of port locations

Category	Port of Humboldt Bay	Port of San Luis	Port Hueneme	Port of Long Beach	Port of Los Angeles
Population	**19,118**	**25,537**	**22,156**	**468,759**	**84,077**
White	69.98%	64.68%	31.40%	28.87%	32.33%
Black	3.05%	2.51%	7.21%	12.18%	7.90%
Indigenous	2.52%	0.39%	0.19%	1.21%	0.26%
Asian	4.03%	5.98%	3.84%	12.41%	7.16%
Pacific Islander	0.16%	0.10%	0.53%	0.65%	0.26%
Other	4.78%	3.64%	2.67%	3.16%	3.76%
Hispanic	15.48%	22.69%	54.15%	41.51%	48.40%
Percentage Persons in Poverty	44.66%	43.15%	36.55%	37.82%	32.22%
Linguistic Isolation[1]	2.56%	3.35%	7.07%	7.82%	9.2%

Source: CalEnviroScreen 2023.
[1] Linguistic isolation is defined by the U.S. Census Bureau as living in a household in which all members aged 14 years and older speak a non-English language and also speak English less than "very well" (https://www.cdc.gov/pcd/issues/2006/jan/05_0055.htm).

Ocean Economy Considerations

In addition to determination of environmental justice communities based on race and poverty levels, NOAA provides a tool that identifies stressors on coastal communities that may be affected by offshore activities. For example, in environmental justice communities with high poverty, low-income workers may rely disproportionately on recreational fishing to augment their food supply. They may also be employed by the commercial fishing and supporting industries that provide employment in marine trades, vessel and port maintenance, and marine industries such as marinas or boat yards, boat builders, and marine equipment suppliers and retailers. Due to the lack of subsistence fishing reliance indicators, this analysis uses recreational fishing reliance, as defined by the NOAA social indicator, as a proxy for subsistence fishing reliance.

As noted previously, although the Draft PEIS can supply county-level analyses, the community-level analyses needed for a disproportionate adverse impact assessment must rely on the detailed information found in a COP. NOAA's social indicator index tool identifies environmental justice communities in coastal areas (NOAA 2019). The social indicator mapping uses two metrics to find low-income or minority communities in the Affected Environment that have a high level of recreational or commercial fishing *engagement* or *reliance*, with a higher rank indicating a higher engagement or reliance:

- Commercial fishing engagement measures the presence of commercial fishing through fishing activity as shown through permits, fish dealers, and vessel landings.
- Commercial fishing reliance measures the presence of commercial fishing in relation to the population size of a community through fishing activity.
- Recreational fishing engagement measures the presence of recreational fishing through fishing activity estimates.
- Recreational fishing reliance measures the presence of recreational fishing in relation to the population size of a community.

NOAA's social indicator mapping also provides community stressor data related to labor force, housing issues, and gentrification pressures (NOAA 2019). *Gentrification* is the process of changing the character of a neighborhood from a low-value to a high-value area. Gentrification occurs when there is an influx of more affluent residents and businesses that leads to increasing prices for housing, goods, and services, resulting in the displacement of less affluent existing residents. For this environmental justice analysis, these data provide additional characteristics of communities and are valuable for assessing potential impacts on onshore environmental justice communities. The data on the indicator mapping tool include the following:

- The labor force structure pressure index includes the percentage of the total population and the number of females that are in the labor force, the percentage of those who may be retired, and the percentage of those who are self-employed. These variables characterize the strength and stability of the labor force, with a higher rank indicating higher levels of vulnerability.
- The housing characteristics pressure index measures the average rent and mortgages and median number of rooms. The percentage of mobile homes in a community adds to that characterization as an indication of either temporary or seasonal housing and an indication of socioeconomic status. A high rank indicates more vulnerability.

Gentrification pressure indicators measure factors that, over time, may indicate a threat to the viability of a commercial or recreational working waterfront, including infrastructure. Gentrification pressure indicators measure factors that are related to housing disruption, retiree migration, and urban sprawl.

- **Housing disruption**: Housing disruption represents factors that indicate a fluctuating housing market where some displacement may occur due to rising home values and rents including change in mortgage value. A high rank means more vulnerability for those in need of affordable housing and a population more vulnerable to gentrification.
- **Retiree migration**: Retiree migration characterizes communities with a higher concentration of retirees and elderly people in the population including households with inhabitants over 65 years of age, individuals receiving social security or retirement income, and level of participation in the work force. A high rank indicates a population more vulnerable to gentrification as retirees seek out the amenities of coastal living.

- **Urban sprawl**: Urban sprawl describes areas experiencing gentrification through increasing population density, proximity to urban centers, home values, and the cost of living. A high rank indicates a population more vulnerable to gentrification.

The NOAA tool also assesses community vulnerability to sea level rise and storm surge. These community stressors are a burden on community planning budgets, property values, and, potentially, recovery from storm events.

Where communities experience racial and poverty environmental justice concerns, reliance on offshore fishing industries may be an additional economic concern if affected by offshore wind activities. As discussed in Section 3.4.1, *Commercial Fisheries and For-Hire Recreational Fishing*, multiple communities in the state of California are highly engaged in commercial fishing. Section 3.4.1.1.2 discusses the regional fisheries economic value and landings data over the last decade. To characterize fisheries operating in the vicinity of the Humboldt and Morro Bay leased areas, landings and value data were obtained from the CDFW data portal for the years 2013 to 2022. The section indicates that commercial fishing contributes substantially to regional economies around associated fishing ports.

Counties in the Affected Environment that may not meet federal and state definitions of environmental justice communities may still have census tracts within their borders that do meet the criteria. Figure 3.4.4-2 through Figure 3.4.4-7 highlight the percentage of non-white individuals, the linguistic isolation percentage, and the percentage of poverty found throughout the Affected Environment. San Luis Obispo, Ventura, and Orange Counties do not meet the federal and state definitions of low-income and minority environmental justice communities, but as indicated in Figures 3.4.4-2 through 3.4.4-7, these counties do contain census tracts that can be defined as environmental justice communities. These communities also may be affected by the environmental and social stressors included in NOAA's analysis. Based on 2023 CalEnviroScreen data (CalEnviroScreen 2023), these include the following stressors.

- **San Luis Obispo County**: In addition to racial and poverty concerns, approximately 17.5 percent of the community experiences housing burden, 4 percent of the community experiences unemployment, 28 percent of the population exists at two times below the federal poverty line, and 9 percent of the population over 25 years of age holds less than a high school diploma.
- **Ventura County:** In addition to racial and poverty concerns, approximately 16 percent of the community experiences housing burden, 5.2 percent of the community experiences unemployment, 24.8 percent of the population exists at two times below the federal poverty line, and 15.3 percent of the population over 25 years of age holds less than a high school diploma.
- **Orange County:** In addition to racial and poverty concerns, approximately 18 percent of the community experiences housing burden, 4.6 percent of the community experiences unemployment, 24.4 percent of the population exists at two times below the federal poverty line, and 12.9 percent of the population over 25 years of age holds less than a high school diploma.

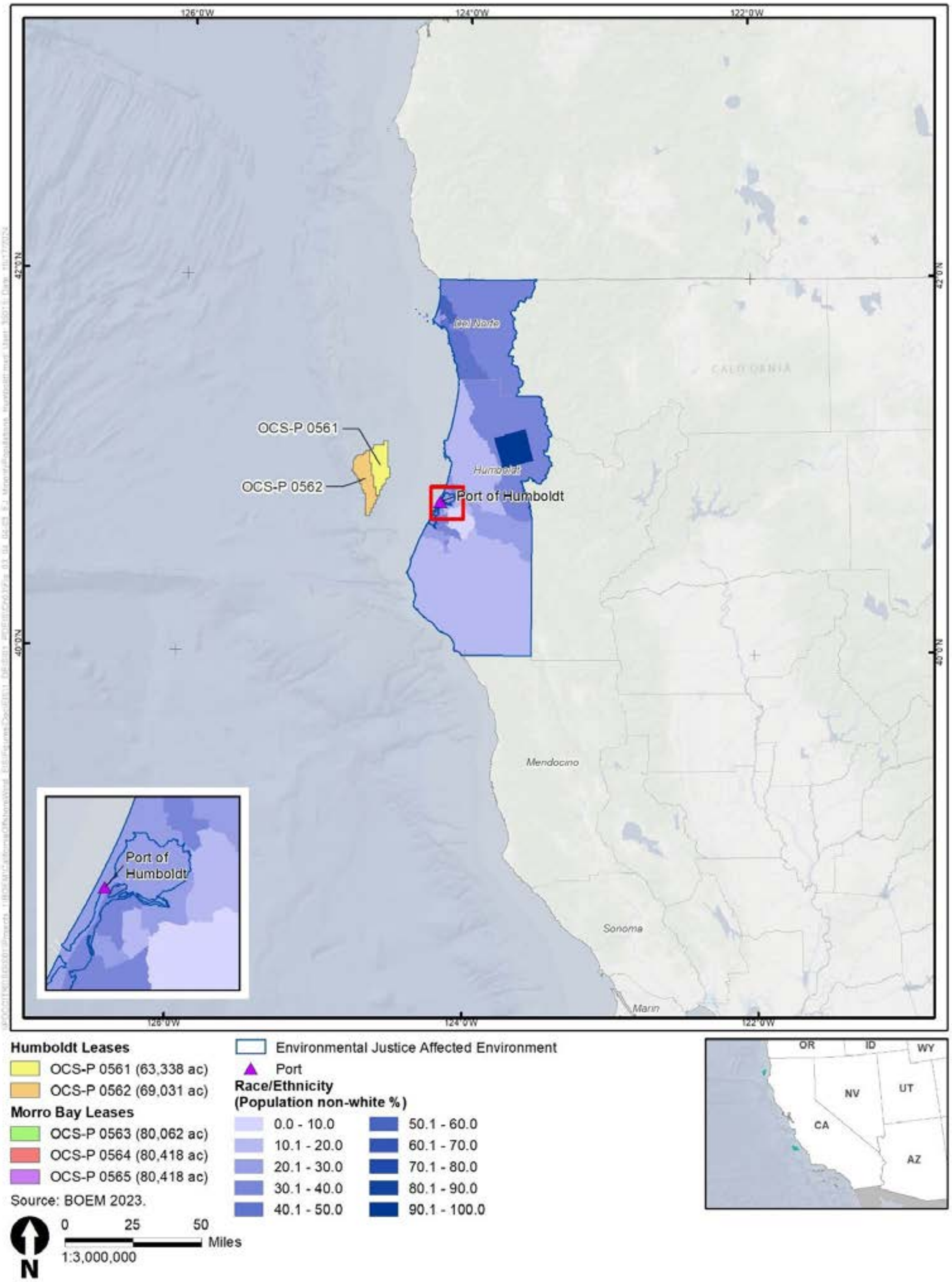

Figure 3.4.4-2. Percentage of non-white population: Humboldt

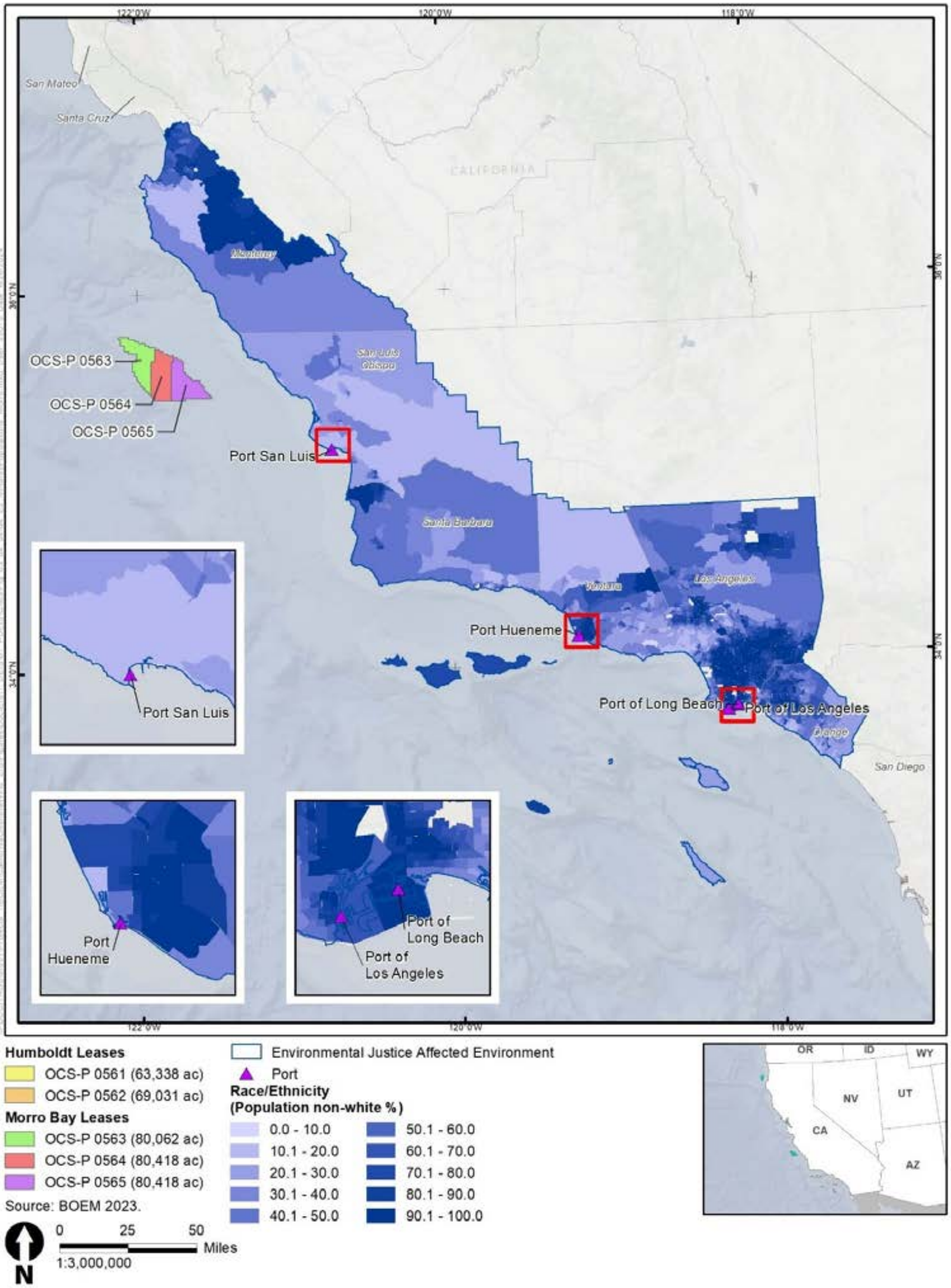

Figure 3.4.4-3. Percentage of non-white population: Morro Bay

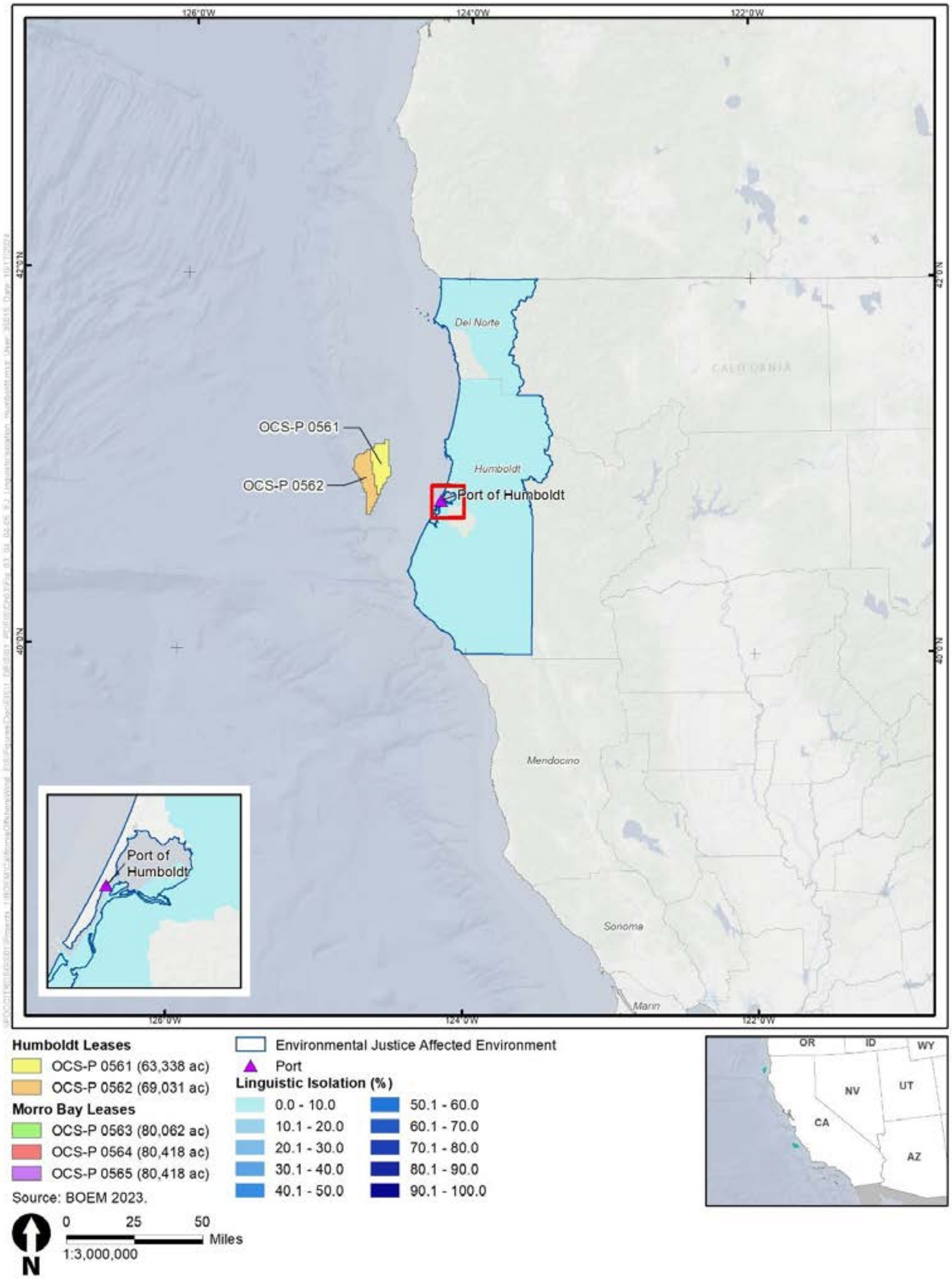

Figure 3.4.4-4. Percentage of those in linguistic isolation: Humboldt

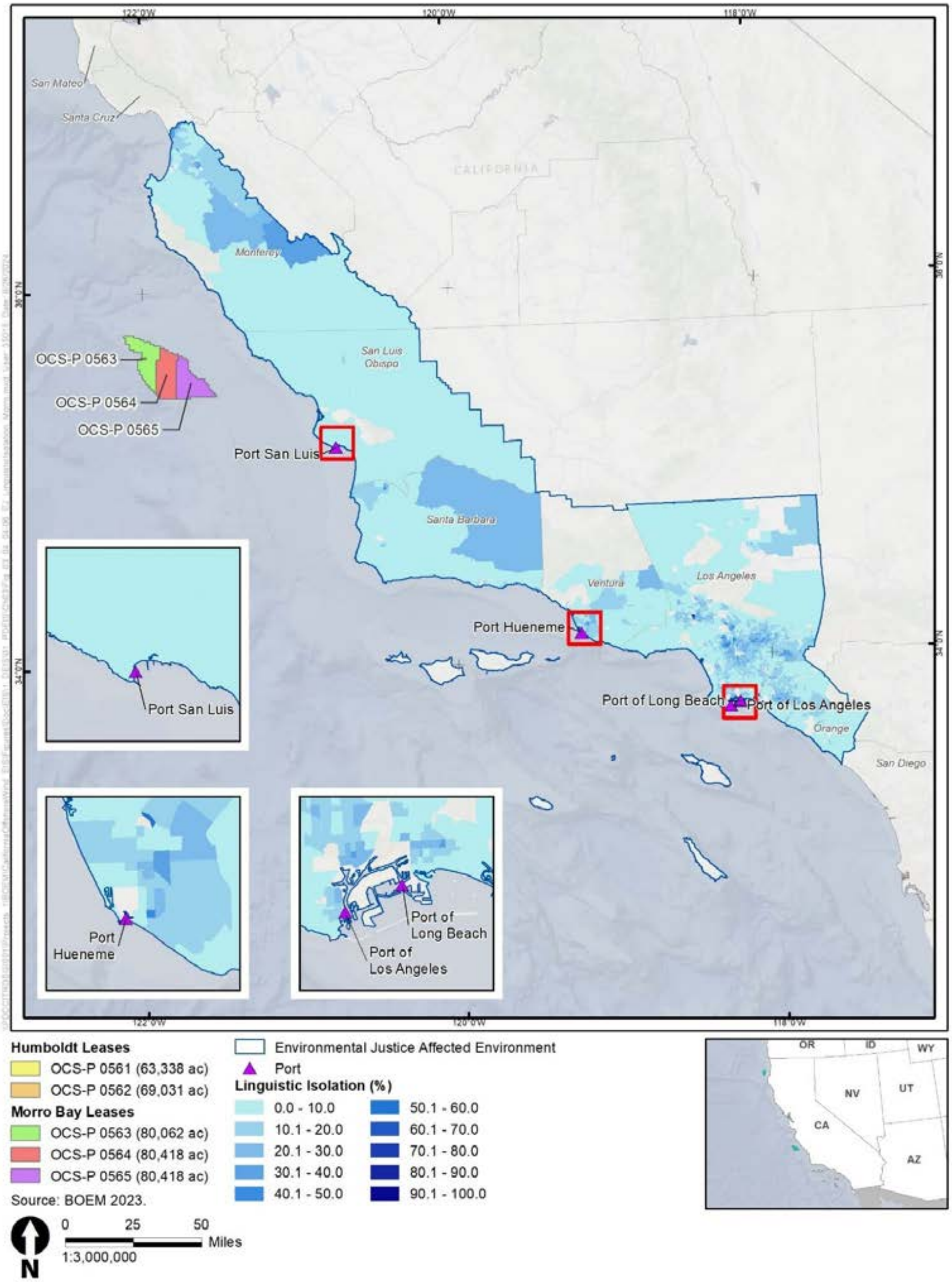

Figure 3.4.4-5. Percentage of those in linguistic isolation: Morro Bay

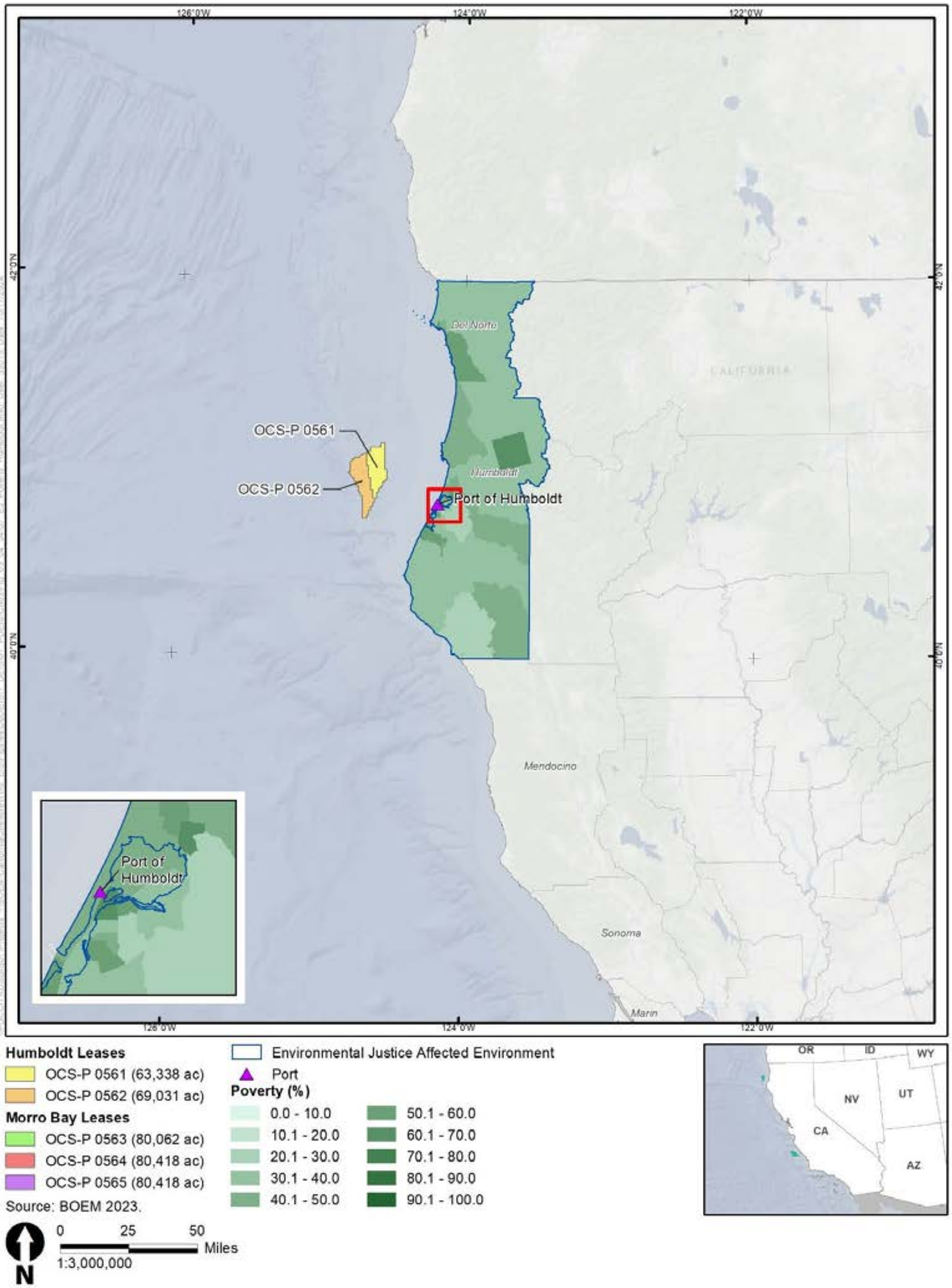

Figure 3.4.4-6. Percentage of poverty: Humboldt

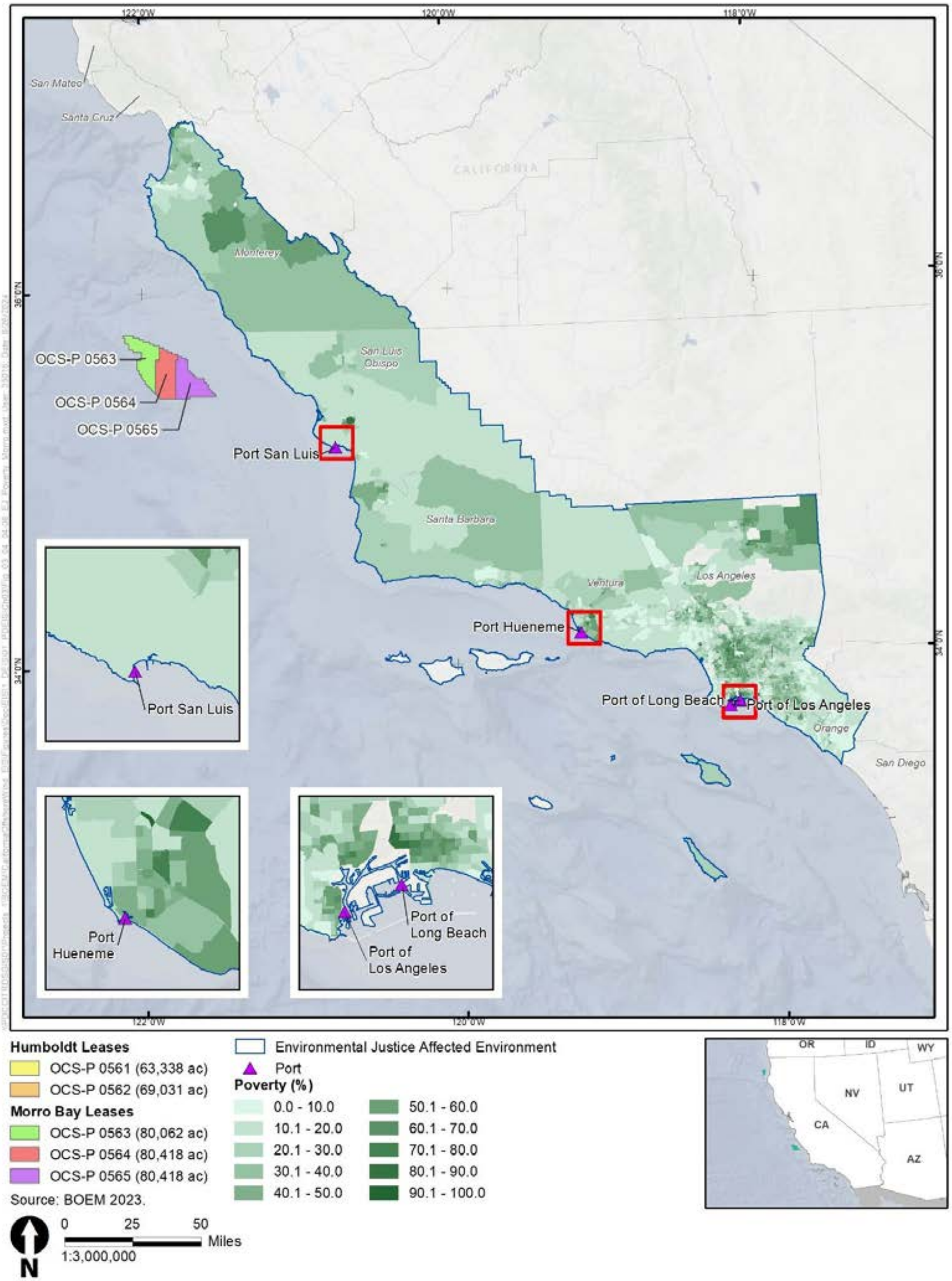

Figure 3.4.4-7. Percentage of poverty: Morro Bay

3.4.4.1.3 Tribal Communities

Environmental justice analyses must also address impacts on Native American Tribes and Indigenous people. Federal agencies should evaluate “interrelated cultural, social, occupational, historical, or economic factors that may amplify the natural and physical environmental effects of the proposed agency action,” and “recognize that the impacts within…Indian Tribes may be different from impacts on the general population due to a community’s distinct cultural practices” (CEQ 1997). Factors that could lead to a finding of disproportionate adverse impacts on environmental justice populations include loss of significant cultural or historical resources and the impact’s relation to other cumulatively significant impacts (USEPA 2016b).

Refer to Appendix D, *Consultation and Coordination*, for a list of federally recognized Tribes BOEM invited to participate in government-to-government consultation and consultation under Section 106 of the NHPA. See Section 3.4.5, *Tribal Values and Concerns*, for an analysis of the geographic extent of the various Tribes’ ancestral and cultural homelands.

3.4.4.1.4 Environmental Justice Engagement

BOEM recognizes that meaningful engagement with environmental justice communities is essential to fully identifying and addressing environmental justice issues, as expressed in CEQ’s Environmental Justice Guidance Under NEPA (CEQ 1997) and the Federal Interagency Working Group on Environmental Justice and NEPA Committee’s guidance (USEPA 2016b). Since the issuance of the Notice of Intent in late 2023, no focused environmental justice outreach has yet occurred but is anticipated for early 2025. Meetings with community leaders and self-identified environmental justice-focused groups began in October 2024 and are planned to continue through the public draft comment period.

Environmental justice communities can also have Indigenous or Tribal affiliations, please refer to Section 3.4.5, *Tribal Assets and Concerns,* for a discussion of meetings and engagement with Tribes.

Additional related outreach conducted since 2021 includes dozens of fishery outreach meetings, which included Fisheries Communications Plan Meetings, CCC 7c working groups, Pacific Fishery Management Council meetings, local community meetings, and BOEM Draft Fisheries Mitigation Guidance meetings.

3.4.4.2 Scope of the Environmental Justice Analysis

To define the scope of the environmental justice analysis, BOEM reviewed the impacts for each resource analyzed in Sections 3.2.1 through 3.4.10 to assess whether the alternatives would result in impacts that have the potential to lead to a disproportionate adverse impact determination given the geographic extent of the impact relative to the locations of environmental justice populations. However, final determinations of disproportionate adverse impacts would need to be based on project-level information at the COP review stage, examined with input from potentially affected communities.

Onshore project infrastructure could be located in areas where environmental justice populations have been identified and could thus affect environmental justice populations. The specific resources and IPFs carried forward for analysis of disproportionately adverse effects in an environmental justice analysis would require project- and site-specific information beyond the scope of the environmental justice assessment in this Draft PEIS. When such detailed information is available, for example in a single lease area's COP, including other planned offshore wind projects, determinations as to whether impacts on low-income and minority populations would be disproportionately adverse would be made.

Offshore activities generally result in only indirect impacts on environmental justice communities. Cable installation and maintenance and construction noise could also contribute to impacts on commercial and recreational fishing. The long-term presence of offshore structures would also have impacts on commercial and recreational fishing and tourism that could affect environmental justice populations. Therefore, impacts of offshore project components are carried forward for analysis under IPFs that include the presence of structures, cable installation and maintenance, and noise. Similar to onshore impacts, more specific analysis of disproportionate adverse effects from offshore activities requires project- and site-specific information beyond the scope of the environmental justice assessment in this Draft PEIS.

Other resource impacts that were concluded to have limited impacts for the alternatives or were unlikely to affect environmental justice populations were excluded from further analysis of environmental justice impacts. This includes impacts related to bats; benthic resources; birds; cultural resources; finfish, invertebrates, and EFH; marine mammals; navigation and vessel traffic; sea turtles; and water quality and wetlands. Future analyses may require site- or project-specific analyses of these resources based on project location, size, and schedule, and based on project-specific input gathered during engagement with environmental justice communities.

3.4.4.3 Impact Background for Environmental Justice

Air emissions, cable installation and maintenance, land disturbance, lighting, noise, port utilization, and presence of structures are contributing IPFs for environmental justice communities. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.4.4-3.

Refer to Table 3.1-1 for definitions of potential beneficial impacts.

Table 3.4.4-3. Issues and indicators to assess impacts on environmental justice

Issue	Indicator
Potential public health and safety impacts (e.g., toxicity of dredged materials, emissions, dust, noise, lighting)	Assessment of impacts on minority and low-income populations from project impacts that could affect public health and safety, including air quality, water quality, noise, and land use impacts
Changes in the economy (e.g., property values, affordable housing availability, tax revenues)	Assessment of impacts on minority and low-income populations from project impacts that could affect the economy
Potential job and income losses due to disruption of ocean and coastal areas (e.g., commercial fisheries, for-hire recreational fishing, recreational fishing/tourism)	Assessment of economic impacts on minority and low-income populations due to project impacts on ocean

Issue	Indicator
or cultural disruption (subsistence fishing and Tribal fishing)	and coastal areas (e.g., commercial fisheries and for-hire recreational fishing and recreation and tourism)
Access to public spaces and the enjoyment of nature	Assessment of impacts on minority and low-income populations from project impacts that could affect access to public spaces or the enjoyment of nature
Impacts on culture and identity (e.g., sense of place)[1]	Assessment of impacts on minority and low-income populations from project impacts that could affect sense of place

[1] *Sense of place* refers to cognitive, affective, functional, and social relationships with and reactions to a spatial setting. It can both evoke and be inspired by place-based concepts of place identity, place attachment, and place dependence (Jorgensen and Stedman 2001).

3.4.4.4 Impacts of Alternative A – No Action – Environmental Justice

When analyzing the impacts of the No Action Alternative on environmental justice, BOEM considers the impacts of ongoing activities on the baseline conditions for environmental justice (there are no ongoing activities on the West Coast). The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative on existing baseline trends, including other planned offshore and non-offshore wind activities, as described in Appendix C, *Planned Activities Scenario.*

3.4.4.4.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for environmental justice would continue to follow current regional trends and respond to IPFs introduced by ongoing activities that have the potential to affect environmental justice populations. Ongoing activities contribute to numerous IPFs, including cable installation and maintenance, which could disrupt fishing; land disturbance, which includes both the adverse impacts of development and beneficial effects that support local population growth, employment, and economies; lighting and noise, which can affect local populations; port utilization, which can affect air quality, jobs, populations, and economies; presence of structures, which can affect fishing, navigation, and coastal views; and marine traffic, which can affect commercial fishing/shipping and recreation and tourism economies. Ongoing activities in the Affected Environment that contribute to impacts on environmental justice communities include growth in onshore development; ongoing installation of submarine cables and pipelines; ongoing commercial shipping; continued port use, upgrades, and maintenance; and ongoing effects from climate change (e.g., damage to property and coastal infrastructure) (see Appendix C for a complete description of ongoing activities).

These activities currently contribute periodic disruptions to environmental justice populations and are typical occurrences in these coastal communities.

The socioeconomic impact of ongoing activities varies depending on each activity. Activities that generate economic activity, such as port maintenance and channel dredging, would generally benefit a local economy by providing job opportunities and generating indirect economic activity from suppliers and other businesses that support activity along coastal areas. Conversely, ongoing activities that disrupt economic activity, such as climate change, may adversely affect businesses, resulting in impacts on employment and wages. Coastal development that leads to gentrification of coastal communities may create space-use conflicts and reduce access to coastal areas and working waterfronts that communities rely on for Tribal use, recreation, employment, and commercial or subsistence fishing. Gentrification also can lead to increased tourism and recreational boating and fishing that provide employment opportunities in recreation and tourism.

As described in Section 3.4.4.1, *Description of the Affected Environment and Baseline Conditions*, social indicator mapping and CalEnviroScreen data indicate approximately 17.6 percent of the households in Del Norte County, 17.5 percent of the households in Humboldt County, 22.5 percent in Los Angeles County, 16.3 percent in Monterey County, 17.4 percent in San Luis Obispo County, 16.2 percent in Ventura County, 18 percent in Santa Barbara County, and 18 percent in Orange County are housing-burdened low-income households. Housing disruption caused by rising home values and rents can displace affordable housing, with disproportionate effects for low-income populations.

Climate Change

Coasts are sensitive to sea level rise, changes in the frequency and intensity of storms, increases in precipitation, and warmer ocean temperatures resulting from climate change. Sea level rise and increased storm frequency and severity could result in property or infrastructure damage, increase insurance costs, and reduce the economic viability of coastal communities. Impacts on marine life due to ocean acidification, altered habitats and migration patterns, and disease frequency would affect industries that rely on these species. The impacts of climate change are likely, over time, to worsen problems that coastal areas already face. Environmental justice communities are likely to be disproportionately affected by climate change and also more likely not to have adequate resources to adapt to climate change impacts.

Table 3.4.4-4 shows the NAAQS status for the applicable criteria pollutants such as O_3, $PM_{2.5}$, and CO for each of the counties surrounding the representative ports. Some of the pollutants are in nonattainment status in those counties, meaning that they exceed the set NAAQS. These include O_3 in Ventura County (Port of Hueneme), O_3 in San Luis Obispo County (Port San Luis) and Los Angeles County (Port of Long Beach, Port of Los Angeles), and $PM_{2.5}$ in Los Angeles County (Port of Long Beach, Port of Los Angeles). Exceeding the standards can cause negative and harmful impacts on the environment and individuals.

Table 3.4.4-4. NAAQS attainment status for representative ports

Port	Port of Humboldt Bay (Humboldt County)	Port of Hueneme (Ventura County)	Port San Luis (San Luis Obispo County)	Port of Long Beach, Port of Los Angeles (Los Angeles County)
Air Pollutant and Current NAAQS Status	O_3 – Attainment	O_3 – Nonattainment	O_3 – Nonattainment	O_3 – Nonattainment
	$PM_{2.5}$ – Attainment	$PM_{2.5}$ – Attainment	$PM_{2.5}$ – Attainment	$PM_{2.5}$ – Nonattainment
	CO – Attainment	CO – Attainment	CO – Attainment	CO – Maintenance

USEPA (2021) examined the degree to which socially vulnerable populations—based on income, educational attainment, race and ethnicity, and age—may be more exposed to the highest impacts of climate in six categories: Air Quality and Health, Extreme Temperature and Health, Extreme Temperature and Labor, Coastal Flooding and Traffic, Coastal Flooding and Property, and Inland Flooding and Property. USEPA (2021) found that minority populations are more likely (compared to non-minority populations) to live in areas that are projected to experience the highest levels of climate change impacts, including increased mortality due to extreme temperatures, childhood asthma diagnoses due to climate-driven changes in particulate air pollution, labor hour losses in weather-exposed industries due to high-temperature days, and increases in traffic delays from climate-driven changes in high-tide flooding. Those with low-income or no high school diploma are approximately 25 percent more likely than non-low-income individuals and those with a high school diploma to currently live in areas with the highest projected losses of labor hours due to increases in high-temperature days.

3.4.4.4.2 Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impact of the No Action Alternative on existing baseline trends, including other planned activities (without any development of the Humboldt and Morro Bay lease areas). Offshore wind is a new industry on the Pacific coast. There are currently no planned offshore wind projects in the region. However, as of summer 2024, prospective WEAs off the Oregon coast are being studied, but have not been leased, and are therefore too speculative to include in analysis. More information can be found in Chapter 2, *Alternatives*. The NOAA Office of National Marine Sanctuaries proposes to designate a portion of the Central California coast and offshore waters, specifically the coast offshore San Luis Obispo and northern Santa Barbara Counties, as the Chumash Heritage National Marine Sanctuary. The Chumash Heritage National Marine Sanctuary Draft EIS (NOAA ONMS 2023) analyzed the potential for the project to result in disproportionate adverse human health or environmental effects on low-income or minority populations and found largely beneficial impacts if the project were adopted. The establishment of a sanctuary in this region may positively affect environmental justice populations through working with Indigenous groups for participation and management and working with local and regional organizations to promote sustainable and equitable tourism, activities, and events. Designation of the sanctuary is anticipated in late 2024 or early 2025.

3.4.4.4.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, environmental justice populations would continue to be affected by existing environmental trends and ongoing activities. BOEM anticipates that the impacts of ongoing activities (including commercial fishing, cable installation, pipeline construction, dredging and port improvement projects, marine minerals use and ocean dredging, military use, marine transportation, and onshore development activities) would have effects on environmental justice populations in the Affected Environment. These are typical, current activities occurring along the California state coastline and would not disproportionately adversely affect environmental justice communities.

Overall, BOEM anticipates impacts on environmental justice populations, largely driven by the effects of climate change and the ability for coastal communities to readily adapt to population migration (housing disruptions), sea level rise, and storm surge threats.

Cumulative impacts of the No Action Alternative. Under the No Action Alternative, ongoing and planned activities may affect ocean-based employment and economics, primarily because of the continued operation of existing marine industries. BOEM concludes the cumulative impact of planned non-offshore-wind development, in combination with ongoing activities, would likely have an impact and beneficial impacts on environmental justice communities.

3.4.4.5 Impacts of Alternative B – Development with No Mitigation Measures – Environmental Justice

3.4.4.5.1 Impacts of One Representative Project in Each WEA

The development of a single project within each WEA, without mitigation measures, would result in impacts similar to those described in Section 3.4.4.4.2, *Cumulative Impacts of the No Action Alternative*, but as further described in the following.

Air emissions: Emissions at offshore locations would have regional impacts, with no potentially disproportionate impacts on environmental justice communities. However, environmental justice populations are present near the ports anticipated for use in construction, O&M, and decommissioning. Most emissions would occur temporarily during construction, offshore in the lease area, onshore at the landfall sites, along the offshore and onshore export cable routes, at the onshore substation/converter station, and at construction staging areas. These emissions would be distributed across areas with and without environmental justice populations. While permitting authorities, including USEPA and states, are responsible for ensuring regulated pollutants do not exceed standards in place to protect human health, construction activities for a single representative project in each WEA could nonetheless result in brief periods of intense activity around one or more involved ports.

Emissions from air quality impacts from a single offshore wind project in each WEA and emissions from raw material extraction, materials processing, and manufacturing of components (i.e., full life-cycle analysis) have not been quantified. As explained in Section 3.2.1, *Air Quality and Greenhouse Gas Emissions*, one representative project in each WEA would provide long-term beneficial impacts on regional air quality to the anticipated extent that wind energy would displace energy produced by fossil-fueled power plants. These beneficial impacts would consist of reductions in air pollutant concentrations, which would lead to reductions in adverse effects on human health in the region.

Table 3.4.4-4 lists the nonattainment areas for criteria pollutants in the counties surrounding the representative ports. One representative project may contribute short-term and temporary impacts on the local environmental justice communities and surrounding areas during construction. However, during operations, installation of offshore wind is expected to have beneficial impacts on environmental justice communities due to improved air quality. In addition to the criteria air pollutants established under the NAAQS, USEPA regulates HAPs such as DPM. DPM is emitted from diesel-powered engines and can be formed from the gaseous compounds emitted by diesel engines. Because of DPM's small size, it is highly respirable and can reach deep into lung tissue. DPM is concerning to environmental justice communities that are at risk for health concerns and are living near construction, as diesel-powered trucks are likely to be used during construction. Section 3.2.1 provides additional DPM details.

Anchoring: One representative project would add floating, moored offshore wind structures, which could affect marine-based businesses such as commercial and for-hire recreational fishing, and offshore recreation businesses. Such businesses may be affected by entanglement and gear loss/damage, navigational issues, risk of allision, fish aggregation, habitat alteration, and space-use conflicts. The wind structures may also cause cultural disruptions to those who rely on subsistence or Tribal fishing during anchoring due to potentially limited access to fishing areas, but beneficial impacts may occur once structures are present due to fish aggregation (from the reef effect, further discussed under the *Presence of Structures* IPF). Environmental justice communities could experience impacts due to potential job and income loss from the anchoring of structures.

Cable installation and maintenance: Impacts from offshore cable installation and maintenance for the project would be localized and short term, primarily affecting commercial fishing and recreational fishing in the Affected Environment. Recreational or subsistence fishing could be locally and temporarily disrupted in nearshore areas, which may cause impacts on low-income individuals who rely on subsistence fishing. Businesses or workers in commercial and offshore recreational fishing would be affected by loss of business during times of cable installation. Impacts on environmental justice populations from cable installation and maintenance for the project would be short term, occurring during cable installation.

Land disturbance: While precise onshore facility locations have not been determined, construction could result in disturbances of communities near cable routes, cable landfalls, and onshore construction sites due to typical construction impacts (e.g., traffic, dust, road disturbances). Recreational/subsistence fishing near onshore construction areas and in proximity to inland water crossings could be temporarily disrupted if construction activities occur close to public fishing sites. BOEM expects project impacts from land disturbance on environmental justice populations by disrupting the normal or routine functions of the affected population only for the period of construction. Impacts of land disturbance on environmental justice populations would be measurable but short term during construction and eventual decommissioning.

Additionally, Section 3.4.3, *Demographics, Employment, and Economics*, Table 3.4.3-5 shows that Humboldt and San Luis Obispo Counties have a low number of workers in the marine construction and transportation industries. During construction, it is reasonably foreseeable that workers may need to be brought in from other regions to facilitate construction and O&M activities. Temporary housing camps, a frequent practice in extractive industries such as oil, gas, and coal, may be necessary if workers cannot find or afford lodging. The potential influx of workers into the region may create a demand for lodging, causing lodging prices to increase, which may result in disproportionate short-term impacts on low-income environmental justice communities in the region.

Lighting: Visible nighttime lighting for transit or construction vessels could occur and disrupt environmental justice communities, especially near the ports or along transit routes for vessels accessing those ports. Active lighting in ports would remain unchanged. However, due to the minimal incremental increase in vessel traffic for the project the impacts of increased lighting from passing vessel traffic would result in impacts on environmental justice communities along transit routes for the port utilized.

Offshore WTGs require aviation warning lighting that would be visible from beaches and coastlines at nighttime. Nighttime lighting could have long-term impacts on recreation and tourism businesses that employ environmental justice populations if the lighting influences visitor decisions in selecting coastal locations to visit. Because of the distance from shore (the lease area nearest to shore is 20 miles [32.2 kilometers] offshore), lighting on the WTGs and OSSs is not anticipated to have a substantial effect on views and therefore would result in impacts on recreation and tourism, industries that support employment especially of people from disadvantaged communities.

Noise: Noise from vessel traffic during maintenance and construction and from pile-driving for the project could drive away or adversely affect individuals or populations of species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities. In turn, this could affect employment and economic activity for members of environmental justice populations that rely on fishing, tourism, and recreation. Impacts would be localized, with potential for more dispersed impacts depending on where members of environmental justice populations who work in fishing and tourism reside. Impacts would be temporary, mainly occurring during construction and decommissioning, with impacts during O&M. Onshore construction noise could temporarily affect residents, possibly also resulting in a short-term reduction of economic activity for businesses near construction sites. The magnitude of onshore noise impacts from the project would be localized, but impacts on environmental justice populations would be similar to those of other onshore utility construction activities and would be intermittent and short term.

Port utilization: Offshore wind development for the project would support the use and expansion of ports and ancillary industries in the state, bolstering investment, employment, and revenue at ports and supporting industries. Environmental justice populations reside close to and have the potential to be affected by activities at, the ports of Humboldt Bay, San Luis, Hueneme, Long Beach, and Los Angeles. In the O&M phase, port activity would be lower than during construction but more consistent. Port utilization from offshore wind may result in beneficial impacts on local economies from the short-term creation of new construction jobs and long-term job creation during the O&M phase, if collective bargaining agreements, project labor agreements, or other guarantees are implemented. Notwithstanding, particularly in lower-population areas like Humboldt Bay and San Luis Obispo County, each of which have relatively few people employed in marine transportation and related fields—and each of which have relatively high housing costs—potential influxes of workers could have certain adverse effects, as further described in Section 3.4.3. Offshore wind project–related influxes of workforces from outside the region could simultaneously result in increased employment activity (beneficial) while also resulting in negative externalities more locally. Increased traffic is anticipated; however, the specific locations are unknown at this time as onshore facilities are not yet identified. The impact from onshore facilities will be analyzed at the COP NEPA stage. To the extent that workforce development and employment initiatives are put into place in such communities, offshore wind construction could result in long-term, beneficial impacts on environmental justice communities.

As discussed for the *Air Emission*s IPF in this section and in Section 3.4.1, increased onshore emissions during construction, and to a lesser extent during the O&M phase, are expected to be small relative to larger emission sources such as fossil-fueled power plants. The project would have to demonstrate compliance with the NAAQS and must demonstrate no impact on air quality–related values as part of its air permitting process.

Presence of structures: Commercial fishing operators, marine recreational businesses, and shore-based supporting services in environmental justice communities could experience both short-term impacts during construction and long-term impacts from the presence of structures that could result in economic impacts. The presence of structures could eventually produce a beneficial impact from their fish-aggregation characteristic. Businesses that would benefit from fish-aggregation and reef effects as a result of the project—such as those that cater to highly migratory species and offshore fishing recreationists—may increase business and catch. The presence of structures as result of the project may result in impacts for environmental justice communities reliant on commercial fishing due to navigational complexities and beneficial impacts on those who participate in or are reliant on recreational/subsistence fishing.

BOEM anticipates there would be no meaningful visual impact on environmental justice communities from the presence of structures. Section 3.4.9, *Recreation and Tourism,* describes currently available studies and the distance of the project from shore (the lease area nearest to shore is 20 miles [32.2 kilometers] offshore). BOEM anticipates that the project would be unlikely to affect shore-based or marine recreation and tourism businesses that are a source of employment for environmental justice populations. Additionally, because visual impacts from the presence of structures are not anticipated to have meaningful impact across the environmental justice Affected Environment, impacts are not likely to disproportionally affect environmental justice communities.

3.4.4.5.2 Impacts of Five Representative Projects

The same types of IPFs, impacts, and mechanisms that affect the environmental justice populations in the Affected Environment as described for one representative project would apply to five representative projects. There would be the potential for greater impacts associated with these IPFs due to the greater level of activity under five representative projects (Shields et al. 2023). If multiple projects are being constructed at the same time, temporary impacts associated with construction could be greater than those identified for one representative project. If projects are staggered, some impacts may be less intense but last for a longer period.

3.4.4.5.3 Cumulative Impacts of Alternative B

The construction, O&M, and decommissioning of both onshore and offshore infrastructure for offshore wind activities across the Affected Environment would also contribute to the primary IPFs of air emissions, cable installation and maintenance, land disturbance, anchoring, lighting, noise, port utilization, and presence of structures. In the context of reasonably foreseeable environmental trends and planned activities, there could be a range of cumulative impacts of five representative projects. The magnitude and extent of impacts would largely depend on whether the projects are staggered or concurrent. For example, if all five representative projects were to use the same or adjacent ports at similar times, there would be short-term increases in vessel and vehicle traffic near ports, which could affect members of environmental justice populations who live near, or work at, the ports, and result in increases in air emissions near environmental justice communities that could result in health impacts. If the projects are not concurrent, or if multiple ports are used, these same impacts on traffic and air emissions may not be detectable. The economic viability of some coastal environmental justice communities is dependent on tourism, recreation, and fishing industries. Alternative B would contribute to the cumulative impact on recreational fishing from the combination of the project and planned activities (including offshore wind activities) that could affect local economies and environmental justice.

3.4.4.5.4 Conclusions

Impacts of Alternative B. Construction, installation, and decommissioning of Alternative B would likely have impacts on environmental justice communities, depending on the port locations, the timing of construction, and the proximity to fishing or recreation/tourism areas that might affect local economies. Noise impacts would be temporary, primarily during the construction phase. Land disturbance impacts would also occur primarily during construction and would be localized and temporary. Emissions impacts are expected to be temporary during construction but result in long-term beneficial impacts from replacement of fossil-fuel energy-generation emissions.

The presence of structures may have impacts on environmental justice communities who rely on fishing industry jobs and revenues, depending on the timing of construction and the siting of structures and their potential to disrupt recreational and commercial fishing operations. Any long-term impacts on jobs and revenues would remain for as long as the structures are present.

The environmental justice communities that may be affected by the project are dynamic and diversified. In the context of the region's ongoing levels of economic and employment activity, BOEM expects slight changes, with mostly temporary and largely indirect impacts affecting the region's environmental justice communities. BOEM also expects there may be opportunities for beneficial impacts from port expansion and utilization for environmental justice communities resulting from positive contributions to employment and revenue from offshore wind energy development activities.

In addition, the potential long-term health benefits associated with displacement of energy produced by fossil-fueled power plants would have beneficial effects on the health of environmental justice populations if the source of current health issues is related to fossil-fuel power plants.

Cumulative impacts of Alternative B. BOEM anticipates that there would be cumulative impacts on environmental justice communities in the Affected Environment under the project. In context of reasonably foreseeable environmental trends, the incremental impacts on environmental justice communities contributed by the project would likely be noticeable.

BOEM does not anticipate any significant changes to the region's environmental justice communities and expects beneficial impacts on regional or ocean industry–related employment, unemployment, or persons living below the poverty level in the Affected Environment (Section 3.4.3).

The potential long-term benefits for environmental justice communities depend on the state, local governments, and the offshore wind industry targeting workforce development and jobs for the benefit of environmental justice community residents. The affected coastal counties would continue to rely economically on marine transportation and tourism and recreation, more so than the inland counties in the Affected Environment that have more diversified economic bases. Environmental justice communities may indirectly experience temporarily increased economic activity through industries peripheral to the offshore wind development (e.g., housing, transportation, and restaurants for temporary workers) during the construction and installation phases and a lower level of increased economic activity over the long-term O&M phase of offshore wind energy production.

3.4.4.6 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Environmental Justice

Alternative C, the Proposed Action, is the prospective adoption of mitigation measures such that the potential impacts described in Alternative B may be avoided or reduced. The analysis of Alternative C considers the change in impacts relative to Alternative B. Appendix E, *Mitigation*, identifies mitigation measures that may be included as part of the Proposed Action. Table 3.4.4-5 describes the mitigation measures relevant to environmental justice.

Table 3.4.4-5. Summary of mitigation measures for environmental justice

Measure ID	Measure Summary
MM-25	This measure requires lessee to develop an Environmental Justice (EJ) Communications Plan, in collaboration with communities that have environmental justice concerns. The plan should aim to outline how the lessee will communicate with environmental justice communities. The plan should be developed in consultation with community leaders and community organizations who work with environmental justice communities. Plans should be specifically designed for environmental justice populations and advance meaningful engagement based on each affected community's unique communication and information needs. Environmental justice populations should be identified by any applicable federal and state-level environmental justice and related screening tools, or other relevant local information.
MM-26	This measure requires an Environmental Justice Impact Mitigation Plan to be developed with communities that have environmental justice concerns. The plan must acknowledge existing regulations (such as noise control) that may help mitigate impacts. The plan should outline procedures for responding to reported impacts, detailing the actions the lessee will take. During the development of this plan, BOEM encourages the lessee to engage with other stakeholders.

3.4.4.6.1 Impacts of One Representative Project in Each WEA

Specific details and impacts are not currently known, and may not be quantifiable until project- and location-specific data are known. For example, onshore construction can have negative impacts on a local community (e.g., from noise and traffic). MM-25 and MM-26 are the development of plans for future actions, and as such, the impact of MM-25 and MM-26 on environmental justice communities needs to be assessed when project- and location-specific data are available. Alternative C impacts would remain the same as described for Alternative B, as described in Section 3.4.4.5.4.

3.4.4.6.2 Impacts of Five Representative Projects

Impacts of five representative projects under Alternative C would be expected to be similar to those for one representative project in each WEA. The impact of MM-25 and MM-26 on environmental justice communities needs to be assessed when project- and location-specific data are available. Impact levels would remain the same as projected for Alternative B, as described in Section 3.4.4.5.4.

3.4.4.6.3 Cumulative Impacts of Alternative C

Under Alternative C, cumulative impacts on environmental justice communities are anticipated to be the same as described under Alternative B.

3.4.4.6.4 Conclusions

Impacts of Alternative C. Under Alternative C, impacts on environmental justice communities would likely remain the same as those of Alternative B.

Cumulative Impacts of Alternative C. In context of reasonably foreseeable environmental trends, the incremental impacts on environmental justice communities contributed by Alternative C would be noticeable. The combination of Alternative C and other ongoing and planned activities would likely result in the same impacts and beneficial cumulative impacts on environmental justice communities as Alternative B.

3.4 Socioeconomic Conditions and Cultural Resources

3.4.5 Tribal Values and Concerns

Many Tribes have ancestral ties and current connections to lands, offshore areas, and marine ecosystems along the northern and Central California coasts. Tribes' connections to these regions include their traditional and ancestral homelands, customary uses of terrestrial and marine resources for food and cultural connections, and stewardship of resources and ecosystems within their ancestral homelands and waters (Cordero et al. 2016; Van Pelt et al. 2017). Coastal landscapes and seascapes, including viewsheds, are important components of Tribes' relationships to these regions. Moreover, before the last rise in sea levels, the coastline of the region extended beyond the present-day coast to include now-submerged areas that were likely inhabited by ancestors of California Tribes.

BOEM, as an agency under the Department of the Interior, has a trust responsibility to consult with federally recognized Tribes whenever there is a Departmental Action with Tribal Implications (DOI 2022). Additionally, particularly in California, non-federally recognized Tribes have interests in prospective offshore wind development off both Humboldt and Morro Bay. This assessment of potential impacts on resources of Tribal value and concern is informed by communications between Tribes and BOEM through numerous informational and consultation meetings broadly relating to energy development offshore California over several years. Issues raised by Tribes during these meetings included: impacts on the marine environment and dependent species; disruption to marine species, particularly during migration; impacts on cultural resources; and impacts on submerged archaeological resources (BOEM and California Energy Commission 2021).

BOEM invited the following 22 federally recognized Tribal Nations to consult and participate as a cooperating Tribal Nation in the preparation of this PEIS.

- California Tribal Nations
  - Bear River Band of Rohnerville Rancheria
  - Big Lagoon Rancheria
  - Blue Lake Rancheria
  - Cher-Ae Heights Indian Community of the Trinidad Rancheria
  - Elk Valley Rancheria, California
  - Hoopa Valley Tribe
  - Karuk Tribe
  - Pulikla Tribe of Yurok People (formerly Resighini Rancheria)
  - Quartz Valley Indian Community
  - Redding Rancheria

- Santa Rosa Rancheria Tachi-Yokut Tribe
  - Santa Ynez Band of Chumash Indians
  - Tolowa Dee-Ni' Nation
  - Tule River Indian Tribe
  - Wiyot Tribe
  - Yurok Tribe
- Oregon Tribal Nations
  - Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians
  - Coquille Indian Tribe
- Washington Tribal Nations
  - Hoh Indian Tribe
  - Makah Tribe
  - Quileute Tribe
  - Quinault Indian Nation

BOEM further identified potential consulting parties pursuant to 36 CFR § 800.3(f) through December 19, 2023, letter to non-recognized Tribal governments, certified local governments, historical preservation societies, and museums, which solicited public comment and input regarding the identification of, and potential effects on, historic properties for the purpose of obtaining public input for the Section 106 review (36 CFR § 800.2(d)(3)) and invited them to participate as a consulting party.

BOEM received eleven letters providing comments on its NOI for this PEIS. BOEM has subsequently convened numerous meetings (including government-to-government consultations) to receive feedback from Tribes. Table 3.4.5-1 summarizes Tribal concerns expressed to BOEM in NOI comment letters.

Table 3.4.5-1. Summary of Tribal concerns regarding prospective offshore wind energy development

Topic	Summary
Tribal, cultural, and natural resources	Ten Tribes raised concerns about the natural importance of the proposed development areas. Several Tribes emphasized the need to protect Tribal cultural resources and landscapes. Several Tribes highlighted the significance of their ancestral territory and the need for awareness of significant sites and landscapes. Three Tribes expressed concerns about potential impacts to viewsheds and ways to mitigate visibility of wind energy development from sacred places and addressing historic properties concerns.
Environmental and biodiversity impacts	Several Tribes stated concerns about environmental impacts, including on wildlife and biodiversity. One Tribe mentioned the need for vibration and sound studies and a fish population census. One Tribe raised concerns about the potential electromagnetic impacts of wind energy development and potential impacts on marine species.
Climate change and resilience	Three Tribes expressed concern regarding climate change and its potential impacts on ecosystems. One Tribe also stressed the importance of long-term studies on climate

Topic	Summary
	change and resilience, while three Tribes highlighted the need for decarbonization efforts.
Treaty rights and ancestral territory	Three Tribes expressed concerns about Treaty rights and the potential impact of the proposed development on their sovereignty, ancestral territories, and related cultural and natural resources.
Adaptive management and transparency	One Tribe highlighted the importance of incorporating Traditional Ecological Knowledge and called for adaptive management and data transparency. This Tribe also stressed the need for research and oversight. Two Tribes echoed these concerns and also emphasized the need for public engagement and transparency.
Socioeconomics and technology	One Tribe acknowledged potential community benefits of wind energy development and stressed the importance of meeting equity requirements. Two Tribes echoed these concerns and highlighted the need for consideration of sensitive areas and technological advancements and best practices. One tribe also mentioned the importance of addressing environmental justice and socioeconomic impacts. One Tribal citizen expressed concern about the potential impacts on their commercial fishing company.
Tribal capacity to participate in environmental process	Several Tribes expressed concern about their Tribe's capacity and technical expertise to review proposed activities associated with construction and operation of commercial offshore wind facilities and meaningfully participate in the process.

3.4.5.1 Description of the Prospective Affected Environment

BOEM must consider the following broad cross-section of Tribal values and concerns when describing the prospective Affected Environment.

- Ancestral and cultural homelands, including tangible and intangible cultural heritage resources (e.g., grave sites, sacred sites, plant gathering areas, and locations that embody a Tribe's worldviews and are memorialized in stories, songs, customs, traditions, beliefs, and ceremonies, such as seascapes and open ocean).
- Customary uses of terrestrial and marine resources for food and cultural connections, and stewardship of resources and ecosystems within Native American and Indigenous Ancestral homelands and waters.
- Viewsheds of cultural and spiritual significance.
- Migratory species of cultural, spiritual, and economic importance
- Sacred Lands such as Morro Rock, Western Gate/Humgag (Point Conception), and Point Estero.

Pending further engagement and consultations with Tribes, BOEM does not at this time have enough information to fully delineate a Tribal concerns and values Affected Environment inclusive of all areas potentially subject to effects from offshore wind development in the Humboldt and Morro Bay WEAs.

BOEM will consider the geographic extent of the various Tribes' ancestral and cultural homelands, as defined in the Environmental Assessments prepared for Commercial Wind Lease, Grant Issuance, and Site Assessment for the Humboldt WEA (BOEM 2022a) and Morro Bay WEA (BOEM 2022b), to facilitate further ongoing discussions with Tribal Nations. Collectively, these Tribal regions span marine, coastal, and inland areas that intersect or encompass the Humboldt and Morro Bay lease areas, as well as submerged areas in between. Additionally, Tribes along the Washington coast with adjudicated treaty fishing rights offshore have expressed concern that wind energy development offshore California may affect the California Current ecosystem and, in turn, species of cultural, economic, and spiritual importance.

Although the PEIS assumes inland areas may be affected by offshore wind development, BOEM has not identified any specific onshore facilities at this programmatic stage. Moreover, while BOEM assumes ports would be used in all stages of wind energy development, the PEIS does not contemplate any specific improvements to any port. BOEM has invited consultations with Tribal Nations and seeks to analyze the adoption of potential mitigation measures for avoiding or reducing significant impacts on resources of Tribal value and concern. During future COP-specific NEPA and NHPA reviews, BOEM also will include Tribal Nations in reviewing and assessing reports and technical analyses pertinent to issues of Tribal value and concern and will invite Tribes to participate in the environmental review process as a cooperating Tribal Nation.

At this time, however, the following other sections of the PEIS define the Affected Environment by resource. Collectively, these Affected Environments encompass some of the areas of concern discussed above.

- Section 3.3.2, *Benthic Resources*
- Section 3.3.4, *Coastal Habitat, Fauna, and Wetlands*
- Section 3.3.5, *Fishes, Invertebrates, and Essential Fish Habitat*
- Section 3.3.6, *Marine Mammals*
- Section 3.4.1, *Commercial Fisheries and For-Hire Recreational Fishing*
- Section 3.4.2, *Cultural Resources*
- Section 3.4.3, *Demographics, Employment, and Economics*
- Section 3.4.4, *Environmental Justice*
- Section 3.4.7, *Navigation and Vessel Traffic*
- Section 3.4.10, *Scenic and Visual Resources*

For subsequent project-specific COP-level analyses, BOEM expects each lessee to identify relevant Tribal values and concerns for a particular lease area through its own direct engagement with affected Tribes. Tribal values and concerns may also be identified through BOEM's ongoing government-to-government consultations with Tribal Nations. Contributing IPFs to impacts on resources of Tribal value and concern include accidental releases (e.g., fuels, hazardous materials, trash), anchoring, cable installation and maintenance, gear utilization, land disturbance, lighting, noise, port utilization, presence of structures, and vessel traffic. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.4.5-2. Further, Tribal engagement may yield additional issues of concern or contributing IPFs.

Table 3.4.5-2. Issues and indicators to assess impacts on resources of Tribal value and concern

Issue	Impact Indicator	Relevant IPFs
Bottom disturbance and entanglements impacts	Assessment of impacts on archaeological resources and submerged landforms of Tribal concern subject to physical impacts from activities occurring in offshore areas. Assessment of impacts on marine biological resources and ocean systems (e.g., upwelling) resulting from benthic disturbance and marine species entanglements.	Accidental releases, anchoring, cable installation, gear utilization
Port improvements	Assessment of impacts from future port improvements that may be associated with specific lease areas in the larger context of standalone, ongoing improvement projects (such as the Humboldt Bay Offshore Wind Heavy Lift Multipurpose Marine Terminal Project) that are proceeding independently of any development specific to a lease area.	Port utilization, vessel traffic, electric and magnetic fields and cable heat
Fisheries impacts	Assessment of impacts on fisheries from offshore wind development (construction and operation); potential for conflict with one or more treaties between Tribes and U.S. Government.	Accidental releases, electric and magnetic fields and cable heat, gear utilization, presence of structures
Viewshed impacts	Qualitative assessment of Tribal sensitivity to the settings and tolerance for change: susceptibility to impact and perceived cultural value. Qualitative assessment of impacts of maritime settings/ocean views of lands and Tribal values and concerns subject to visual impacts from components constructed or activities occurring offshore, which could affect Tribes for whom unobstructed ocean views hold important cultural and spiritual significance. Magnitude of change: the combination of visual contrast, size, and scale of the change to existing conditions caused by offshore wind development; the geographic extent of the area subject to such development's effects; and the effects' duration and reversibility.	Lighting, presence of structures
Noise Impacts	Assessment of impacts on increases in construction and operational noise levels affecting species in marine and coastal habitats and Tribal community members' experience of a maritime or cultural landscape.	Noise
Economic and employment impacts	Assessment of monetary impacts on Tribal businesses. Assessment of impacts on employment opportunities related to the construction and operation of commercial offshore wind facilities. Changes in employment in commercial fisheries, marine-based tourism and recreation businesses, small boat harbor services, and hospitality. Tribal capacity and technical expertise to review proposed activities associated with construction and operation of commercial offshore wind facilities. Availability of housing and transportation infrastructure near project areas, including consideration of possible need for transient workforces (and how such workforces could affect Tribal communities)	Anchoring, Cable installation and maintenance, Land disturbance, Presence of structures, vessel traffic
Vessel traffic impacts	Assessment of impacts on Tribal use of Humboldt Bay, Morro Bay, and offshore areas for cultural activities and commercial and customary fishing activities and subsistence harvesting.	Vessel traffic, port utilization

The effects analysis is informed by BOEM's assessment as the lead federal agency preparing the PEIS and the views of the Tribal Nations with vested interests in the Humboldt and Morro Bay lease areas (and prospective, to-be-determined locations of onshore facilities).

3.4.5.2 Impacts of Alternative A – No Action –Tribal Values and Concerns

When analyzing impacts of the No Action Alternative on resources of Tribal value and concern, BOEM considered the impacts of ongoing activities against baseline conditions for such resources. The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative on existing baseline trends, including other planned activities, which are described in Appendix C, *Planned Activities Scenario*.

3.4.5.2.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for resources of Tribal value and concern would continue and respond to IPFs introduced by both natural processes and ongoing activities. Natural processes such as coastal erosion, sea level rise, or atmospheric conditions could contribute to the deterioration of resources of Tribal value and concern. Similarly, global climate change presents risks for such resources. Increased temperatures, sea levels, ocean acidity, and frequency/intensity of storms, along with changes in ocean circulation and precipitation patterns, could individually or collectively affect resources of Tribal value.

Ongoing activities that could affect resources of Tribal value and concern include any activities that result in seabed, coastal, or terrestrial disturbance (with or without associated noise or visual impacts); fishing and anchoring activities (and related entanglements); any activities that would increase vessel traffic, and activities that would influence economies of Tribal communities. Such activities could include (but are not limited to) ongoing commercial and recreational fishing, military activities, port operations, and vessel traffic. Ports would continue to serve marine traffic and associated industries, generating vessel traffic (and noise), as well as periodically requiring dredging of travel channels. Ongoing activities are further described in several sections of this PEIS, including Sections 3.4.1*, Commercial Fisheries and For-Hire Recreational Fishing*, 3.4.7, *Navigation and Vessel Traffic*, and 3.4.8, *Other Uses*.

Anthropogenic noises associated with ongoing activities in the prospective Affected Environment would continue. Such noise sources include construction, G&G survey activities, vessels, cable-laying activities, and military activities. Noise from large commercial ships, as well as smaller fishing and recreational vessels, is likely to be present and persistent in the prospective Affected Environment and may induce changes in behavior or acoustic masking for all fishes and invertebrates and can have physiological and behavioral effects on marine mammals. Impacts from these activities on fish and marine mammal species of Tribal value and concern could negatively affect Tribal customary subsistence and commercial fishing activities, particularly if such disturbances occur during seasonal spawning or migration periods.

3.4.5.2.2 Cumulative Impacts of the No Action Alternative

Planned activities in the prospective Affected Environment could also contribute to impacts on resources of Tribal value and concern. As summarized in Appendix C, such planned activities include the continuation of ongoing activities described above, plus port improvements, the prospective designation of a new marine sanctuary, and planned onshore development. Collectively, such planned activities may affect Tribal resources through a variety of means including vessel traffic, land disturbance, noise, and anchoring. Some of these activities may have beneficial economic or employment impacts on Tribal communities.

As discussed in Appendix C, several ports are considering various improvement projects, including efforts to support offshore wind development more generally (not tied to any specific lease area at this time). Such improvements could increase port use, the need for dredging, and noise and visual impacts in and near ports. Increased vessel traffic can also result in behavioral changes in fish species and marine mammals and increased risk of collisions with vessels. Increased port activity could also result in beneficial economic and employment impacts for surrounding communities, including Tribal communities.

Anticipated for designation in late 2024/early 2025, the Chumash Heritage National Marine Sanctuary will protect important regional marine ecosystems and maritime heritage resources, support ocean-dependent economies, and highlight the cultural values and connections of Tribal Nations to the area. The sanctuary designation extends along 116 miles (187 kilometers) along the Central California coast over more than 4,543 square miles (11,766 square kilometers; (NOAA 2023 and 2024).

Planned onshore development, such as commercial and industrial development, could affect resources of Tribal value and concern, even if such development is in conformance with existing land use regulations.

Other planned activities may contribute to bottom disturbance and entanglement impacts through cable installations and maintenance, sediment dredging, vessel anchoring, accidental releases of hazardous substances, and use or loss of survey and fishing gear. These activities have the potential to cause permanent impacts on marine biological and cultural resources, such as disturbance to or destruction of benthic habitat or marine cultural resources on or just below the seafloor surface. The damage to marine biological species and habitat and marine cultural resources from these activities could result in the permanent and irreversible loss of biological and cultural resources of Tribal value and concern, could negatively affect Tribal economies and employment.

3.4.5.2.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, resources of Tribal value and concern would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing temporary, long-term, and permanent impacts on resources of Tribal value and concern in the prospective Affected Environment through seabed, terrestrial, and visual disturbances and intrusions (ground disturbance and entanglements, changes in coastal views, noise, economy, and vessel traffic). Additional contributing impacts and IPFs may be identified through BOEM's consultation and engagement with Tribes. Impacts on resources of Tribal value and concern would be possible when such resources are present and subject to alteration or damage as a result of ongoing activities.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and resources of Tribal value and concern would continue to be subject to impacts by a variety of human-caused IPFs. Planned activities would contribute to impacts on resources of Tribal value and concern due to the disturbance, damage, disruption, and destruction of individual resources of Tribal concern located onshore and offshore.

3.4.5.3 Impacts of Alternative B – Development with No Mitigation Measures –Tribal Values and Concerns

Alternative B considers potential impacts of offshore wind development in the Humboldt and Morro Bay lease areas without mitigation measures. Because BOEM does not have enough information to fully define an Affected Environment pending (1) a future COP submission, and (2) further engagement with involved Tribes, BOEM is analyzing potential impacts on resources of Tribal value and concern based on Tribal ancestral and cultural regions and impact concerns expressed by Tribes to BOEM through comments on the NOI.

While subsequent project-level analyses (of COPs) will be informed by more comprehensive accounting as well as Tribal engagement with individual lessees, there is no comprehensive or sufficient existing survey of resources of Tribal value covering the totality of the prospective Affected Environment at this programmatic level. As such, there may be Tribally valued resources not yet identified that could be affected by offshore wind development in the Humboldt and Morro Bay lease areas.

3.4.5.3.1 Impacts of One Representative Project in Each WEA

One representative project in each WEA would introduce additional environmental effects on top of the ongoing projects and environmental trends discussed for Alternative A. Contributing IPFs to impacts on resources of Tribal value and concern of one representative project in each WEA include accidental release, anchoring, cable installation and maintenance, EMFs and cable heat, gear utilization, land disturbance, light, presence of structures, noise, economic and employment impacts, and vessel traffic.

Accidental releases: Construction and operation of offshore wind development would increase the potential for accidental releases of fuels and wastes from vessels, as well as ambient trash. BOEM assumes that such releases would change the context of resources of Tribal value and concern. Regulations would help limit the number and extent of accidental releases, but greater impacts could occur if a release were geographically extensive or resulted in permanent consequences to resources of Tribal value and concern.

Anchoring: Installation of a single representative project would involve long-term anchoring of up to 200 WTGs and 6 OSSs. Anchoring methods described in the RPDE would have different seabed footprints.

Installation of a single representative project also assumes shorter-term vessel anchoring. Depths of the lease areas would likely preclude ancient, submerged landscapes, but ongoing engagement and consultations with Tribes may identify other resources of Tribal value and concern in such areas. Overall, BOEM anticipates impacts on such resources from anchoring WTGs, OSSs, or vessels from a single representative project in each WEA would be localized and permanent, depending on the types and quantity of resources present and the anchoring locations. More substantial impacts could occur if final project designs could not avoid known resources or if previously undiscovered resources of Tribal value and concern are identified after the start of construction.

Cable installation and maintenance: Further seabed disturbances are anticipated from interarray and offshore export cable installation. While interarray cables would be suspended in the water column, offshore export cables would be buried at a target depth or protected. Such burial or protection would result in seafloor disturbance between a lease area and a to-be-determined cable landfall area. Activities causing increased impacts could include site-preparation activities (e.g., dredging, trenching), cable installation via jet trenching, plowing/jet plowing, or mechanical trenching.

While subject to NEPA compliance and review, as well as consultation with Tribal Nations, final project design may or may not be able to avoid all resources of Tribal value and concern. For these reasons, BOEM anticipates these activities may have localized and permanent impacts on resources of Tribal value and concern. More substantial impacts could occur if final project designs could not avoid known resources of Tribal value and concern.

EMFs and cable heat: Interarray cables and export cables would each have the potential to generate EMFs or emit cable heat. Such effects on marine species are considered in subsections of Section 3.3, *Biological Resources*. To the extent that marine species are considered resources of Tribal value and concern, refer to subsections of Section 3.3 for detailed discussions of EMFs and cable heat effects on such species.

Gear utilization: Marine entanglement with monitoring and survey equipment may result in physical impacts. Construction, O&M, and decommissioning of one representative project in each WEA may necessitate additional monitoring or geophysical surveys, from which gear utilization could cause entanglements with marine species of Tribal value and concern or other submerged resources of Tribal value and concern (including but not limited to marine archaeological resources).

BOEM expects that impacts of gear utilization on marine archaeological resources would be infrequent and isolated, though entanglements could have permanent, irreversible impacts. More substantial impacts could occur if final project designs could not avoid known resources or if previously undiscovered resources are discovered during construction.

Potential effects of gear utilization on marine species are discussed in several other sections of this PEIS, including Sections 3.3.6, *Marine Mammals* and 3.3.7, *Sea Turtles*. These sections indicate the potential for marine species to be harmed by entanglement but conclude that such effects would be limited to individuals and would not result in population-level effects.

Land disturbance: Installation of one representative project would likely involve land-based facilities such as substations, as well as a POI between the export cable and onshore facilities. BOEM has not identified any specific onshore facilities at this programmatic stage. Accordingly, it is not possible for BOEM to make conclusive impact determinations on resources of Tribal value and concern (including but not limited to terrestrial archaeological resources and landscapes).

Lighting/presence of structures: One representative project in each WEA would introduce structures in the water that would include navigation lighting; lighting and vessels would also be present during construction. These have the potential to affect viewsheds of Tribally important resources along the north and central coasts of California by introducing structures and lighting into settings that may have historically consisted of unimpeded maritime views. Refer to Section 3.4.2, *Cultural Resources*, and Section 3.4.10, *Scenic and Visual Resources*, for further discussions of viewshed impacts. Pending further engagement and consultation during COP-specific NEPA reviews, BOEM will be better able to determine if the Affected Environment for resources of Tribal value and concern is similar to those identified in these sections. Lacking clarity at this time, impacts would likely diminish with distance between offshore wind developments and resources of Tribal value and concern.

Noise: Construction and operation of WTGs and OSSs would involve a variety of noise sources, both underwater and terrestrial. Anchoring and cable installation could require jetting, plowing, or other methods to prepare the seabed. Site preparation may also entail the clearance of UXO, including by detonation. These activities may result in behavioral disturbances for some fish species and marine mammals of Tribal value and concern, though these are expected to be low intensity and localized (Hoffman 2012; Pirotta et al. 2013). Low-frequency cetacean species may face a nominally higher risk of behavioral effects or masking given the overlap between their hearing and the frequency of cable-laying noise. However, activities associated with one representative project in each WEA are expected to be short term and localized. To the extent that marine mammals and other marine species are considered resources of Tribal value and concern, impacts are expected. Refer to the following sections for discussions of noise impacts: Sections 3.3.2, *Benthic Resources*; 3.3.4, *Coastal Habitat and Fauna*; 3.3.5, *Fishes, Invertebrates, and Essential Fish Habitat*; Section 3.3.6, *Marine Mammals*; and 3.4.1, *Commercial Fisheries and For-Hire Recreational Fishing.*

Economic and employment impacts: The development of one representative project in each WEA, without mitigation measures, would potentially impact Tribal economics and employment; beneficial impacts would be contingent on the successful implementation of community benefit agreements. Refer to the following sections for discussions of economic and employment impacts: Sections 3.4.3, *Demographics, Employment, and Economics,* and 3.4.1, *Commercial Fisheries and For-Hire Recreational Fishing*.

Vessel traffic: One representative project in each WEA would increase vessel traffic compared to the No Action Alternative, with traffic peaking during project construction. Overall, BOEM expects vessel activities in the open waters of the prospective Affected Environment between lease areas and ports and along to-be-determined offshore export cable routes to impact commercial fisheries and for-hire recreational fishing, and Tribal cultural uses of the offshore environment. Refer to the following sections for discussions of vessel traffic impacts: Sections 3.3.6, *Marine Mammals*, and 3.4.1, *Commercial Fisheries and For-Hire Recreational Fishing.*

3.4.5.3.2 Impacts of Five Representative Projects

Overall, IPFs from the development of five representative projects would affect resources of Tribal value and concern in the same manner as those described for the corresponding IPFs for one representative project in each WEA but would be of greater likelihood, intensity, or extent. Further engagement and consultation between BOEM and Tribal Nations may result in identifying impacts from additional IPFs and greater magnitude and intensity of impacts on resources of Tribal value and concern.

3.4.5.3.3 Cumulative Impacts of Alternative B

The combination of five representative projects plus planned activities would increase the geographic extent of impacts on resources of Tribal value and concern, likelier entailing a larger number of resources and/or subjecting such resources to more intensity (of construction, level of development, etc.).

3.4.5.3.4 Conclusions

Impacts of Alternative B. Construction, O&M, and decommissioning of one representative project in each WEA or five representative projects would likely result in impacts, the degree and extent of which would be greater in proportion to the level of development. Greater economic activity in ports could have benefits to Tribal communities and, in turn, resources of Tribal value and concern.

Development of one or more lease areas closer to the shoreline or entailing seabed disturbances is likely to have more intense impacts on resources of Tribal value and concern than projects developed farther from the shoreline, which may have smaller areas of disturbance, depending on final project designs. Five representative projects would increase the amount of development and thus the likelihoods that 1) impacts would be physically damaging or cause permanent setting changes, and 2) that such impacts would occur to a greater number of resources of Tribal value and concern. Impacts of one or five representative projects would be due to the extent of onshore and offshore development that could introduce physical and visual impacts on resources of Tribal value and concern.

Cumulative Impacts of Alternative B. BOEM anticipates cumulative impacts on resources of Tribal value and concern would depend on the extent of planned onshore and offshore development and potential extent of resources of Tribal value and concern in the region subject to impacts. In the context of other reasonably foreseeable environmental trends, the incremental impacts on resources of Tribal value and concern contributed by Alternative B would likely be noticeable.

3.3.1.1 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Tribal Values and Concerns

The analysis of the Proposed Action considers how BOEM's adoption of mitigation measures may avoid or decrease the impacts described in Alternative B. The analysis for this alternative is presented as the change in impacts from those discussed under Alterative B. While BOEM has not yet identified any mitigation measures specific to resources of Tribal value and concern, many of the mitigation measures developed for other resources (Appendix E, *Mitigation*) are likely to apply to resources of Tribal value and concern. Table 3.4.5-3 presents an initial list of such measures that apply to resources of Tribal value and concern. As BOEM's understanding of the Affected Environment and Tribal resources increases through engagement and consultation, the analysis in this section and the list of mitigation measures may expand.

Table 3.4.5-3. Prospective mitigation measures for impacts on resources of Tribal value and concern

Mitigation Measure	Description
MM-1	This measure requires implementation of a near real-time PAM system to detect cetaceans to provide awareness to mariners involved in offshore wind activities to reduce the risk of vessel strike and impacts from project activities.
MM-2	This measure requires long-term PAM monitoring to inform future predictions of potential impacts on marine mammals. The lessee must also document the data collected and archive a full acoustic record, submitting cetacean detections to BOEM, BSEE, and NMFS.
MM-4	All offshore wind-related vessels will travel at 10 knots (18.5 kilometers per hour) or less during project-related activities, and while operating in lease areas. The only exception is when the safety of the vessel or crew necessitates deviation from this vessel speed limit.
MM-5	This measure requires that lessees submit a Low Visibility Monitoring Plan (LVMP) for any project alternatives requiring marine mammal and sea turtle monitoring conducted at night or in low-visibility conditions.
MM-7	This measure requires that, to the extent reasonable and practicable, lessees must follow the most current IMO guidelines for the reduction of underwater radiated noise, including propulsion noise, machinery noise and dynamic positioning systems of any vessel associated with the project.
MM-8	This measure requires qualified third-party PSOs onboard vessels during project activities, details the required PSO training, and data collection requirements.
MM-9	Sulfur hexafluoride (SF_6) is an extremely potent greenhouse gas that is used as an anti-arcing insulator in electrical and transmission systems. Lessees should ensure that a substitute insulator gas rather than SF_6 in in project infrastructure, as long as the substitute materials do not impose a higher environmental or safety risk. If the lessee determines using non-SF_6 switchgear is infeasible then the Lessee should provide written justification of this determination to BOEM. Any instances where the Lessee believes there is technical (and/or economic) infeasibility should be supported by a technical feasibility analysis, as appropriate.
MM-10	The Lessee is encouraged to use zero-emissions technologies when feasible, and to replace diesel fuel and marine fuel oil with alternative fuels such as natural gas, propane, or hydrogen, to the extent that use of such alternative fuels is feasible and provides emissions reductions.
MM-11	All vessels transiting between a port and the project location must comply with the vessel strike avoidance measures consistent with measures for other marine wildlife. Vessels must avoid transiting through areas of visible aggregations of birds and particularly for species that can occur in larger numbers including alcids, albatrosses, shearwaters, storm-petrels, and cormorants. If operational safety prevents avoidance of such areas, vessels must slow to 4 knots while transiting through such areas. The disturbance avoidance zone for birds is defined as 100 meters from any surface-sitting birds and includes Federally listed species under the ESA (e.g., Marbled Murrelet and

Mitigation Measure	Description
	Short-tailed Albatross). If surface-sitting birds are sighted within the operating vessel's forward path, the vessel operator must slow down to 4 knots (unless unsafe to do so) and steer away as much as possible. The vessel may resume normal operations once the vessel has passed the individual or flock. Any incidents must be reported.
MM-19	This measure requires lessees to submit an anchoring plan that identifies hard-bottom, sensitive habitats, cultural resources, ASLFs, potential shipwrecks, potential hazards, and existing and planned infrastructure. The plan will describe protocols to prevent or minimize anchor dragging and require all vessels deploying anchors to use mid-line anchor buoys when possible to reduce seafloor impacts.
MM-20	Lessee must develop and submit a plan to characterize the marine biological species and habitats in the water column or on the seafloor that may be affected by a project's activities. Species and habitats that are particularly sensitive to impacts, and beyond those already addressed specifically elsewhere in the Appendix, will be identified, avoided, and require monitoring to track changes over time, allowing for the identification of adverse effects and evaluation of mitigation efforts. Consolidated seafloor sediments (e.g. hard bottom, hard grounds, reefs) are equivalent to sensitive habitats and species (e.g. hard corals, sponges, commercially important fish species, endangered species) and shall be avoided from direct and indirect impacts unless data exists to demonstrate no harm to sensitive species and habitats. Upon or after COP submission, BOEM may require the Lessee to conduct additional surveys to define boundaries and avoidance distances and/or may specify the survey methods and instrumentations for conducting the biological survey and specify the contents of the biological report. If, during the conduct of Lessee's approved activities, the Lessee or BOEM finds that sensitive seafloor habitats, essential fish habitat, or habitat areas of particular concern may be adversely affected by Lessee's activities, BOEM must consult with the NFMS (30 CFR 585.703).
MM-21	This measure requires the lessee to prepare a Scour and Cable Protection Plan (SCPP) to include location and extent of scour and cable protection, the habitat delineations for the areas of cable protection measures, and detailed information on the proposed scour or cable protection materials for each area and habitat type. This measure also describes what materials lessees should avoid using in complex habitat, such as concrete mattresses, as practicable and/or feasible.
MM-22	Lessees should consider establishing a compensation process if a project is likely to result in lost income to commercial and recreational fisheries. The compensation process should be equitable and fair across fisheries and fishing communities and consider best practices and consistency across other offshore wind energy projects. Financial Compensation can include compensation for gear loss and damage and lost fishing income.
MM-23	Lessees should prepare a Fisheries Communication Plan, outlining the specific methods for engaging with and disseminating project information to the local fishing community, as well as other associated stakeholders, throughout each phase of the project. To the greatest extent practicable, the plan should describe how the lessee intends to engage with the various fishing constituencies that are active within a project area. The FCP must include the contact information for an individual retained by the Lessee as its primary point of contact with fisheries stakeholders (i.e., Fisheries Liaison).
MM-24	Lessees should work cooperatively with commercial/recreational fishing entities and interests to minimize potential disruptions to commercial and recreational fishing interests during construction, operation, and decommissioning of a project. Lessees should review planned activities with potentially affected fishing organizations and port authorities to prevent unreasonable fishing gear loss or damage. Lessees should notify registered fishermen of the location and time frame of the

Mitigation Measure	Description
	project construction activities well in advance of mobilization and provide updates throughout the construction period.
MM-25	This measure requires the lessee to develop an Environmental Justice (EJ) Communications Plan, in collaboration with communities that have EJ concerns. This plan should aim to outline how the Lessee will communicate with these communities, identified as populations affected by environmental justice issues under Executive Order 14096 and the revised implementation regulations for NEPA (National Environmental Policy Act Implementing Regulations Revisions Phase 2; 89 Federal Register 35554 – 35577 (May 1, 2024)), referred to herein as "EJ populations"). Draft EJ Communications Plan should be developed in coordination with community leaders and community organizations who work with the identified EJ population(s). Plans should be specifically designed for EJ populations and advance meaningful engagement based on each affected community's unique communication and information needs. EJ populations should be identified by any applicable federal and state-level EJ and related screening tools, or other relevant local information. The Lessee may utilize efforts or language developed for any state requirements (e.g., measures identified through state renewable energy procurement processes or as requirements of state permits) to satisfy this Draft EJ Communications Plan partially or wholly.
MM-26	The Environmental Justice Impact Mitigation Plan should be developed in collaboration with communities that have environmental justice concerns. The plan must acknowledge existing state or local regulations (such as noise control) that may help mitigate impacts, ensuring that there is no redundancy. The plan should outline procedures for responding to reported impacts, detailing the actions the Lessee will take, including the distribution of mitigation resources or other strategies. During the development of this plan, BOEM encourages the Lessee to engage with other stakeholders and align this engagement with the broader communication strategy for the project.
MM-27	This measure requires all static cables should be buried below the seabed where technically feasible and a benefit to the environment. Lessees should avoid installation techniques that raise the profile of the seabed, such as the ejection of large, previously buried rocks or boulders onto the surface. The ejection of this material may damage fishing gear. The intent of this mitigation measure is to ensure that new obstructions are not unduly introduced for mobile fishing gear. Removal of large marine objects and decommissioning instrumentation and/or anchors should occur as soon as practicable and within required regulations and permits. Future mitigations could include gear identification and or lost survey gear monitoring and reporting.
MM-28	This measure states that the lessee must provide the methods and results of an archaeological survey with its COPs. This includes HRG surveys prior to conducting bottom disturbing activities, and avoidance of all potentially eligible cultural resources or historic properties. BOEM will establish and lessees must comply with requirements for all protective buffers recommended by BOEM for each marine cultural resource (i.e., archaeological resource and ASLFs) based on the size and dimension of the resource.
MM-29	This measure states that BOEM will establish avoidance criteria for any historic property or any unevaluated terrestrial archaeological resource, and lessees must avoid impacts on all historic properties and unevaluated archaeological resources. If avoidance is not feasible, the lessee must develop a plan to be submitted to BOEM that addresses the adverse effect on the terrestrial archaeological resource. This measure includes the details of that plan.
MM-30	This measure includes the potential use of a third-party managed compensatory mitigation fund to address visual impacts on aboveground historic properties related to OCS offshore wind activities.

Mitigation Measure	Description
MM-31	This measure requires the lessee to comply with monitoring and post-review discovery plans, which may be developed in the course of BOEM's project-level NEPA review and Section 106 consultation.
MM-32	This measure encourages lessees to coordinate transmission infrastructure among projects by using, for example, shared intra- and interregional connections, meshed infrastructure, or parallel routing, which may minimize potential impacts from offshore export cables.
MM-34	This measure recommends lessees use standard underwater cables that have electrical shielding to reduce the intensity of EMFs.
MM-36	This measure requires the lessee to develop an Oceanographic Monitoring Plan, and details the Plan requirements.
MM-37	This measure encourages lessees to incorporate technologies for detecting tagged sea turtles and fish to monitor the effect of increases in habitat use and residency around WTG foundations and share monitoring results, propose alternative mitigation measures, or monitoring methods as appropriate.
MM-38	This measure requires disengaging dredge pumps when dragheads are not in use for activities requiring the use of a trailing suction hopper dredge offshore to prevent impingement or entrainment of ESA-listed fish and sea turtle species.
MM-39	This measure requires lessees, in coordination with BOEM, to prepare and implement a scenic and visual resource monitoring plan that monitors and compares the visual effects of the wind farm during construction and operations/maintenance (daytime and nighttime) to the findings in the COP Visual Impact Assessment and verifies the accuracy of the visual simulations (photo and video). The monitoring plan must include monitoring and documenting the meteorological influences on actual wind turbine visibility over a duration of time from selected onshore key observation points, as determined by BOEM and the lessee.

3.4.5.3.5 Impacts of One or Five Representative Projects in Each WEA

Either one or five representative projects would be expected to have similar types of impacts on resources of Tribal value and concern, with more intense and geographically expansive impacts associated with more offshore wind energy development.

Mitigation measures proposed for particular resources may indirectly affect resources of Tribal value and concern, for example such as those measures that aim to lessen seafloor disturbance, noise, and visual impacts associated with construction and operation of offshore wind development. However, the dynamics of such interactions are complex and not easily quantifiable, absent both certainty about the nature and locations of resources of Tribal value and concern and more precise locations for wind energy facilities, both off- and onshore. The impact of any proposed measure on any particular resource of Tribal value and concern needs to be assessed when project-specific specific information (such as anticipated to be included in lessees' COPs) in tandem with engagement and consultation between BOEM and Tribal Nations. Adherence to the mitigation measures listed in Table 3.4.5-3 would avoid or lessen impacts associated with construction and operation of wind energy development, likely including impacts on resources of Tribal value and concern. However, the effectiveness of these measures in avoiding or lessening impacts on any specific resource of Tribal value and concern is uncertain and will remain uncertain until further identification of such resources (through COP preparation) and project-level environmental review. Accordingly, impact conclusions at this programmatic level would remain the same as described for Alternative B.

3.4.5.3.6 Cumulative Impacts of Alternative C

The combination of five representative projects plus planned activities would likely increase the degree and/or geographic extent of impacts on resources of Tribal value and concern. The measures listed in Table 3.4.5-3 would, as noted previously, avoid or lessen impacts associated with construction and operation of wind energy development, potentially also avoiding or lessening impacts on resources of Tribal value and concern. However, the extent to which these measures would reduce impacts on resources of Tribal value and concern is uncertain at this stage for the reasons described previously. Accordingly, impact conclusions would remain the same as described for Alternative B.

3.4.5.3.7 Conclusions

Impacts of Alternative C. Under Alternative C, adherence to mitigation measures could lessen impacts on resources of Tribal value and concern, but given numerous uncertainties about the location, nature, and extent of such resources, more precise conclusions are not possible at this programmatic stage.

Cumulative Impacts of Alternative C. BOEM anticipates cumulative impacts on resources of Tribal value and concern due to the numerous uncertainties described previously. BOEM anticipates that ongoing engagement and consultation will inform a better understanding of the Affected Environment and, in turn, greater clarity on the need for and efficacy of mitigation measures to avoid or lessen impacts on resources of Tribal value and concern.

3.4 Socioeconomic Conditions and Cultural Resources

3.4.6 Land Use and Coastal Infrastructure

This section discusses potential impacts on land use and coastal infrastructure from the Proposed Action, alternatives, and ongoing and planned activities. Figure 3.4.6-1 shows the Affected Environment, which includes the counties where onshore infrastructure may be located and the counties with representative ports that are expected to be used to support construction, O&M, and decommissioning of the Humboldt and Morro Bay lease areas.

Because the precise locations of onshore elements to support the Humboldt and Morro Bay lease areas are not known at this time, the land use impact analysis is dependent on a hypothetical project, and impact conclusions consider a maximum-case scenario for onshore development.

3.4.6.1 Description of the Affected Environment and Baseline Conditions

Figure 3.4.6-2 illustrates the diversity of land uses in the four counties composing the Affected Environment.

- Approximately 80 percent of Humboldt County is forested, which includes a mix of commercial timberland and state and federal public land (Humboldt County 2017). Development in Humboldt County is generally on or near the coast (such as the cities of Eureka, Arcata, McKinleyville, and Fortuna).
- San Luis Obispo County is a relatively rural county and is characterized by open space, agricultural, and rural lands (San Luis Obispo County 2023a, 2023b). Developed areas include both coastal communities (Cambria, Cayucos, Morro Bay, Los Osos–Baywood Park, and the beach cities of Avila, Pismo, and Grover) and inland cities (San Luis Obispo, Atascadero, and Paso Robles).
- In Ventura County, Los Padres National Forest accounts for approximately 47 percent of land in the county. The remaining land in the county includes approximately 528,000 acres in unincorporated areas (43 percent) and approximately 121,000 acres in cities (10 percent, including Port Hueneme, Oxnard, and Ventura) (Ventura County 2020).
- With nearly 10 million residents as of 2022, Los Angeles County is the most populous county in the United States. Coastal areas of the county are highly urbanized, including the areas around the Ports of Los Angeles and Long Beach.

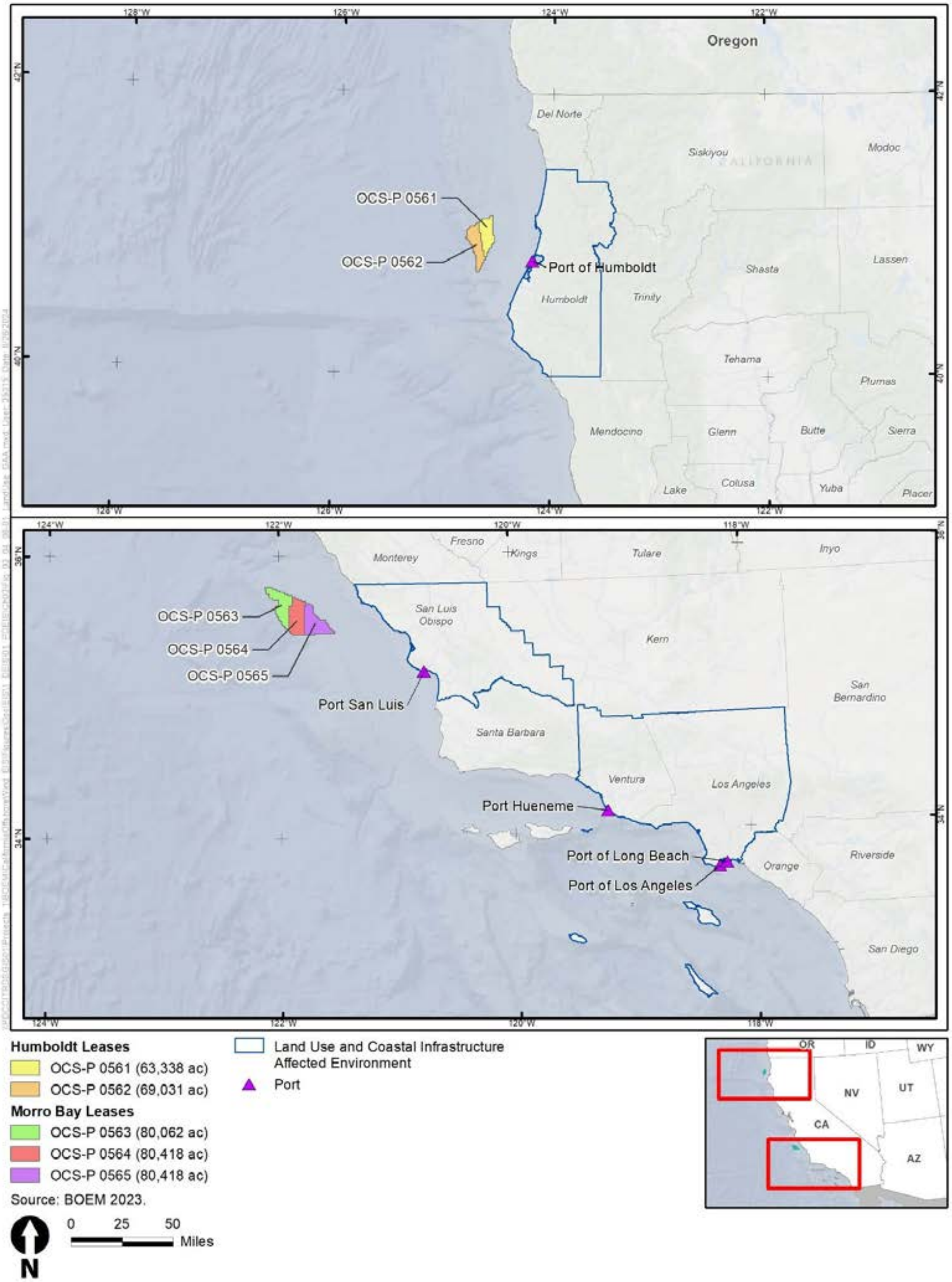

Figure 3.4.6-1. Land use and coastal infrastructure Affected Environment

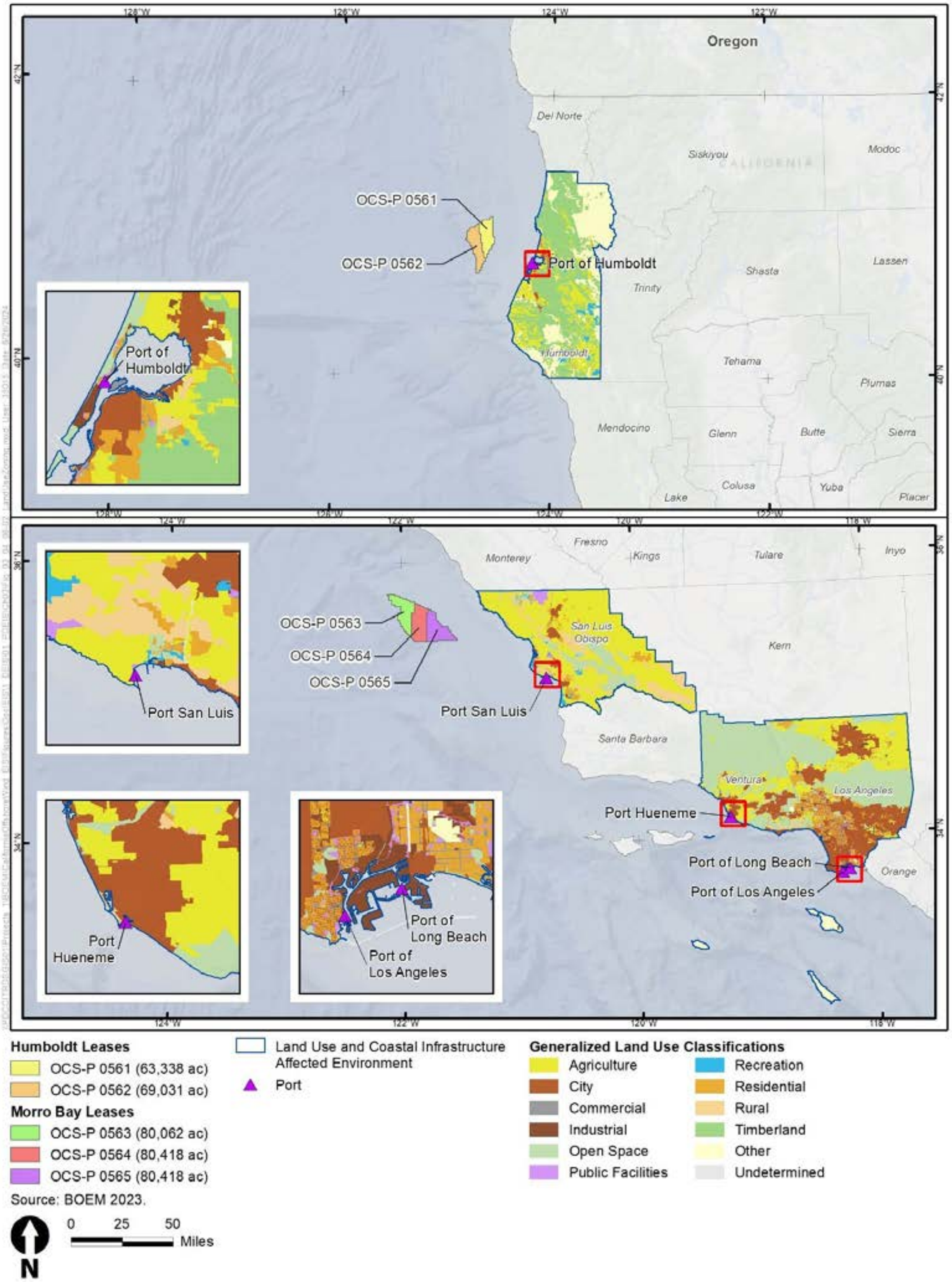

Figure 3.4.6-2. Affected Environment existing land uses

Listed below are the land uses surrounding the five ports with the greatest potential to be affected by the activity anticipated from the Humboldt and Morro Bay lease areas.

- **Port of Humboldt**: Industrial, commercial, residential, and open space (Humboldt County 2023).
- **Port San Luis**: Agricultural (grazing) and recreation (San Luis Obispo County 2023b).
- **Port Hueneme**: Residential, commercial, and recreation (City of Oxnard 2023; Ventura County 2023).
- **Port of Long Beach and Port of Los Angeles**: Commercial, residential, industrial, open space, and recreation (City of Long Beach 2023; City of Los Angeles Harbor Department 2013).

Every California county and city has a land use plan that establishes allowable uses and intensities and that is enforced and regulated through zoning laws. The California Coastal Commission provides further regulation and oversight for coastal zones extending 3 miles seaward and generally about 1,000 yards (910 meters) inland but wider in areas with significant estuarine, habitat, and recreational values and narrower in developed urban areas (California Public Resources Code 20 30103(a)). The California Coastal Act of 1976 requires any local government with jurisdiction wholly or partially within the coastal zone to prepare a Local Coastal Program for its portion of the coastal zone. Nearly all development within the coastal zone requires a coastal development permit from either the California Coastal Commission or a local government with a certified Local Coastal Program.

3.4.6.2 Impact Background for Land Use and Coastal Infrastructure

Accidental releases, lighting, port utilization, presence of structures, land disturbance, and traffic may all affect land use and coastal infrastructure (Table 3.4.6-1).

Table 3.4.6-1. Issues and indicators to assess impacts on land use and coastal infrastructure

Issue	Impact Indicator	IPFs
Public health and safety	Construction- or operation-related volume increases, traffic delays, traffic re-routes, and noise	Accidental releases, land disturbance, traffic
Port improvements and operations	Changes to vehicle, vessel traffic volumes, and working waterfront infrastructure demands	Port utilization, land disturbance, traffic
Land use code and zoning	Qualitative assessment of impacts on compliance with local land use regulations	Lighting, presence of structures, land disturbance, traffic

3.4.6.3 Impacts of Alternative A – No Action – Land Use and Coastal Infrastructure

When analyzing the impacts of the No Action Alternative on land use and coastal infrastructure, BOEM considers the impacts of ongoing activities on the baseline conditions. The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative on existing baseline trends, including other planned activities, which are described in Appendix C, *Planned Activities Scenario*. Planned activities that may contribute to land use impacts include port improvement projects, dredging, and onshore development activities.

3.4.6.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions described in Section 3.4.6.1, *Description of the Affected Environment and Baseline Conditions*, are expected to continue to follow current regional trends and respond to IPFs introduced by other onshore development activities. The Affected Environment includes developed communities that are likely to continue experiencing commerce and development activity in accordance with established land use patterns and zoning regulations. The Affected Environment, particularly near the coast, is generally developed, and most construction projects would likely affect land that has already been disturbed, although some undeveloped land could also be affected. The Affected Environment includes coastal areas that may experience long-lasting impacts from climate change such as sea level rise, more frequent and intense storms, flooding, and fires (USEPA 2024). Climate change impacts may require resilience measures to overcome impacts on land use and coastal infrastructure.

3.4.6.3.2 Cumulative Impacts of the No Action Alternative

The cumulative impact analysis considers the impacts of the No Action Alternative on existing baseline trends, including other planned activities (without the Humboldt and Morro Bay lease areas). Planned activities that may contribute to impacts include port improvement projects, dredging, and onshore development activities (refer to Appendix C, Section C.2.5, *Port Improvement and Dredging Projects*, and Section C.2.12, *Onshore Development Activities*). Ports in the Affected Environment would continue to serve marine traffic and industries and experience periodic dredging and improvement projects to meet ongoing needs. Planned port improvements independent of any specific offshore wind development include the Port of Humboldt Bay Offshore Wind Heavy Lift Multipurpose Marine Terminal and the Port of Long Beach Pier Wind and Deep Draft Navigation Projects (Moffatt & Nichol 2023). Dredging and port improvements would allow larger vessels to use the ports and may result in increased port use and conversion of surrounding land if the ports are expanded. Planned onshore commercial and industrial development would conform with existing land use regulations and could contribute to ongoing construction activities and development in the region.

Accidental releases: The use of heavy equipment during onshore construction would involve fuel and lubricating and hydraulic oils and could result in potential spills during use or refueling activities. BOEM assumes all projects and activities would comply with laws and regulations to minimize releases. Accidental releases could result in temporary use restrictions on adjacent properties and coastal infrastructure during the cleanup process; however, the impacts would be localized and short term. BOEM anticipates that a major spill would be very unlikely due to safety measures as well as the distributed nature of the material. Refer to Section 3.2.2, *Water Quality*, for a discussion of accidental releases into water and associated impacts on water quality. Impacts from accidental releases on land use and coastal infrastructure would be limited.

Lighting: Nighttime lighting from port facilities could disrupt existing or planned uses on adjacent properties in the long term, depending on the location of these facilities and the land use and zoning of adjacent properties. Because facilities are expected to be sited consistent with local zoning regulations and onshore activities would be clustered at or near ports already experiencing lighting impacts, BOEM anticipates limited impacts from facility lighting.

Port utilization: To meet the State of California's goal to deploy 30 GW of floating offshore wind energy by 2030, ports in the Affected Environment are making improvements to support future offshore wind projects independent of any particular proposed offshore wind development (Moffatt & Nichol 2023), including the Port of Humboldt Bay Offshore Wind Heavy Lift Multipurpose Marine Terminal and the Port of Long Beach Pier Wind and Deep Draft Navigation Projects. However, as of 2024, only the Humboldt and Morro Bay lease areas are considered reasonably foreseeable.[1] Port improvements would occur within the boundaries of existing port facilities, within areas planned for expansion, or within repurposed industrial facilities; would be similar to existing activities at the existing ports; and would support state strategic plans and local land use goals for the development of waterfront infrastructure (Moffatt & Nichol 2023). BOEM expects that ports would experience long-term beneficial impacts from greater economic activity and increased employment due to demand for vessel maintenance services, vessel berthing, warehousing and fabrication facilities for offshore wind components and other business activity related to offshore wind (Port of Long Beach 2024; Moffatt & Nichol 2023). For example, the Port of Long Beach estimates that up to 1,005 workers would be required for the operation of the new Pier Wind Terminal (Port of Long Beach 2023). Federal, state, and local agencies would be responsible for minimizing the potential impacts of these future port expansions through zoning regulations and permitting planned improvements and in-water work.

Overall, planned activities would have long-term, socioeconomic beneficial impacts on port utilization due to the productive use of ports, as well as localized and short-term impacts when individual port improvements are being constructed.

Land disturbance: Planned onshore development, such as commercial and industrial development as well as port improvements, would contribute to ongoing construction activities in the region. Planned onshore infrastructure would be developed in conformance with existing land use regulations.

Traffic: Planned activities could result in increased traffic that may affect land use and coastal infrastructure because traffic volumes may dictate where residents and businesses choose to locate. The exact extent of impacts would depend on the specific project and traffic management plans developed with local governments. Traffic impacts on land use and coastal infrastructure are anticipated and would be analyzed during project-specific environmental reviews.

3.4.6.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, land use and coastal infrastructure would continue to be affected by existing environmental trends and ongoing activities, as

[1] Other prospective WEAs are being studied off the California and Oregon coasts (including but not limited to Del Norte, Mendocino Coast, Brookings, and Coos Bay).

well as climate change. BOEM expects ongoing activities under the No Action Alternative to have continuing temporary and permanent impacts on land use and coastal infrastructure.

Cumulative Impacts of the No Action Alternative. BOEM anticipates that the cumulative impacts associated with the No Action Alternative, when combined with all other planned activities in the Affected Environment, would likely be limited and may result in a beneficial impact.

3.4.6.4 Impacts of Alternative B – Development with No Mitigation Measures – Land Use and Coastal Infrastructure

3.4.6.4.1 Impacts of One Representative Project in Each WEA

Accidental releases: Accidental releases of fuel, fluids, or hazardous materials could occur during construction, O&M, and decommissioning of one representative project in each WEA. The required Spill Prevention, Control, and Countermeasures and OSRP for the representative project would provide for rapid spill response, cleanup, and other measures to minimize potential impacts from spills and accidental releases. BOEM anticipates major spills to be very unlikely due to vessel and offshore wind energy industry safety measures and the distributed nature of the material. If accidental releases occur, there could be temporary restrictions placed on the affected properties during the cleanup process. BOEM anticipates that accidental releases would have localized and short-term impacts on land use.

Lighting: Aviation obstruction lights on offshore WTGs would be visible from beaches and coastlines within the Affected Environment. Nighttime lighting during onshore project construction and decommissioning could disrupt existing uses on properties adjacent to ports. These impacts would be localized and short term. Long-term impacts from nighttime lighting at onshore substation and O&M and port facilities would depend on the specific location of these facilities, the land use and zoning of adjacent properties, and the extent of visual screening incorporated into the facility design. BOEM anticipates potential impacts from facility lighting for one representative project in each WEA, given existing coastal development in the Affected Environment and adherence to local zoning regulations.

Port utilization: The Ports of Humboldt, San Luis, Hueneme, Long Beach, and Los Angeles have been identified as potential locations to support construction, O&M, and decommissioning activities for offshore wind projects, as well as potential landfall locations. Some ports have or are in the process of implementing improvements to accommodate offshore wind activities independent of any particular wind energy project. Use of ports by one representative project in each WEA would result in beneficial impacts through greater economic activity and increased employment opportunities. Vessel activity within ports would increase during the construction and decommissioning stages of the project and would decrease during the O&M stage (refer to Section 3.4.7, *Navigation and Vessel Traffic*, for additional detail on anticipated vessel traffic). Therefore, construction, O&M, and decommissioning would have impacts resulting from port utilization on land use and coastal infrastructure.

Presence of structures: BOEM expects that onshore export cables would generally be buried and would not introduce aboveground structures to the Affected Environment. Onshore substations, O&M facilities, and overhead electric power transmission lines are expected to be sited consistent with local zoning regulations and ordinances or would be required to obtain a zoning change or other relief. Transmission POIs for the Humboldt and Morro Bay WEAs would be identified in the COPs. Depending on where the facilities are ultimately sited, new aboveground infrastructure could result in the long-term conversion of land from existing conditions to a new use for electric power generation and transmission. Electrical facilities constructed shoreside could be sited on parcels currently within the public trust (e.g., shorelines, parks), which could pose conflicts with public land uses, such as recreation and coastal resilience projects. The environmental effects of such locations would be analyzed and disclosed in future project-level environmental reviews under NEPA. Based on BOEM's experience with other offshore wind projects, larger electrical facilities (e.g., substations, O&M facilities) are typically sited on previously disturbed areas and industrial locations (BOEM 2022, 2023). Such siting would be unlikely to result in long-term changes in land use. Given the existing level of development in the Affected Environment, particularly along the coast and directly adjacent to the ports, and that facilities would be sited consistent with local zoning regulations, BOEM anticipates localized impacts on land use.

As described in Section 3.4.10, *Scenic and Visual Resources*, visibility of offshore WTGs would vary with distance from shore, topography, and atmospheric conditions. WTGs would be visible while they are being assembled and staged onshore, although impacts would be temporary and localized (particularly on areas around ports). Given that WTGs would be at least 20 miles offshore and thus would not predominate views from most coastal locations, substantial changes to existing land use patterns are not expected.

Land disturbance: Specific locations for onshore facilities including POIs are unknown at this time. These locations would be identified in the COPs and analyzed in future project-level environmental reviews under NEPA. Construction projects must comply with local and state requirements to maintain proper erosion and sedimentation controls to minimize unstable soils movement due to wind and runoff. HDD is expected to be used at landfall sites to minimize land disturbance near the shoreline. Additionally, to reduce land disturbance, co-locating export cables within the existing public ROW is preferred. Land disturbance from onshore construction would produce noise that could affect nearby residential or commercial areas, but construction would be required to comply with local or state noise requirements. Overall, impacts on land use and coastal infrastructure from land disturbance are anticipated.

Traffic: Increased traffic may affect land use and coastal infrastructure because traffic volumes may dictate where residents and businesses choose to locate. Onshore construction of cables would likely disrupt road traffic for a short period of time. BOEM expects construction, O&M, and decommissioning of offshore components to increase road traffic at ports. BOEM does not anticipate the increase in road traffic associated with one representative project per WEA to be above levels typically expected at ports. Ports are typically adjacent to major transportation corridors and other industrial or commercial land uses. As such, impacts on land use and coastal infrastructure from road traffic are anticipated.

3.4.6.4.2 Impacts of Five Representative Projects

The same IPFs described under one representative project in each WEA apply to five representative projects. There would be the potential for greater impacts from these IPFs due to the greater amount of onshore development from five representative projects. If multiple projects are constructed at the same time, temporary impacts associated with land disturbance, traffic, and port utilization could be greater than those identified for one representative project in each WEA. The development of electric infrastructure for five representative projects could affect a variety of land uses across the Affected Environment, reducing the availability of land for other uses. Impacts from five representative projects are anticipated, but specific impacts would be unknown until COPs were developed for each project, when there would be more detailed project information and analysis.

3.4.6.4.3 Cumulative Impacts of Alternative B

The construction and O&M of five representative projects would contribute to the land use impacts from ongoing and planned activities in the Affected Environment. Five representative projects could contribute to cumulative impacts if multiple projects developed did not integrate separate onshore infrastructure in the same location as other planned projects. In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impacts associated with five representative projects under Alternative B, when combined with ongoing and planned activities, would be beneficial for land use and coastal infrastructure.

3.4.6.4.4 Conclusions

Impacts of Alternative B: Construction, O&M, and decommissioning of one representative project under Alternative B would likely have impacts and beneficial impacts on land use and coastal infrastructure. Five representative projects would likely have greater impacts because of increased onshore land disturbance and infrastructure as well as beneficial impacts from port utilization.

Cumulative Impacts of Alternative B: BOEM anticipates that land use and coastal infrastructure from five representative projects associated with Alternative B, combined with ongoing and planned activities, would likely result in cumulative impacts and beneficial impacts. In context of reasonably foreseeable environmental trends, the incremental impacts on land use and coastal infrastructure contributed by Alternative B would likely be noticeable, depending on site-specific project component locations relative to coastal infrastructure locations.

3.4.6.5 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Land Use and Coastal Infrastructure

Alternative C, the Proposed Action, is the prospective adoption of mitigation measures intended to avoid or reduce Alternative B's potential impacts. Accordingly, this analysis considers the change in impacts relative to Alternative B. Appendix E, *Mitigation*, identifies the mitigation measures that would be included in the Proposed Action. Table 3.4.6-2 summarizes the mitigation measure relevant to land use and coastal infrastructure.

Table 3.4.6-2. Summary of mitigation measure for land use and coastal infrastructure

Measure ID	Measure Summary
MM-7	This measure requires that, to the extent reasonable and practicable, lessees follow the most current IMO Guidelines for the reduction of underwater radiated noise, including propulsion noise, machinery noise and dynamic positioning systems of any vessel associated with the project.

3.4.6.5.1 Impacts of One Representative Project in Each WEA

Implementation of MM-7 could reduce noise impacts during construction and operation of onshore facilities, thereby minimizing impacts on nearby land uses that may be sensitive to noise, such as residences. Because the representative project in each WEA would have to comply with applicable state or local noise regulations regardless of alternative and the specific types of equipment and reductions in noise levels are not known at this time, BOEM anticipates any change in impacts realized by this measure would likely be minimal.

While some impacts may be minimized with implementation of the mitigation measure, the extent of the impacts cannot be determined without project-specific information. BOEM does not anticipate this measure would substantively reduce the overall impact for one representative project per WEA compared to Alternative B, or increase the overall beneficial impact.

3.4.6.5.2 Impacts of Five Representative Projects

For five representative projects, the mitigation measure would have a wider application because it would be applied to a broader geographic area and, therefore, affect more nearby or adjacent land uses. Implementation of MM-7 would collectively minimize impacts on land disturbance by limiting some construction impacts (reducing noise), but it would not avoid the development activities that could temporarily and permanently affect land use patterns in the Affected Environment. Therefore, the overall magnitude of anticipated impacts would not change.

3.4.6.5.3 Cumulative Impacts of Alternative C

Under Alternative C, the same ongoing and planned activities as those under Alternative B would contribute to impacts on land use and coastal infrastructure. The construction, O&M, and decommissioning for five representative projects with the mitigation measure would still cumulatively affect land use across the Affected Environment, although at a slightly reduced level.

3.4.6.5.4 Conclusions

Impacts of Alternative C: The construction and decommissioning of one representative project per WEA under Alternative C would likely have short-term impacts and beneficial impacts on land use and coastal infrastructure. Five representative projects would likely have greater short-term impacts and similar beneficial impacts compared to the one representative project scenario. The mitigation measure that would be implemented under Alternative C may slightly reduce overall impacts on land uses by minimizing temporary construction impacts.

Cumulative Impacts of Alternative C: BOEM anticipates that land use and coastal infrastructure from five representative projects, when combined with ongoing and planned activities, would likely have cumulative impacts and beneficial impacts. The mitigation measure that would be implemented under Alternative C would slightly reduce overall impacts. In context of reasonably foreseeable environmental trends, the incremental impacts on land use and coastal infrastructure contributed by Alternative C would be noticeable.

3.4 Socioeconomic Conditions and Cultural Resources

3.4.7 Navigation and Vessel Traffic

This section discusses navigation and vessel traffic characteristics and potential impacts on waterways and water approaches from the Proposed Action, alternatives, and ongoing and planned activities. Figure 3.4.7-1 shows the navigation and vessel traffic Affected Environment, which includes the following waters and waterways.

- Coastal and marine waters within a 10-mile (16.1-kilometer) buffer of the Humboldt and Morro Bay lease areas.
- Waterways leading to the representative ports that may be used by lessees of the Humboldt and Morro Bay lease areas.

The Affected Environment encompasses locations where BOEM anticipates direct and indirect impacts on navigation and vessel traffic associated with construction, O&M, and decommissioning of all development activities in the lease areas.

3.4.7.1 Description of the Affected Environment and Baseline Conditions

3.4.7.1.1 Regional Setting

California's coastal and offshore marine environments serve collectively as a critical conduit for bringing vital economic commerce into and out of northern continental waterways through commercial (deep-draft) shipping operations. Towing vessels, recreational vessels, pilot boats, research vessels, military vessels, and fishing vessels share coastal and offshore marine waters with deep-draft ships.[1] Natural regional characteristics affecting vessel activities include adverse weather hazards, constant shoaling in places, onshore geologic features, and steep drop-offs in offshore depths.

In addition to environmental characteristics of the California coastline and existing vessel traffic, the location of port infrastructure needed for offshore wind development activities will influence vessel traffic (e.g., distance traveled by vessels serving the lease areas and port congestion). California ports, including the representative ports in this analysis, all require facility and potentially other port-related upgrades (such as channel dredging) to support offshore wind development activities (Trowbridge 2023).

[1] Refer to Section 3.4.1, *Commercial Fisheries and For-Hire Recreational Fishing*, and Section 3.4.9, *Recreation and Tourism*, for additional information on some of these resources.

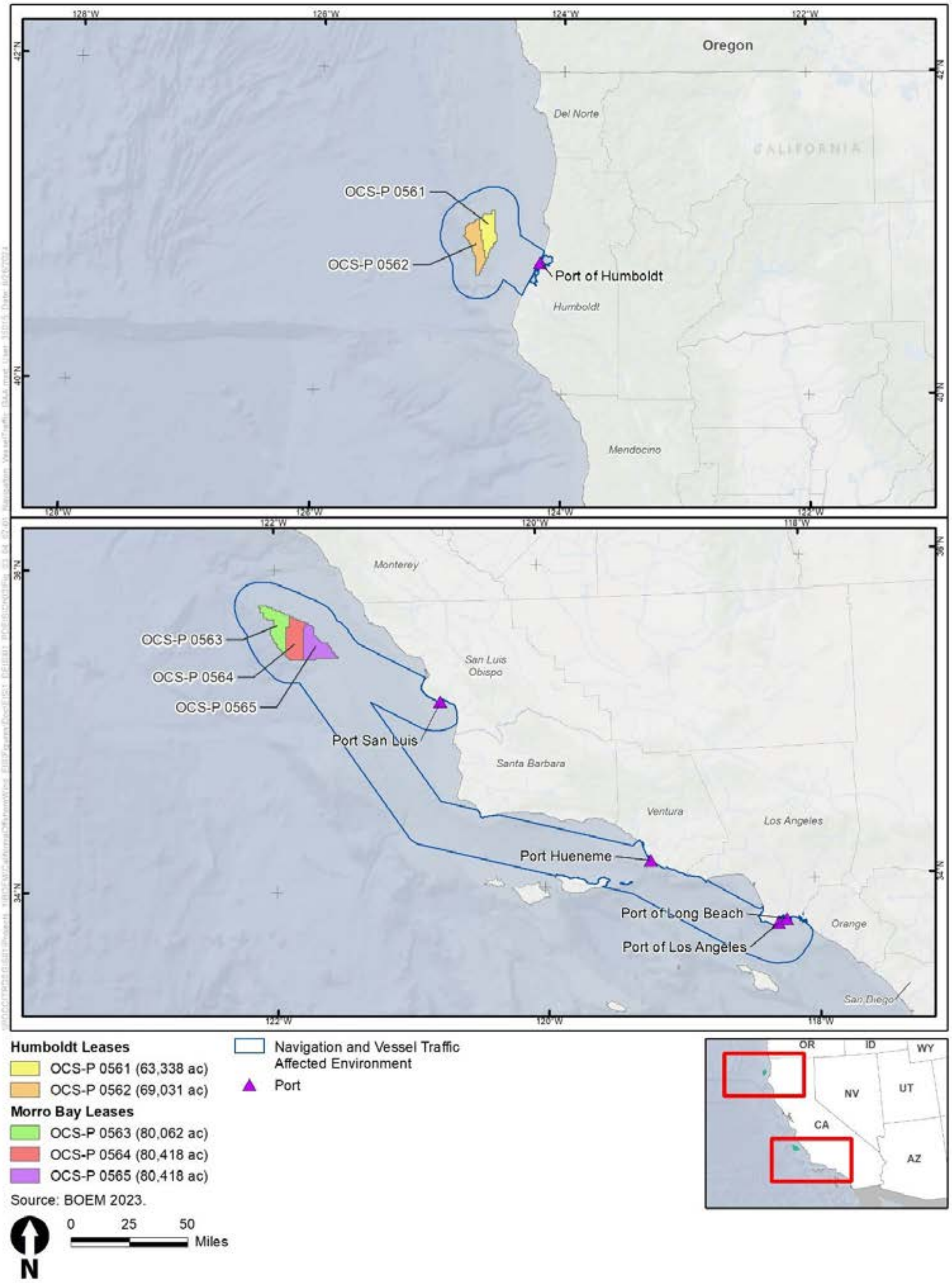

Figure 3.4.7-1. Navigation and vessel traffic Affected Environment

Formal vessel-routing measures and recommended tracks support the safe transit of maritime traffic and facilitate unimpeded deep-draft vessel traffic into and out of harbors and ports.[2] Existing vessel-routing measures (Traffic Separation Schemes [TSS]), Precautionary Areas, and a Safety Fairway) and recommended tracks in the Affected Environment include the following.

- Port Hueneme Safety Fairway (33 CFR 166.300).[3]
- Santa Barbara Channel between Point Vicente and Point Conception.
- Santa Barbara Channel between Point Conception and Point Arguello.
- San Francisco TSS consisting of a Precautionary Area, a Northern Approach, a Southern Approach, a Western Approach, a Main Ship Channel, and an Area To Be Avoided.
- Los Angeles-Long Beach TSS consisting of a Precautionary Area, a Western Approach, and a Southern Approach.
- IMO Recommended Tracks organized into north–south lanes offshore of the Monterey Bay National Marine Sanctuary (USCG 2023a; NOAA 2023a).

Studies, including the Pacific States/British Columbia Oil Spill Task Force Study (2002) and the Pacific Coast Port Access Route Study (PAC-PARS; 2023), have resulted in recommended (voluntary) vessel transit corridors (in the case of PAC-PARS, a proposed fairway system) consistent with current vessel routes (Figure C-10, Appendix C, *Planned Activities Scenario*). BOEM considered the Humboldt and Morro Bay WEAs during the PAC-PARS preparation.

The final PAC-PARS coastal analysis (covering 2012, 2015, 2017–2021) found that vessel traffic in the study area increased over time (USCG 2023a).[4] Using the data extracted for this analysis, between 2017 and 2022, vessel traffic (as measured by vessel tracks) increased by 15 percent in the Humboldt Bay Affected Environment and 61 percent in the Morro Bay Affected Environment (Figure 3.4.7-1).[5] Based on these findings, an increase in vessel traffic over time is an existing baseline trend in the Affected Environment.

The PAC-PARS looked at SAR data in the study area over the last 10 years from the date of the study. Most cases (80 percent) occurred in either inland waters such as rivers, bays, harbors, or territorial waters (within 12 nm or 22.2 kilometers from shore). The PAC-PARS authors note that this trend may

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[2] Guidelines for establishing routing measures and areas to be avoided are contained in the IMO "Ships' Routing" publication. See USCG (2015, 2020) Appendix B for definitions.

[3] A shipping safety fairway or fairway means a lane or corridor in which no artificial island or fixed structure, whether temporary or permanent, will be permitted (33 CFR 166.105). It increases navigation safety by ensuring that an obstruction-free route is available to vessel traffic transiting the vicinity (48 *Federal Register* 49018-49019).

[4] The scope of the PAC-PARS Study included vessel traffic in waters of the Pacific Ocean from the baseline of Washington, Oregon, and California extending 200 nm (370 kilometers) off the West Coast.

[5] Vessel track line routes are based on a track break separation of 24 hours. Unique vessel counts shown in Tables 3.4.7-2 and 3.4.7-3 may be represented by a single or numerous track lines depending upon the frequency of a vessel's transit through a specific area.

change in the future and that the proposed fairways will help mitigate maritime safety risks around emerging ocean uses (USCG 2023a).

3.4.7.1.2 Lease Areas

The Humboldt WEA is approximately 21 nm (38.9 kilometers) west, northwest to Humboldt Bay, approximately 232 nm (429.7 kilometers) from the Port of San Francisco, and approximately 600 nm (1,111 kilometers) from the Port of Los Angeles/Long Beach (Figure 3.4.7-2). The Morro Bay WEA is approximately 111 nm (206 kilometers) south of the Port of San Francisco approaches and borders the southwestern edge of the Monterey Bay National Marine Sanctuary (Figure 3.4.7-3).

Ports, Harbors, Navigation Channels, and Anchorages

Table 3.4.7-1 lists representative ports that may be used in development of the Humboldt and Morro Bay lease areas and includes the geographic California region to which they are linked.[6] A recent study conducted by Shields (2023) divides the California coastline into northern, central, and southern regions to describe the existing port network in relation to offshore wind.[7] The Shields (2023) study, which builds upon the BOEM study (Trowbridge 2023), reiterates the need for expansion of existing port capabilities to support floating offshore wind energy deployment.

Table 3.4.7-1. Representative ports that may be used during development of Humboldt and Morro Bay lease areas

Port	Location	California Region
Humboldt Bay	Adjacent to the City of Eureka; 21 miles (34 kilometers) north of Cape Mendocino.	Northern California
San Luis	On the shore of San Luis Obispo Bay and approximately midway between Los Angeles and San Francisco, in San Luis Obispo County.	Central California
Hueneme	60 miles (97 kilometers) north of Los Angeles.	Central California
Los Angeles	Los Angeles harbor is at the west end of San Pedro Bay. The port includes the districts of San Pedro and Wilmington and a major part of Terminal Island. Frequently referred to jointly with the Port of Long Beach as Port of Los Angeles/Long Beach.	Southern California
Long Beach	Long Beach harbor is in the east part of San Pedro Bay. The port is in City of Long Beach and part of Terminal Island.	Southern California

Sources: NOAA 2023a: Chapter 2; NOAA 2019; Shields 2023.

[6] References to specific ports, harbors, navigation channels, and anchorages in the following discussions (Sections 3.4.7.2–3.4.7.5) are not predictive of port functionality with respect to wind farm construction, O&M, or decommissioning.

[7] San Francisco Bay is a separate "region" due to the large concentration of potential wind development port sites.

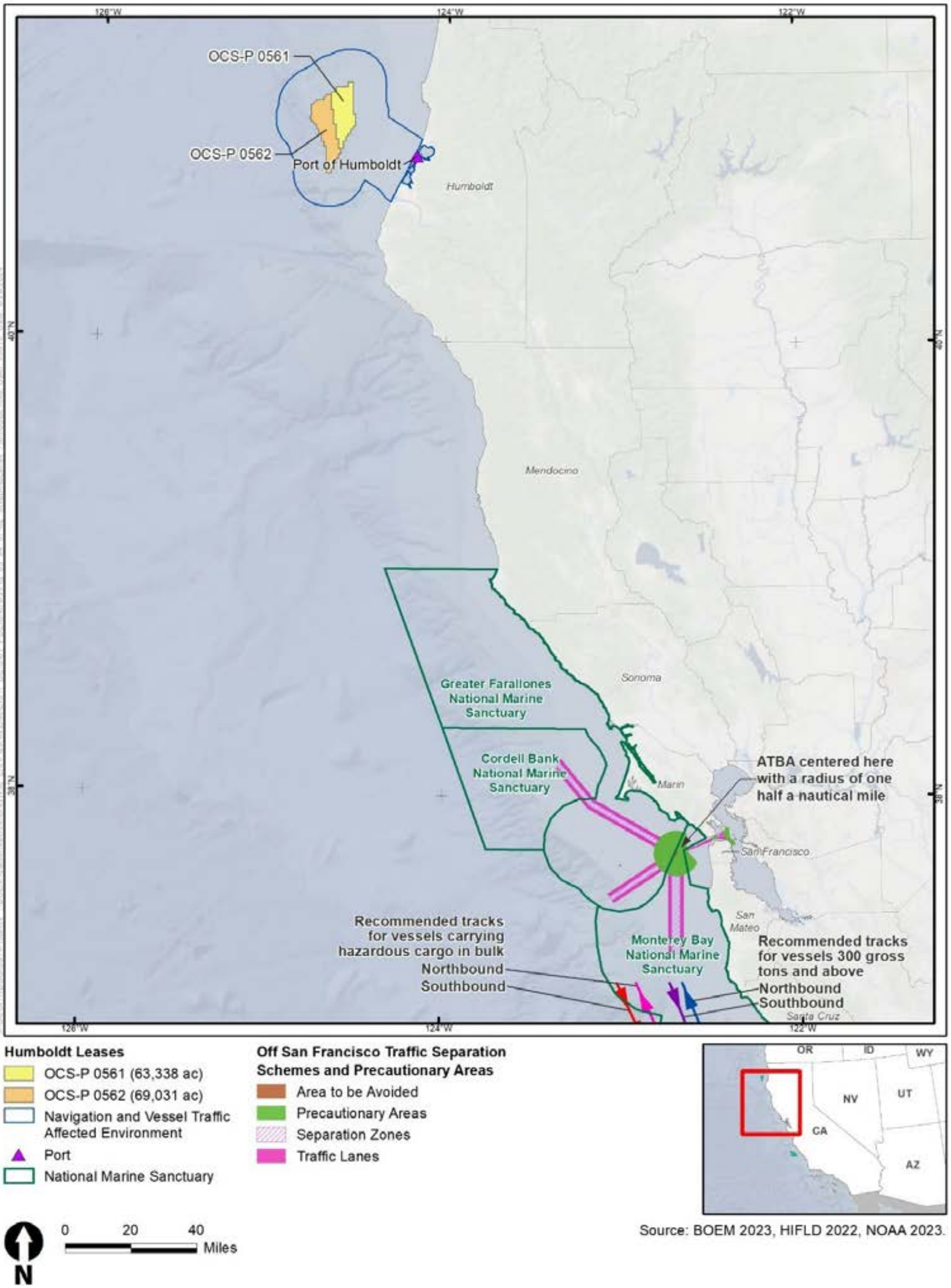
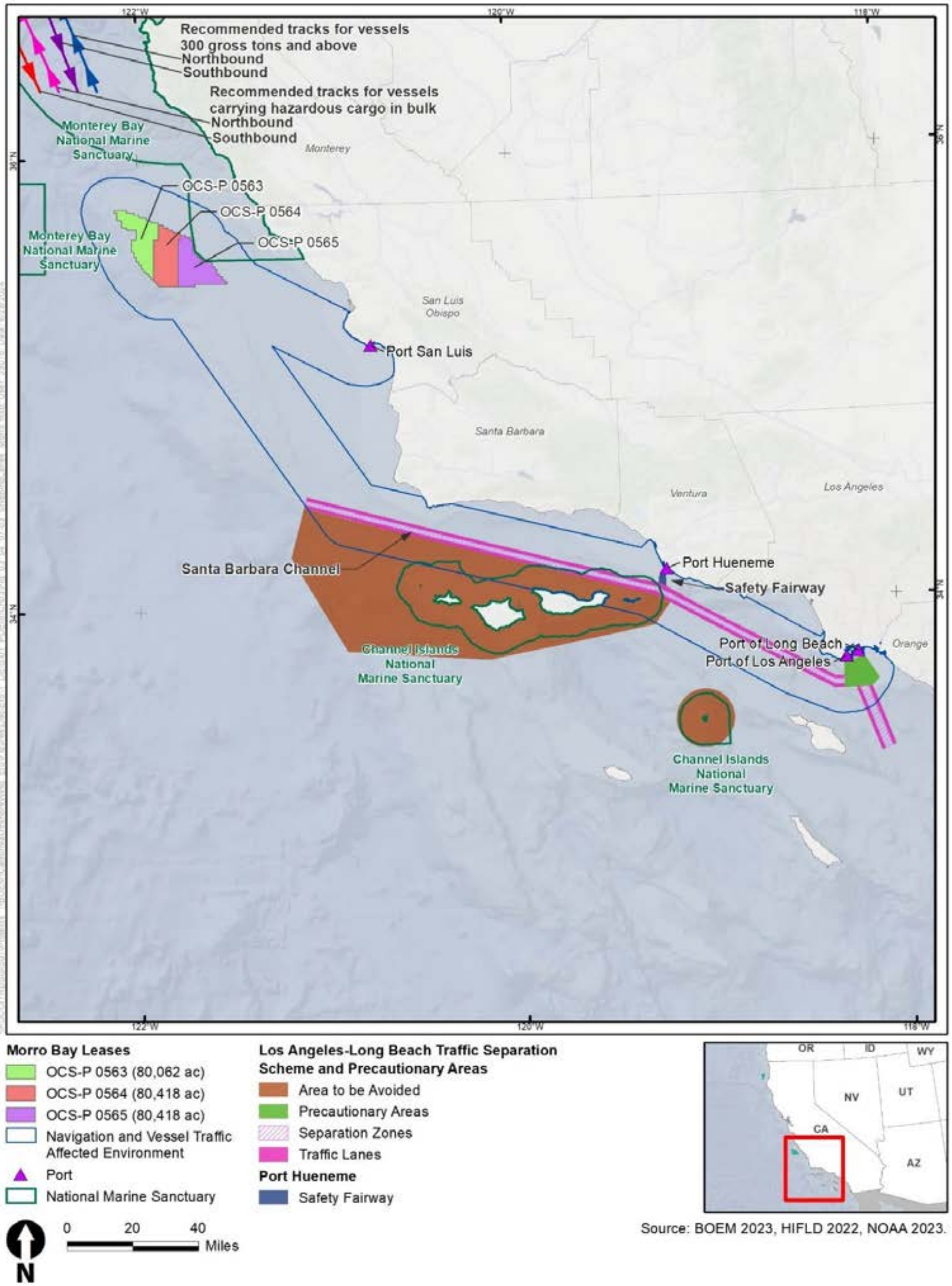


Figure 3.4.7-2. Humboldt WEA leases and nearby ports and routing measures



Source: BOEM 2023, HIFLD 2022, NOAA 2023.

Figure 3.4.7-3. Morro Bay WEA leases and nearby ports and routing measures

Figure 3.4.7-4 shows anchorages along the California coastline (from north of Humboldt Bay to Los Angeles/Long Beach).[8]

Access to Humboldt Bay is via the Humboldt Bay Bar Channel. Pilots are required on all vessels (drawing up to 38 feet) over 300 gross tons (Harbor Overview 2023; NOAA 2023a). There is a Regulated Navigation Area encompassing all navigable waters of the Humboldt Bay Bar Channel and Entrance Channel; a Security Zone is applicable to certain vessels in the bay.[9] There are no established anchorages in Humboldt Bay.[10]

While the Port of San Francisco is not in the Affected Environment, vessel traffic approaching or departing this port operates in the same general area as vessels transiting from or to the Humboldt and Morro Bay WEAs (Figure 3.4.7-2).[11] USCG operates a San Francisco Vessel Traffic Service (VTS) system along approximately 133 miles of waterway from offshore to the inland ports of Stockton and Sacramento (USCG 2023b). The VTS system is mandatory and, although regulatory jurisdiction is limited to the navigable waters of the United States, certain vessels are encouraged or may be required as a condition of port entry, to report to the Offshore Vessel Movement Reporting System established in the ocean approaches. Vessel traffic management regulations are covered in 33 CFR 161. Alongside the north TSS are two National Marine Sanctuaries: Greater Farallones and Cordell Bank. The Final PAC-PARS notes USCG's collaboration with NOAA and other groups to formulate the recommended navigation protocols in the San Francisco Bay area, emphasizing that that the current TSSs established in San Francisco Bay provide safe navigation corridors to meet the needs of vessels entering and departing the ports of San Francisco Bay (USCG 2023a). Sanctuary-wide prohibitions are listed in 15 CFR 922.82 (Greater Farallones) and 15 CFR 922.112 (Cordell Bank).

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[8] All anchorages except for offshore anchorages are labeled in accordance with 33 CFR Part 110. Within special anchorage areas (33 CFR 110.93–110.126a) vessels of less than 65 feet (20 meters) in length, when at anchor, will not be required to carry or exhibit anchorage lights. General anchorage areas noted on Figure 3.4.7-4 are described in 33 CFR 110.214–224 (Anchorage Grounds). Offshore anchorages are described in the Coast Pilot (NOAA 2023a).

[9] The Regulated Navigation Area requires the owner/operator of a tank vessel transporting oil or hazardous material as cargo to request and obtain permission within 4 hours of crossing the Humboldt Bay Bar (33 CFR 165.1195). A Security Zone designed to keep a 500-yard (457-meter) buffer around a tanker, cruise ship, or any other waterside asset of high value (including military vessels) applies to these types of vessels when transiting, anchored, or moored in Humboldt Bay (33 CFR 165.1183).

[10] Anchorage grounds (33 CFR 109.05) as identified in 33 CFR Part 110 are established and enforced by USCG for vessels whenever it is apparent that these are required by the maritime or commercial interests of the United States for safe navigation. The Coast Pilot (NOAA 2023) describes an offshore anchorage site about halfway between Prisoner Rock and Trinidad Head just north of Humboldt Bay (Figure 3.4.7-4).

[11] Parts of the charted Off San Francisco TSS have been amended by IMO and have not been updated in the CFR. Figure 3.4.7-2 has been prepared using the CFR coordinates. See IMO COLREG.2/Circ.64.

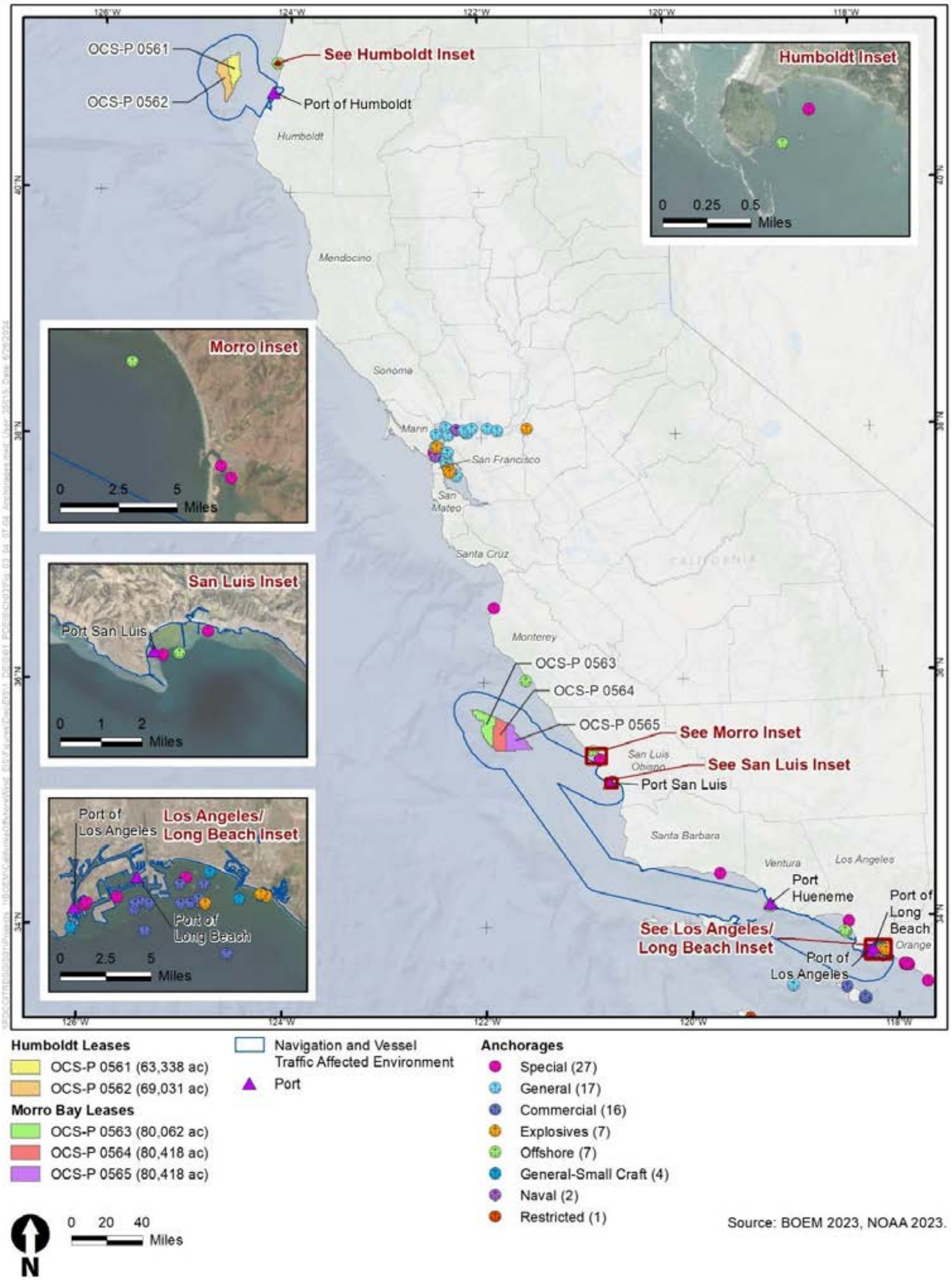

Figure 3.4.7-4. General anchorages and offshore anchorages along California coastline and ports

Port San Luis (Figure 3.4.7-3) is approximately 57 nm (105.6 kilometers) southeast of the Morro Bay lease area. Port San Luis is a small-craft harbor (ACOE 2023). There are approximately 165 privately owned moorings in the harbor, with additional seasonal mooring and guest spaces available (Port San Luis 2023, 2015, 2013). Anchoring for small craft is available in the port but is not recommended during inclement weather (NOAA 2023a). Port San Luis has a general anchorage and special anchorages (A-1 and A-2).[12] Refer to 33 CFR 110.1 and 110.120, for limits and special anchorage regulations. Mariners should contact the harbor master's office for anchorage information.[13]

Port Hueneme (Figure 3.4.7-3) is east of the Channel Islands, 60 miles (97 kilometers) northwest of Los Angeles. Port Hueneme is an inland basin partially under U.S. Navy jurisdiction (Naval Base Ventura County). The southeast part of the basin operates as a deep-draft commercial terminal by the Oxnard Harbor District. The port's approach has an established Safety Fairway (33 CFR 166.300).[14] Port Hueneme is a commercial port used by cargo vessels, general commercial and sport fishing craft, and offshore supply vessels. Port pilots are required for all commercial vessels 300 gross registered tons and over entering, leaving, or shifting within the port (NOAA 2023a:225–226; Port Facts 2023). There is no anchorage area in the Port Hueneme harbor basin. A recommended anchorage for deep-draft vessels is about 1.7 miles (2.7 kilometers) south of Port Hueneme Light (NOAA 2023a).

The Ports of Los Angeles and Long Beach are adjoining ports on the shores of San Pedro Bay (Figure 3.4.7-3). The bay is protected by breakwaters and is a safe harbor in any weather (NOAA 2023a). The distance between the seaward entrance to the two harbors is about 4 miles (6 kilometers). The Main Channel leads to the Port of Los Angeles terminals and berths. The Long Beach Channel leads to the Port of Long Beach terminals and berths. The Main Channel winds east and becomes the East Basin Channel and then the Cerritos Channel, which connects Los Angeles and Long Beach harbors along the north edge of Terminal Island.

The Los Angeles/Long Beach TSS consists of a Precautionary Area, a Western Approach, and a Southern Approach.[15] Vessel pilots board and deboard transiting vessels within the respective Pilot Operating Areas for each port. Normal Pilot Operating Areas are within the Precautionary Area. All vessels 300 gross registered tons and over and all foreign vessels leaving, entering, or shifting within the Ports of Los Angeles and Long Beach are subject to pilotage. Vessels sailing under U.S. enrollment (conducting coastwise trade) or engaged in the fishing trade and under the direction of an officer federally licensed for the port are exempt (NOAA 2023a).

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[12] Figure 3.4.7-4 identifies this general anchorage as "offshore" to avoid confusion with the codified "Anchorage Grounds" (33 CFR 110 Subpart B).

[13] Morro Bay Harbor sits just to the north of San Luis Obispo Bay and is on the edge of the Affected Environment boundary. Special anchorages are in Morro Bay, 1 and 2 miles (1.6 and 3.2 kilometers) above the entrance (33 CFR 110.1 and 110.125).

[14] The safety fairway at the approach to Port Hueneme was originally established by USACE (2023) and transferred to USCG in 1983 (48 *Federal Register* 49018-49019).

[15] Parts of the charted Los Angeles-Long Beach Traffic Separation Scheme have been amended by the IMO and have not been updated in the CFR. Figure 3.4.7-3 has been prepared using the CFR coordinates. See IMO COLREG.2/Circ.64.

The Port of Long Beach handles more than 9 million, 20-foot (6-meter) container units each year (Port of Los Angeles 2022). Crude oil, a top import, is transported in bulk. The port has 10 piers and 80 berths (Port of Long Beach 2023a). Tank vessels, roll-on/roll-off vessels (transporting automobiles), and cruise ships were also included in the 1,819 vessel arrivals in 2022. There are 25 cargo terminals encompassing over 100 berths (Port of Los Angeles 2022, 2024).

A Port of Los Angeles/Long Beach VTS is jointly operated by USCG and the Marine Exchange. The VTS area includes parts of the TSS Lanes and the Precautionary Area, as well as Santa Monica Bay farther northwest.[16] Vessel movements in the Port of Los Angeles/Long Beach are influenced at certain times and locations by Regulated Navigation Areas, Safety Zones, and Security Zones.[17]

Federal anchorage regulations for the Port of Los Angeles/Long Beach are prescribed in 33 CFR 110.1, 110.100, and 110.214.

Additional Vessel Navigation Considerations

The Monterey Bay National Marine Sanctuary extends south of the Greater Farallones National Marine Sanctuary to a point offshore of Cambria. The Coast Pilot (NOAA 2023a) delineates IMO-endorsed recommended tracks for vessels 300 gross tons and higher transiting the vicinity of this sanctuary (refer to the bottom of Figure 3.4.7-2 and top of Figure 3.4.7-3). Tank vessels are recommended to transit well offshore (at least 50 miles [80 kilometers]) from this sanctuary (NOAA 2023a); 15 CFR 922.132 lists sanctuary-wide prohibitions.

The Channel Islands National Marine Sanctuary lies almost due west of Port Hueneme and consists of an area of approximately 1,110 square nm (3,807 square kilometers) of coastal and ocean waters (including submerged lands). The sanctuary boundary extends seaward to approximately 6 nm (11.11 kilometers) from San Miguel Island, Santa Cruz Island, Santa Rosa Island, Anacapa Island, Santa Barbara Island, Richardson Rock, and Castle Rock. Sanctuary-wide prohibitions are listed in 15 CFR 922.72 and 922.73.

If adopted, the proposed Chumash Heritage National Marine Sanctuary would sit between the Monterey Bay and Channel Islands National Marine Sanctuaries (Figure 3.4.7-3). Although the proposed sanctuary's boundaries are still not fully determined (as of March 2024) the Agency-Preferred Alternative stretches along 134 miles (216 kilometers) of coastline and would encompass more than 5,600 square miles (9,012 square kilometers). Proposed sanctuary prohibitions applicable to vessels include deserting a vessel and discharges within or into the sanctuary (with exceptions) (NOAA 2023b).

Section 3.4.8, *Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys),* describes several danger zones and restricted areas in and near the Affected Environment for U.S. government military use. Commercial, fishing, and recreational vessels should use caution while transiting through these areas because naval test operations involve frequent vessel maneuvers. In some cases, areas may be temporarily closed to access. Regardless of location, in U.S. navigable waters,

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[16] For more information refer to: https://www.navcen.uscg.gov/vessel-traffic-services-locations and 33 CFR Part 161.

[17] See 33 CFR Subpart F for additional information about Safety and Security Zones applicable to San Pedro Bay.

baseline traffic may need to avoid naval vessel protection zones around U.S. naval vessels greater than 100 feet (30 meters) in length whether the large U.S. naval vessel is underway, anchored, moored, or within a floating dry dock (33 CFR 165.2030; NOAA 2023; NOAA chart 18022).

California MPAs are discrete marine or estuarine areas selected to protect the diversity and abundance of marine life, the habitats on which marine life depends, and the integrity of marine ecosystems. Non-extractive uses such as boating, swimming, etc. are allowed in MPAs, while extractive activities such as fishing or kelp harvesting are prohibited or limited in accordance with the type of MPA (CDFW 2024). MPAs are within state (territorial) waters and some are marked with buoys. Management of MPAs is governed by 14 CCR Part 632.

Vessel speeds have a close association with vessel maneuverability and stopping distances, both critical factors for safe navigation. Blue Whales/Blue Skies is a voluntary vessel speed monitoring program designed to reduce both the risk of fatal whale strikes and harmful air pollution emissions. Participating companies with a certain percentage of vessels that travel at a speed of 10 knots (18.5 kilometers) per hour or less in established speed reduction zones from mid-May to December will earn recognition and financial incentive payments. The two speed reduction zones are along the Southern California coast and outside the San Francisco Bay Area (Blue Whales VSR 2022).

The USCG Eleventh District uses the Local Notice to Mariners as the primary means for disseminating information concerning aids to navigation, hazards to navigation, and other items of interest to mariners on waters of the United States, territories, and possessions within the jurisdiction of the District Commander (33 CFR 3.55-1–3.55-25). For example, Local Notice to Mariners will include dates, times, and locations advising mariners of U.S. government offshore activities as described in Section 3.4.8.[18]

Vessel Traffic

BOEM reviewed 4 years of Automatic Identification System (AIS) vessel traffic for this analysis, summarized in the following tables and figures.[19] [20]

- Table 3.4.7-2 shows unique vessel counts in each Humboldt lease area; Table 3.4.7-3 shows similar information for Morro Bay.
- Figure 3.4.7-5 through Figure 3.4.7-9 show graphs representing vessel types as percentages.

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[18] https://www.dco.uscg.mil/Featured-Content/Mariners/Local-Notice-to-Mariners-LNMs/District-11/

[19] Years reviewed were 2017, 2019, 2021, and 2022. Data for vessel traffic analysis was extracted from marinecadastre.gov; 2017 data were extracted for a baseline comparison with the more recent data; 2020 data were assumed to be skewed due to the COVID 19 pandemic and were not included.

[20] AIS is required only on commercial vessels with a length of 65 feet (19.8 meters) or longer. It is likely that non-AIS commercial and recreational vessels navigate through the WEAs; therefore, AIS track counts for fishing and pleasure vessels in Table 3.4.7-2 and Table 3.4.7-3 underrepresent these vessel types. U.S. AIS carriage requirements are proscribed in 33 CFR 164.01, 164.02, 164.46, and 164.53. They are available for reference at https://www.navcen.uscg.gov/ais-requirements.

- Figure 3.4.7-10 (Humboldt WEA) and Figure 3.4.7-11 (Morro Bay WEA) show 2022 track lines for certain vessel types (cargo, fishing, pleasure/sailing, tanker, tug tow).[21]

Vessel traffic transiting the Humboldt WEA consists largely of pleasure craft and cargo vessels, although fishing vessels logged the majority of hours (95,717 hours) during the 4 years analyzed. Cargo vessels dominated the vessel traffic numbers in the Morro Bay WEA averaging 60 percent or over in vessel count volume over the 4 years of data.

Table 3.4.7-2. Humboldt WEA—Number of AIS vessels for 2017, 2019, 2021, 2022

Vessel Type	2017	2019	2021	2022
Lease OCS-P 0561				
Cargo	25	24	37	22
Fishing	21	21	21	27
Passenger	6	3	4	6
Pleasure Craft/Sailing	53	52	68	76
Tanker	-	-	2	2
Tug Tow	17	16	26	24
Other	18	17	21	18
Not Available	24	21	13	5
Total	**164**	**154**	**192**	**180**
Lease OCS-P 0562				
Cargo	78	73	84	74
Fishing	16	12	10	19
Passenger	12	11	1	9
Pleasure Craft/Sailing	30	49	56	58
Tanker	-	1	2	4
Tug Tow	22	18	19	26
Other	17	23	22	21
Not Available	25	23	14	4
Total	**200**	**210**	**208**	**215**

Note: Data were extracted and grouped using the following AIS ship type codes:
0/null (null/unavailable)
30 (fishing)
31, 32, 52 (Towing, Tug)
36, 37 (Recreational or Pleasure Craft/Sailing)
60–69 (Passenger)
70–79 (Cargo)
80–89 (Tanker)
90–99 (Other such as pilot vessels, law enforcement vessels, and medical transport vessels)

[21] One year of data allows for a detailed visual of density comparisons across vessel types.

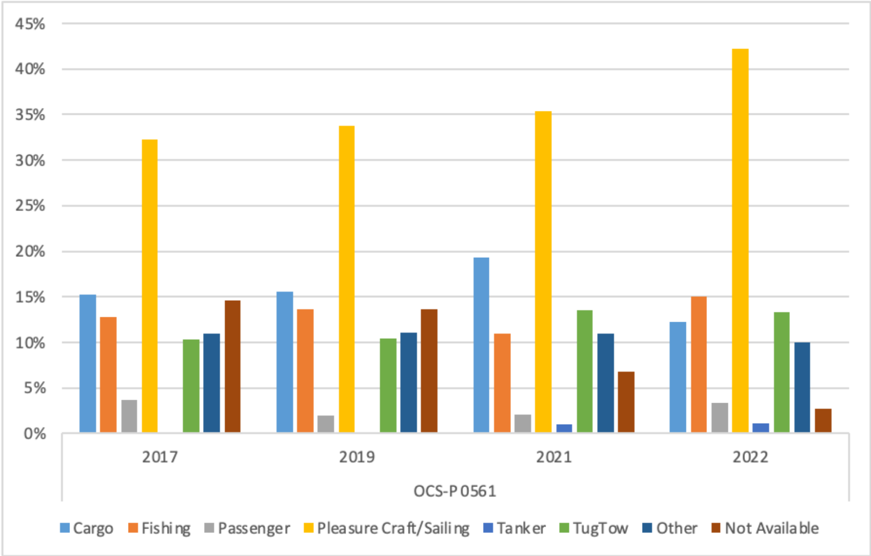

Figure 3.4.7-5. Vessel types as percentages (Lease OCS-P 0561)

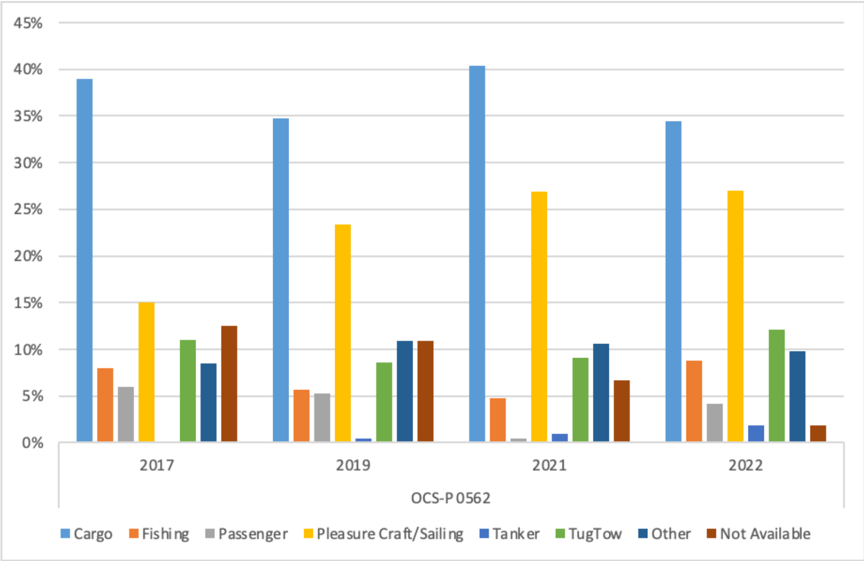

Figure 3.4.7-6. Vessel types as percentages (Lease OCS-P 0562)

Table 3.4.7-3. Morro Bay WEA—Number of AIS vessels for 2017, 2019, 2021, 2022

Vessel Type	2017	2019	2021	2022
Lease OCS-P 0563				
Cargo	388	345	434	416
Fishing	10	2	4	4
Passenger	20	23	9	25
Pleasure Craft/Sailing	27	24	46	34
Tanker	113	87	95	88
Tug Tow	19	23	28	29
Other	20	27	26	23
Not Available	23	67	61	6
Total	**620**	**598**	**703**	**625**
Lease OCS-P 0564				
Cargo	449	399	457	406
Fishing	11	4	6	5
Passenger	28	25	9	24
Pleasure Craft/Sailing	35	34	58	49
Tanker	107	80	82	81
Tug Tow	24	26	27	29
Other	21	29	29	25
Not Available	22	76	63	8
Total	**697**	**673**	**731**	**627**
Lease OCS-P 0565				
Cargo	439	384	393	284
Fishing	12	9	7	9
Passenger	19	17	4	8
Pleasure Craft/Sailing	48	55	76	49
Tanker	68	46	51	45
Tug Tow	23	23	27	29
Other	19	26	27	21
Not Available	29	79	64	5
Total	**657**	**639**	**649**	**450**

Note: Data were extracted and grouped using the following AIS ship type codes:
- 0/null (null/unavailable)
- 30 (fishing)
- 31, 32, 52 (Towing, Tug)
- 36, 37 (Recreational or Pleasure Craft and Sailing)
- 60–69 (Passenger)
- 70–79 (Cargo)
- 80–89 (Tanker)
- 90–99 (Other such as pilot vessels, law enforcement vessels, and medical transport vessels)

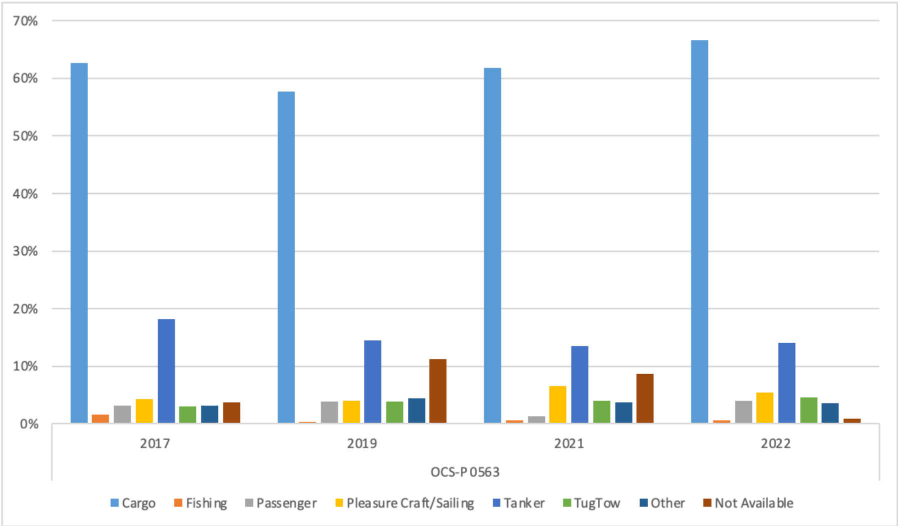

Figure 3.4.7-7. Vessel types as percentages (Lease OCS-P 0563)

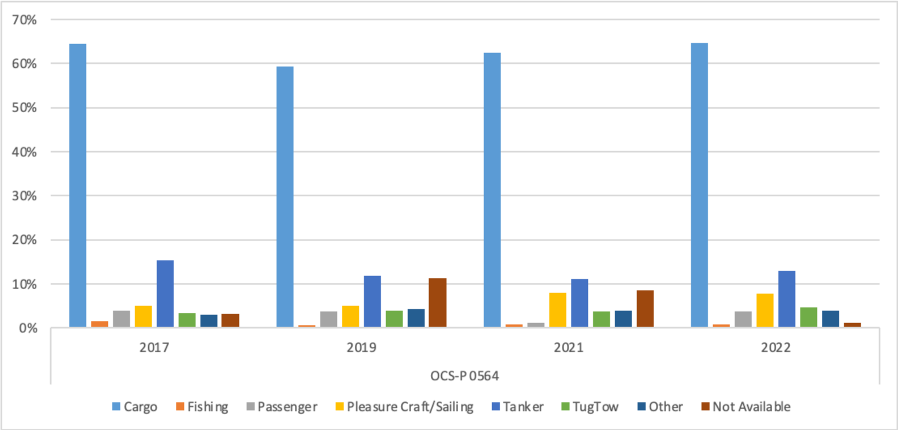

Figure 3.4.7-8. Vessel types as percentages (Lease OCS-P 0564)

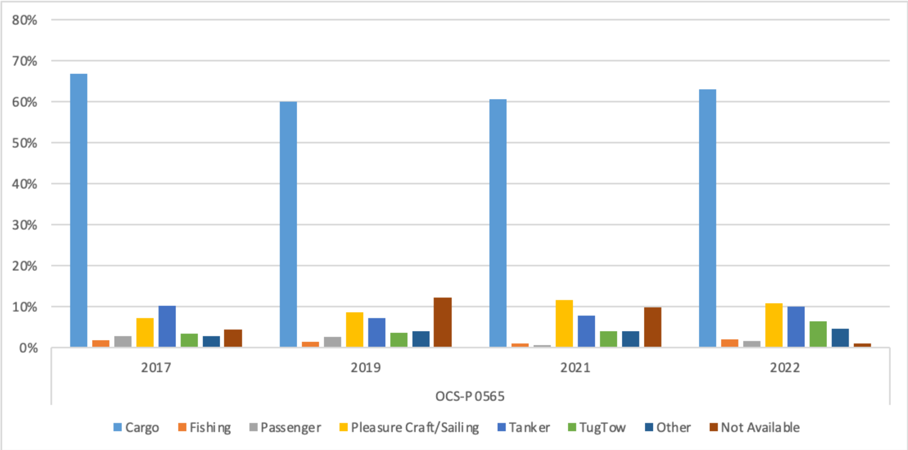

Figure 3.4.7-9. Vessel types as percentages (Lease OCS-P 0565)

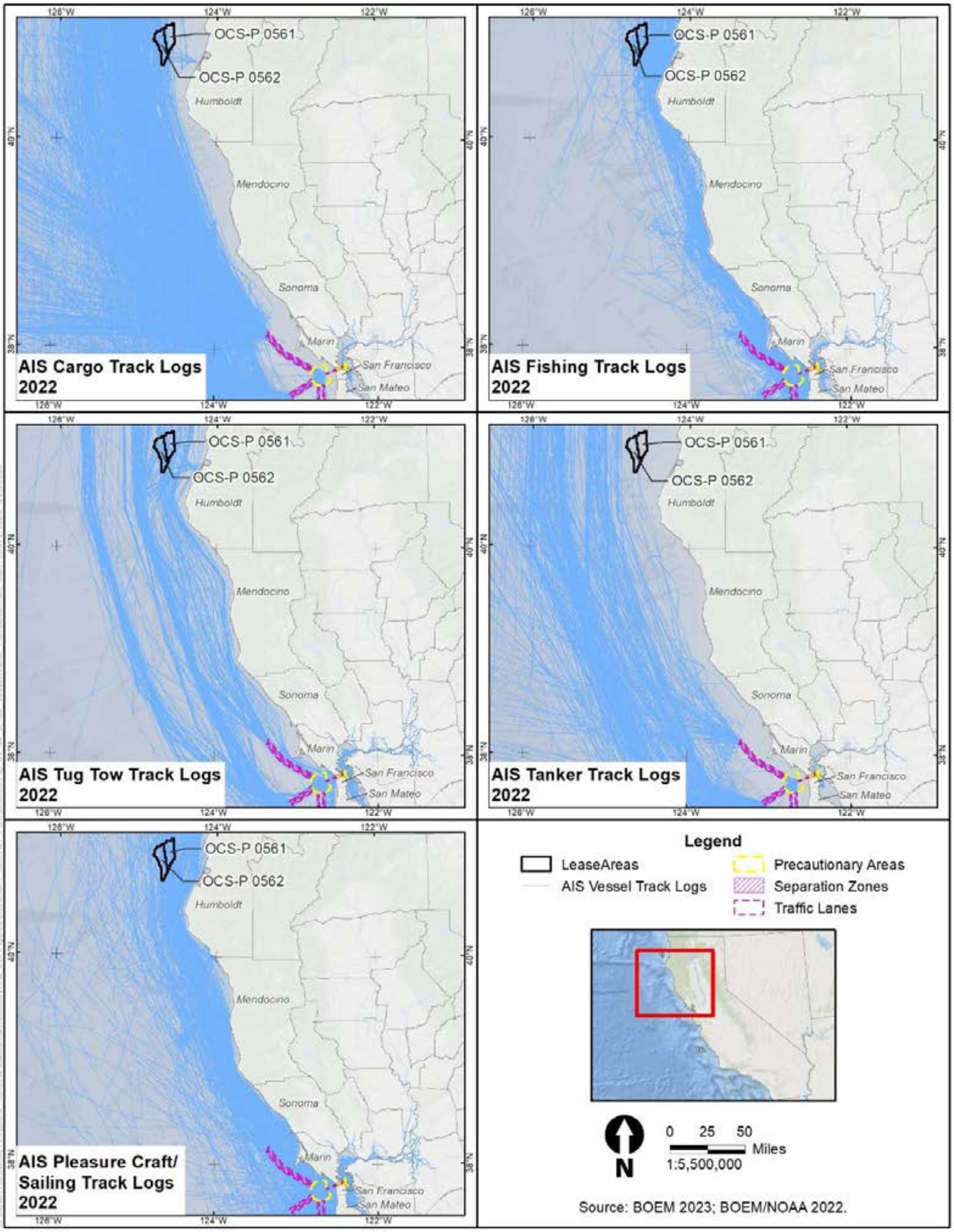

Figure 3.4.7-10. Humboldt WEA vessel track lines (2022)

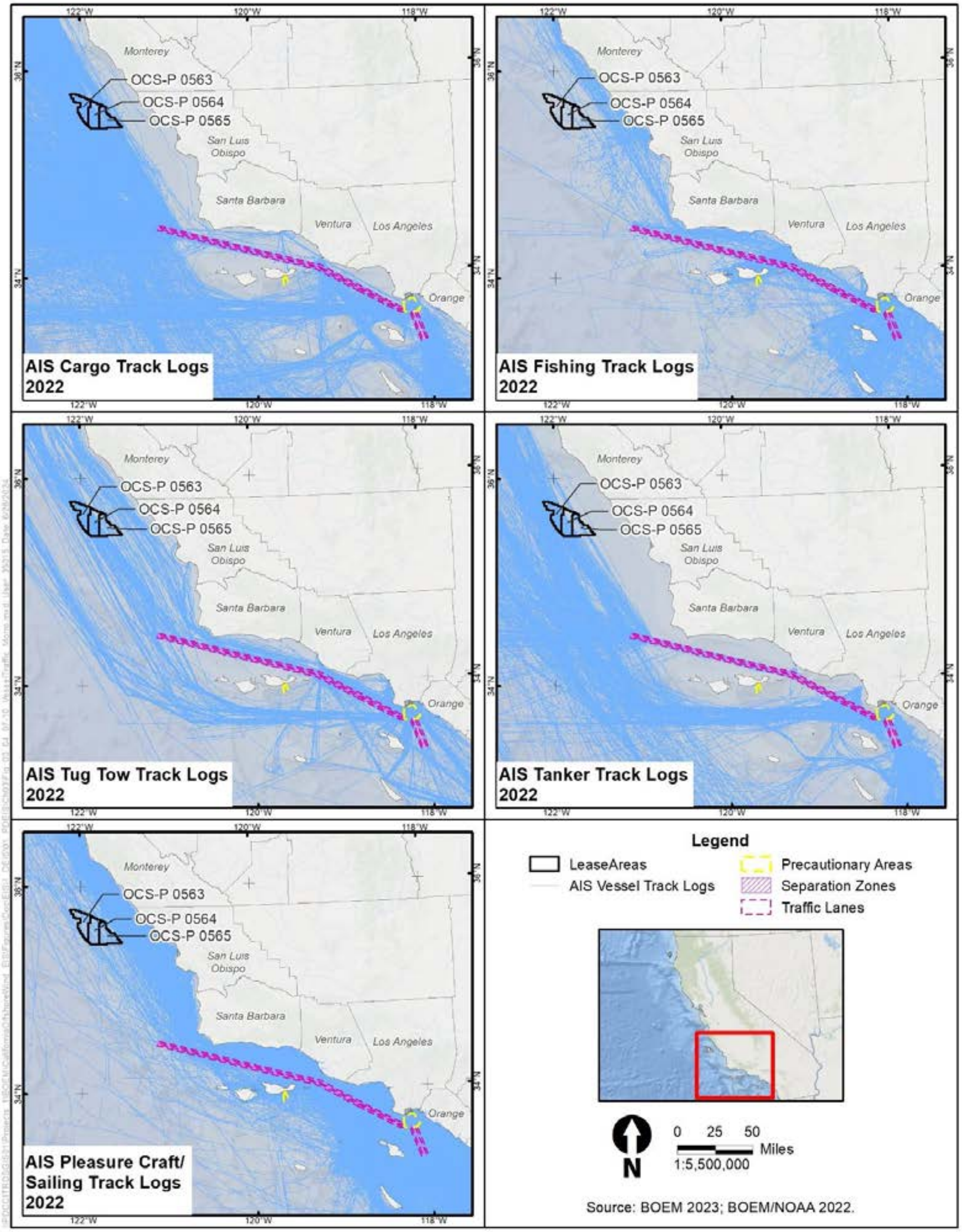

Figure 3.4.7-11. Morro Bay WEA vessel track lines (2022)

Aids to Navigation and Weather Buoys

USCG has developed and maintains federal aids to navigation (ATON) to assist mariners in determining their position and identifying safe courses. In some instances, ATONs warn of dangers and obstructions. PATON are owned and maintained by any individual or organization other than USCG. Other ATONs in the vicinity of the WEAs include radar transponders (such as lights, sound horns, buoys, and onshore lighthouses).

Refer to Figure 3.4.7-12 (Humboldt WEA) and Figure 3.4.7-13 (Morro Bay WEA) for a visual of federal ATON, PATON, and NOAA, National Weather Service weather buoy locations.

NOAA, National Data Buoy Center operates weather buoys in coastal and offshore waters from the western Atlantic Ocean to the Pacific Ocean, and from the Bering Sea to the South Pacific. Weather buoys are moored to ensure optimum performance in the environment in which they operate. NOAA, NDBC 46028 weather buoy, due north of OCS-P-0563 and OCS-P-564 (Morro Bay lease) is the closest weather buoy to the proposed WEAs (2.3 nm [4.3 kilometers] from the northern edge of OCS-P 0563 and 3.46 nm [6.41 kilometers] from the northern edge of OCS-P 0564).

On October 3, 2020, the U.S. Department of Energy Pacific Northwest National Laboratory deployed a meteorological buoy within the Humboldt WEA. The buoy Wind Sentinel (120) gathered meteorological and oceanographic data from the date of deployment to July 7, 2022 (BOEM 2022; USDOE 2023).

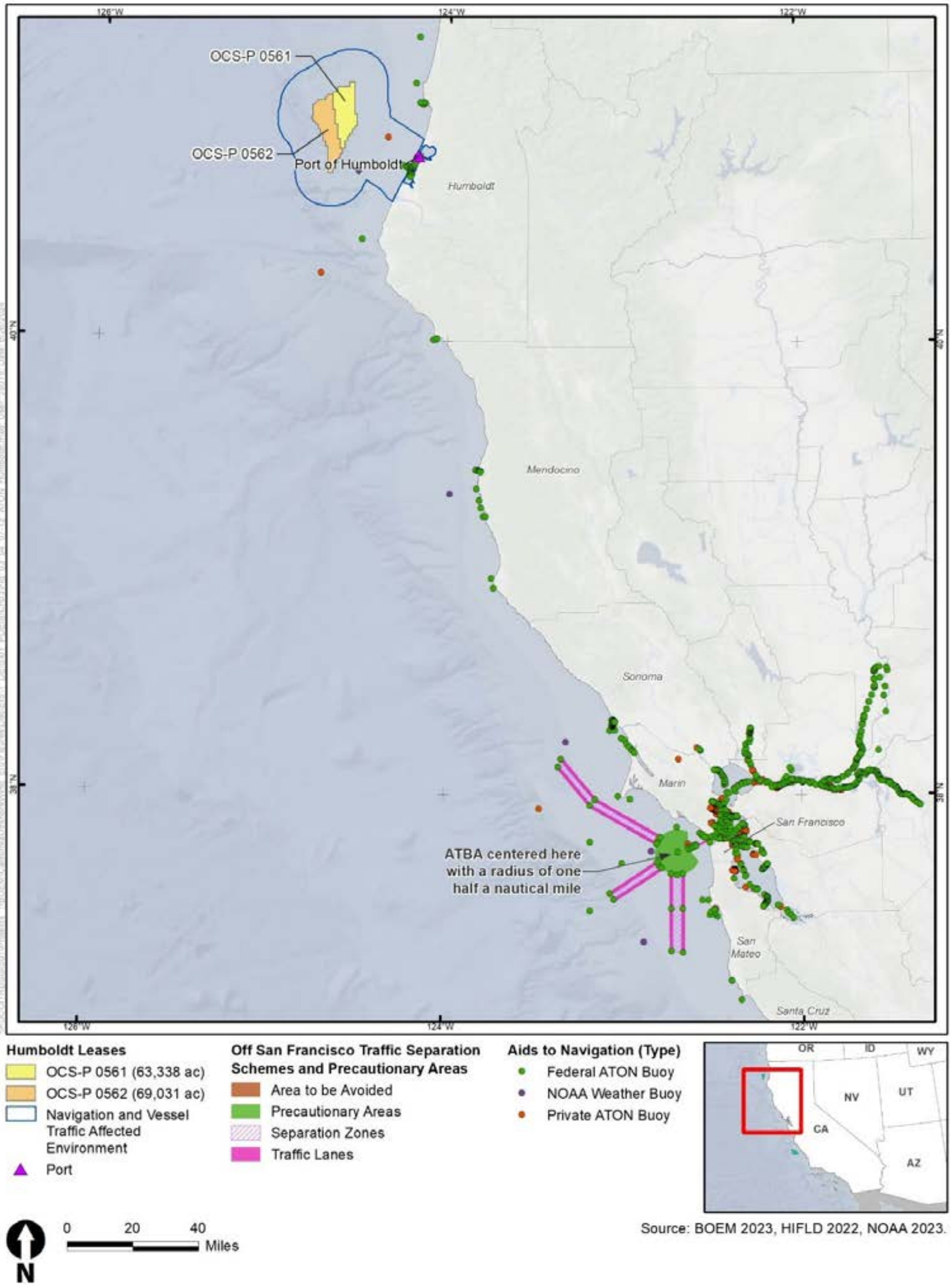

Figure 3.4.7-12. ATON and PATON in and around the Humboldt WEA

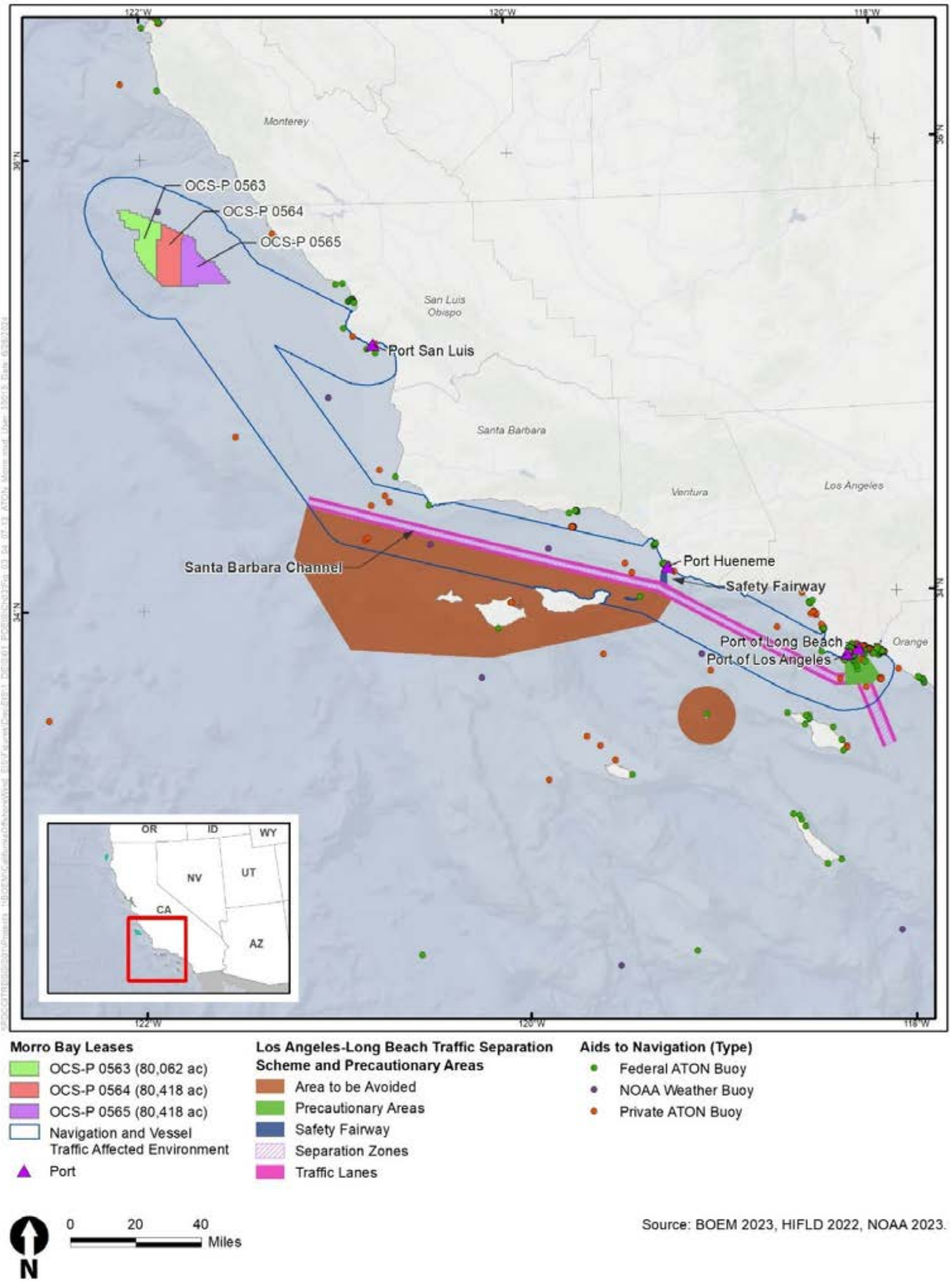

Figure 3.4.7-13. ATON and PATON in and around the Morro Bay WEA

3.4.7.2 Impact Background for Navigation and Vessel Traffic

Anchoring, cable installation and maintenance, port utilization, presence of structures, and vessel traffic are contributing IPFs to impacts on navigation and vessel traffic. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.4.7-4. Refer to Section 3.1.2, *Impact Terminology*, for background on beneficial impacts.

Table 3.4.7-4. Issues and indicators to assess impacts on navigation and vessel traffic

Issue	Impact Indicator
Vessel or structural damage due to incident	Increased frequency of strikes/allisions, collisions, and groundings due to restricted vessel movement.
Navigation risk	Changes to navigational patterns and increased risk of navigational hazards.
Port expansion	Changes to port accessibility depending on port construction or maintenance.
Port congestion	Increased delays for vessels to get berthing or services.
Increased vessel traffic	Increased frequency of vessel incidents, delays in berthing, and services.

3.4.7.3 Impacts of Alternative A – No Action – Navigation and Vessel Traffic

When analyzing the impacts of the No Action Alternative on navigation and vessel traffic, BOEM considers the impacts of ongoing activities, including ongoing non-offshore wind activities on the baseline conditions for navigation and vessel traffic. The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative on existing baseline trends, including other planned offshore and non-offshore wind activities, which are described in Appendix C.

3.4.7.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for navigation and vessel traffic described in Section 3.4.7.1, *Description of the Affected Environment and Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. Ongoing activities that affect navigation and vessel traffic in the Affected Environment include oil and gas activities, undersea cable installation/maintenance, military use, fishing, and port expansion. Impacts from these activities would increase or otherwise influence vessel traffic in the area, adding to congestion in waterways and ports and increasing the potential for maritime accidents. There are no ongoing offshore wind projects off the west coast.

3.4.7.3.2 Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative on existing baseline trends, including other planned offshore and non-offshore wind activities (without the five representative projects in the Humboldt and Morro Bay lease areas). Planned activities that would affect navigation and vessel traffic in the Affected Environment include dredging and port improvement projects, the late 2024/early 2025 designation of the Chumash Heritage National Marine Sanctuary), and offshore cable or pipeline installation and maintenance (refer to Appendix C for a description of planned activities). Some of these activities may result in short-term increases in vessel traffic. Others, like the Chumash Heritage National Marine Sanctuary, could divert some vessels further offshore given the sanctuary's restrictions on discharges (NOAA, NMS 2023).

Site characterization and site assessment activities of the two Oregon WEAs may affect navigation and vessel traffic in the Affected Environment depending on the ports used. The Proposed Action included vessel transit routes to and from ports located 88 miles or less from the Brookings and Coos Bay WEAs (BOEM 2024), including the ports of Crescent City and Humboldt Bay (Eureka) located in Northern California.

The following summarizes potential impacts of ongoing and planned activities in the Affected Environment on navigation and vessel traffic.

Anchoring: Risk of emergency anchoring impacts for deep-draft vessels is highly unlikely. Generally, larger vessels accidently dropping anchor on top of a submarine cable (buried or otherwise protected) to prevent drifting in the event of vessel power failure could result in damage to the cable, risks associated with an anchor contacting an electrified cable, and impacts on the vessel operator's liability and insurance. Impacts on navigation and vessel traffic would likely be short term; navigation and vessel traffic would be expected to fully recover following the incident.

Cable installation and maintenance: Installation of submarine cables or pipelines (Section 3.4.8) would generate vessel traffic adding slower-moving vessel traffic above cable and pipeline routes. Maintenance on existing submarine cables or offshore oil and gas pipelines (Section 3.4.8) is expected to have similar impacts. Impacts of cable installation and maintenance on navigation and vessel traffic would be long term.

Port utilization: Ongoing and planned port improvements in the Affected Environment are managed at the federal level (USACE), at the local (city) level (i.e., City of Los Angeles for Los Angeles Harbor), or privately under contract per port lease agreements. Federal USACE coastal navigation projects are generally new channel construction and dredging of existing channels to maintain depths (USACE 2024a). For example, a dredging project in 2024 is tentatively planned for the Humboldt bar and channel (USACE 2024b). Independent of any particular offshore wind project, multiple ports in California are investing in expanding and modifying port facilities to accommodate increasing demand (Appendix C). Port expansion and modification could include dredging and structure reinforcement at existing berths and the addition of new berths and could have short-term impacts on navigation and vessel traffic during port infrastructure improvement activities with permanent beneficial socioeconomic impacts (Table 3.1-1) after improvements are completed.

The Oregon WEAs may benefit from planned port expansions and modifications (Appendix C, Section 2.5) within or in proximity to the Affected Environment depending on the timing of these improvements and prospective improvement projects at Oregon ports. During peak site characterization and site assessment, impacts on port utilization would be short term at the ports and within the maritime approaches.

Vessel traffic: Designation of the Chumash Heritage National Marine Sanctuary could divert some vessel traffic, such as tank vessels and cargo ships greater than 300 gross tons, farther offshore, due to renewed emphasis on the West Coast Offshore Vessel Traffic Risk Management Project recommendations (NOAA 2023a, 2023c; Pacific States/British Columbia and USCG Oil Spill Task Force 2002).

Vessel traffic associated with the Oregon WEAs, could impede or create space use conflicts with vessel traffic within the Affected Environment depending on the ports used for site characterization and site-assessment activities. Impacts on baseline navigation and vessel traffic would likely be short term as site survey and assessment activities would be staggered in time, and vessel conflicts in California ports would only be expected for the Brookings WEA (BOEM 2024).

3.4.7.3.3 Conclusions

Impacts of the No Action Alternative: Under the No Action Alternative, navigation and vessel traffic would continue to be affected by existing socioeconomic trends and ongoing activities. BOEM expects ongoing activities to have continuing short- and long-term impacts on navigation and vessel traffic, primarily through the IPFs of anchoring, cable installation and maintenance, port utilization, and vessel traffic.

Cumulative Impacts of the No Action Alternative: Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and navigation and vessel traffic would continue to be affected by the primary IPFs of anchoring, cable installation and maintenance, port utilization, and vessel traffic. Planned activities, including port expansion, new cable installation and maintenance, and the late 2024/early 2025 designation of the Chumash Heritage National Marine Sanctuary would also contribute to impacts on navigation and vessel traffic. BOEM anticipates that the overall effect for most impacts would be noticeable, but vessels would be able to adjust to account for disruptions.

3.4.7.4 Impacts of Alternative B – Development with No Mitigation Measures – Navigation and Vessel Traffic

Impacts of Alternative B would include increased vessel traffic in and near the WEAs and on the approach to ports used in the development of the Humboldt and Morro Bay lease areas. Navigation impacts are likely to include changes to vessel traffic patterns as well as the effectiveness of marine radar and other vessel navigation tools (such as meteorological buoys) at or near operating WTGs. Collectively, this could result in the increased risk of incidents such as collision and allision, which could result in personal injury or loss of life from a marine casualty, damage to boats or turbines, and oil spills. The following summarizes the potential impacts of offshore wind activities in the Affected Environment on navigation and vessel traffic during construction, O&M, and decommissioning of wind energy projects.

3.4.7.4.1 Impacts of One Representative Project in Each WEA

In the context of this analysis, anchoring addresses potential impacts on the use of existing deep-draft vessel anchorages identified in the Affected Environment (Figure 3.4.7-4), as well as emergency anchoring that could result in a vessel anchor hitting an offshore wind-related buried export cable or fouling in mooring lines and array cables.

Anchoring: There are no established anchorages in the Humboldt WEA Affected Environment. North of the Port of Humboldt there is a special anchorage (locally regulated) in Trinidad Bay (33 CFR 110.127c) and an offshore anchorage about halfway between Prisoner Rock and Trinidad Head (NOAA 2023). In the Morro Bay WEA Affected Environment there are established anchorages in Port San Luis and in the Port of Los Angeles/Long Beach. An offshore anchorage used by deep-draft vessels is 1.7 miles (2.7 kilometers) south of Port Hueneme Light (Figure 3.4.7-4). Deviations from "normal" anchorage activities, such as vessels anchoring in an emergency scenario, pose a potential hazard to subsea cables. Depending on the anchor weight, vessels with a tonnage greater than 10,000 deadweight tonnage would be the most likely to carry anchors that could penetrate to cable burial depth if anchoring in an emergency scenario in the vicinity of the export cable corridor (Sharples 2011). The risk of an emergency scenario resulting in an anchor release occurring in the vicinity of a representative project's cable route is low and, if the cable is hit and damaged, would result in short-term due to additional vessel traffic required for investigation and repairs.[22]

Within the perimeter of a developed lease area, mooring lines and interarray cables would be suspended in the water column and could become entangled with vessel anchor chains should anchoring be attempted nearby. However, minimum water depths of each WEA (Humboldt = 1,640 feet [500 meters] and Morro Bay = 2,952 feet [900 meters] per BOEM 2022a, 2022b) would require long and heavy anchor ground tackle most likely not found on smaller vessels. Because larger vessels would avoid the area, it is unlikely that anchor chain entanglement would occur in or near the WEAs. Commercial and recreational vessels would likely avoid anchoring in or near the developed lease area, reducing the potential and severity of impacts.

Cable installation and maintenance: One representative project in each WEA would require installation of submarine export cables and interarray cables. During construction and decommissioning, cable installation activities could affect access to anchorage areas and typical vessel routes. Likewise, during O&M, cable maintenance for one representative project in each WEA could displace routine vessel operations near cable routes. The presence of slow-moving or stationary construction or maintenance vessels would increase the risk of collisions and spills. Vessels not involved in cable installation or maintenance would need to take additional care when crossing cable routes or avoid such areas when installation/maintenance activities are in progress. The presence of construction or maintenance vessels would have intermittent, short-term impacts on navigation and vessel traffic depending on cable routes.

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[22] The most significant impact on the vessel owner would be economic because the repair of broken cables is expensive (Sharples 2011:111).

Port utilization: During construction and O&M, one representative project in each WEA would generate vessel traffic at anticipated ports and their approaching waterways (Table 3.4.7-1). Construction would generate trips by various vessels, such as installation, cable-laying, support, transport/feeder, deck carriers, and crew vessels, along with miscellaneous vessels such as those needed for security purposes. Typical types of O&M vessels include those used for crew transfer and service operation (Shields 2023).

One representative project in each WEA would require more than one type of port site for development.[23] After manufacturing of components at manufacturing/fabrication port sites, these components would be transported to staging and integration sites for final integration, likely by deck carrier vessels (Rüde 2023). After final assembly, construction vessels would transport components from staging and integration sites directly to each of the Humboldt or Morro Bay lease areas. At the project level in the future, BOEM would analyze the ports to be used, for what purpose, and at what intensity, all of which are not known at the time of this programmatic.

The presence of various construction vessels could cause port and waterway congestion and delays for existing vessel traffic. It could also cause some fishing or recreational vessel operators to change routes or use an alternate port. Project vessels may need to travel farther or contend with port improvement projects, as discussed in Section 3.4.7.1.1, *Regional Setting*. The impacts of one representative project in each WEA on vessel traffic due to port utilization would be short term and continuous through construction and decommissioning, and intermittent and long term during O&M.

Presence of structures: Development of one representative project would include up to 200 WTGs and 6 OSSs, operating for approximately 35 years in areas where no such structures currently exist. As of March 2024, there are no formal routing measures in the Affected Environment that would be altered by the presence of the structures for one representative project. Although larger vessels have historically transited through the Humboldt and Morro Bay WEAs, BOEM expects that larger vessels would avoid turbine arrays and navigate around them during construction, as well as once the lease areas are developed. Cargo vessels, cruise ships, tankers, and tug tows would continue to follow the main vessel traffic routes in the vicinity of any of the five subject lease areas. For all current routing measures, the Humboldt and Morro Bay lease areas exceed the USCG recommend 2-nautical-mile (3.7-kilometer) buffer from the parallel outer or seaward boundary of a traffic lane and a 5-nautical-mile (9.3-kilometer) buffer from the entry/exit of a TSS (USCG 2019b).

The USCG Eleventh District offshore fairway system recommended routes within the PAC-PARS considered future offshore wind development in the Humboldt WEA (PAC-PARS, Appendix I and Appendix II). The main trunk of the recommended north–south voluntary fairway is 15 nm (27.8 kilometers) wide to provide sufficient navigational flexibility for vessels to transit around arrays located on the west side of the Humboldt WEA (OCS-P 0562) or the southwest side of the Morro Bay WEA (OCS-P 0563 and OCS-P 0564). The USCG Eleventh District fairway system port approaches were designed to

[23] Primary types of port sites needed for offshore wind energy are manufacturing/fabrication, staging and integration, and O&M. Ports along the California coast have different types of infrastructure and capabilities, which may or may not be a good match to design requirements for offshore wind energy port sites (Shields 2023; Trowbridge 2023).

allow, at a minimum, a 5-nautical-mile (9.3-kilometer) maneuvering area for vessels transiting from the north or from the south to approach the Port of Humboldt.[24] The closest routing measures to the Morro Bay WEA are the Santa Barbara Channel approximately 75 nm (139 kilometers) to the south and the San Francisco TSS, approximately 111 nm (206 kilometers) to the north (Figure 3.4.7-2 and Figure 3.4.7-3). The Humboldt and Morro Bay lease areas do not intersect the USCG-proposed fairways and would not affect implementation of these fairways if they are formally established.

Offshore construction of floating WTGs and OSSs would be progressive, with project vessels moving from one structure location to the next as the array increases in size. Each new structure would present an increased risk of allision. Once completed, structures for one developed wind area would pose a risk of allision either from smaller vessels transiting in the wind farm area or from passing commercial vessels. The increased risk of allisions would, in turn, increase the risk of spills (refer to Section 3.2.2, *Water Quality*, for the likelihood of spills), vessel foundering, engagement of USCG SAR activities, injuries, and loss of life.

The anticipated minimum spacing of the structures once the lease areas are developed would be from 0.5 nm (920 meters) up to 1.6 nm (3 kilometers). Smaller vessels, such as recreational or fishing vessels, would continue to be able to navigate the lease areas, although the minimum structure spacing of 0.5 nm (920 meters) would result in greater challenges to navigating than wider spacing (e.g., 1 nm [1.9 kilometer] or more).[25] Lessees would be required to properly mark and light the WTGs and OSSs in accordance with USCG and BOEM requirements (BOEM 2021), which could serve as additional ATONs. Smaller static and mobile gear fishing vessels, like all vessels, would not be prohibited from transiting or fishing within the array; however, vessel operators would need to take the WTGs and OSSs into account as they set their courses through the lease area and would need to take care when fishing near the WTGs and OSSs to avoid snagging fishing equipment on underwater mooring lines and interarray cables.

Smaller vessels navigating within a developed wind lease area would need to navigate with more caution than is currently necessary to avoid WTGs and OSSs, as well as other vessel traffic, especially during inclement weather. Increased navigational awareness while navigating through WTGs could lead to increased crew fatigue, which could also increase the risk of allision or collision and resultant injury or loss of life. To avoid allision risk, commercial vessels would likely navigate around rather than through a developed wind area.

Marine vessel radars are not optimized to operate in a WTG environment due to a combination of factors ranging from the slow adoption of solid-state technology to the electromagnetic characteristics of WTGs (National Academies of Sciences, Engineering, and Medicine 2022). Therefore, marine radar on vessels near or in the developed wind farm area would likely be affected during O&M, although other

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[24] Lease OCS-P 0561 is 2.7 statute miles (2.3 nm) distant from the west-most edge of the northern port approach of the Port of Humboldt fairway.

[25] In a 2021 personal communication with BOEM, USCG advised that the "minimum width between offshore structures for the safe navigation of vessels less than 200 feet in length is between 0.53 to 1.08 nm, with 0.80 to 1.08 nm being preferred."(Detweiler 2021)

navigational tools are available.[26] BOEM expects the industry to adopt both technological and non-technology-based measures to reduce impacts on marine radar, including greater use of AIS and electronic charting systems, new technologies like LiDAR, employing more watchstanders, and avoiding wind farms altogether.

The navigational complexity of transiting through a wind farm area, including the potential effects of WTGs and OSSs on marine radars, would increase risk of allision with a structure or collision with other vessels. Furthermore, the presence of WTGs and OSSs could complicate offshore SAR operations or surveillance missions in a developed wind farm area and USCG SAR efforts may be negatively affected. Presence of structures impacts on navigation and vessel traffic would be long term and severe, depending on vessel types and routes.

Vessel traffic: Impacts from one representative project would include increased project vessel traffic in and near the associated lease area, on the approach to ports used by each lease area lessee, and at associated ports and anchorages. Various vessel types (installation, cable-laying, support, transport/feeder, deck carriers, and crew vessels) would be deployed from port sites throughout the project area during the construction phase, increasing the risk of allisions and collisions. Additional construction vessels would add congestion to already busy waterways, such as the Port of Los Angeles/Long Beach. The greatest disruption to baseline commercial vessel traffic would likely be during cable installation depending on cable routes.

After construction, related vessel activity would decrease. Vessel activity related to the operation of offshore wind facilities would consist of scheduled inspection and maintenance activities. Project vessel activity would increase again during decommissioning, with intensity and impacts similar to those described for construction.

Impacts on navigation and vessel traffic in the vicinity of an operating wind farm would be specific to different waterway users. Deep-draft commercial vessels (cargo vessels and tank vessels) and, to a lesser degree, pleasure craft and tug tows currently transit through the Morro Bay WEA. Deep-draft commercial vessels and tug tows would likely navigate around construction vessel activity. A large percentage of the vessel traffic that currently transits through the Humboldt WEA (especially OCS-P 0561) is recreational/pleasure craft. Cargo vessels dominate track lines through OCS-P 0562 and would likely deviate from the construction activity. Impacts on vessel traffic would likely be the greatest associated with OCS-P 0561 because of its proximity to the entry point for the Port of Humboldt Bay. However, vessel volume in this area is relatively lower (Tables 3.4.7-2 and 3.4.7-3) than other areas in the Affected Environment.

Recreational vessels and commercial fishing vessels could experience deviations from planned routes during construction as many vessels would likely choose not to pass through the WEA during construction due to the presence of construction-related vessels.

[26] For discussion of the presence of structures on land-based radar systems see Section 3.4.8.

Construction vessel traffic for one representative project would have short-term impacts on overall navigation and vessel traffic in open waters and near the Port of Los Angeles/Long Beach and potentially the smaller ports. O&M vessel traffic for one representative project would have intermittent and long-term impacts on overall navigation and vessel traffic in open waters and offshore wind O&M port sites.

3.4.7.4.2 Impacts of Five Representative Projects

Anchoring: With five representative projects, there would be an increase in offshore wind-related vessels that may need to anchor at established anchorages. There would also be additional offshore cable routes that would increase the risk of anchors coming into contact with buried cables. However, as described previously, there is an overall low risk of emergency anchoring or cable repair.

As with one representative project, smaller vessel anchor chain could become entangled with mooring lines and interarray cables should anchoring be attempted in or on the edge of the developed wind lease areas. Commercial vessels would plan accordingly and avoid anchoring, reducing the potential for impacts. Recreational vessels likely would not be equipped to anchor due to water depths of the lease areas.

Cable installation and maintenance: Offshore export cables and interarray cable installation would increase the presence of slow-moving or stationary construction or maintenance vessels and thereby increase the risk of collisions with other vessels and spills. New cable-installation activities could affect access to navigation and vessel traffic areas including anchorages depending on the route. Likewise, during O&M, cable maintenance would increase to levels that could displace routine vessel transit routes or anchorage operations. Although the number of export cables could increase, impacts would be similar to one representative project in each WEA, assuming new cable installation activities take place in a sequential schedule given vessel and personnel limitations. Impacts would be greater if two or more projects are constructed simultaneously and if cable routes use different corridors to different landfalls. The presence of cable installation vessels would have intermittent and short-term impacts depending on the representative project schedule and cable route. In contrast, the presence of maintenance vessels would have intermittent and long-term impacts on navigation and vessel traffic.

Port utilization: Five representative projects would amplify vessel traffic and related port utilization relative to a single representative project. As ports separately pursue upgrades to support future offshore wind developments in the Pacific Ocean, vessel activity could be concentrated at ports capable of supporting such development. Offshore wind vessel traffic would add congestion to involved ports, potentially resulting in delays for other vessels, prospectively leading some fishing and recreational operatives to change routes or use alternative ports. Five representative projects would cause continuous impacts on port users during construction and decommissioning, and long-term intermittent impacts during O&M.

Presence of structures: Five representative projects would add additional structures in the Humboldt lease areas (up to 400 WTGs and 12 OSSs) and the Morro Bay lease areas (up to 600 WTGs and 18 OSSs) where no such structures currently exist. The navigational complexity for a vessel transiting through any one of the five lease areas at any given time would be the same as described for one representative project. However, structures in all five lease areas would increase the overall navigational complexity near each of the lease areas and, potentially, transiting from one lease area to the next. Impacts would include greater potential for marine radar interference, increased risk of allisions with structures and collision with other vessels, and a larger geographic area with structures that could complicate offshore SAR operations or surveillance missions.

Impacts would be greater if the configurations of WTGs and OSSs do not follow uniform spacing and alignment across lease areas. Overall, BOEM anticipates the presence of structures from five representative projects would have long-term impacts on navigation and vessel traffic depending on vessel types and routes.

Vessel traffic: Development of five representative projects would increase slow-moving construction vessel traffic in and near the Affected Environment. Impacts would be less if construction is staggered because construction vessel trips would be spread out over time. Increased vessel traffic during the construction and decommissioning phases would be similar to that of one representative project but of a greater intensity, resulting in short-term impacts. During O&M, vessel traffic would decrease and have intermittent and long-term impacts on navigation and vessel traffic in open waters and offshore wind O&M ports.

3.4.7.4.3 Cumulative Impacts of Alternative B

Anchoring: Project vessels would compete with baseline vessel traffic for the use of existing anchorages; however, the timing for wind area development would most likely be staggered. USCG monitors and controls use of anchorage space within representative port areas with additional oversight from local maritime stakeholders (pilot associations and harbor masters). Collectively, these reduce the likelihood of impacts. The likelihood of an emergency anchoring scenario impacting a buried export cable is also low. The combined impacts of either one representative project or five representative projects and the planned Oregon offshore wind activity (site characterization and site assessment) on navigation and vessel traffic from anchoring would be long term and undetectable, and impacts on anchoring would be unlikely unless an anchor accidently contacts a buried cable, requiring repairs.

Cable installation and maintenance: Simultaneous construction of export and interarray cables from five representative projects would have an additive effect on the installation and maintenance of submarine cables discussed in Appendix C, Section 2.4. Nevertheless, construction vessels would only be present above a portion of a representative project's cable system associated with each lease area at any given time. Substantial areas of open ocean are likely to separate other simultaneous offshore cable installation activities. The combined impacts of either one representative project or five representative projects including ongoing and planned activities, on navigation and vessel traffic would be long term and noticeable.

Port utilization: Vessel types used for site characterization and assessment activities at the Oregon WEAs that may originate from or terminate in California ports would not be comparable to the vessel types associated with development of the five representative projects. Predicting port utilization impacts from the Oregon WEAs without specific project information, such as which ports will be used and timing, is not possible with existing information. Depending on schedules of the five representative projects, there could be delays for any vessel types using facilities in or accessible from the Port of Los Angeles/Long Beach, Port Hueneme, or other deep-draft ports if two or more projects are under construction at the same time. Either one representative project in each WEA or five representative projects would have long-term and appreciable impacts from ongoing and planned activities on navigation and vessel traffic due to increased port utilization particularly during the construction and decommissioning phases.

Presence of structures: Construction of five representative projects would add an estimated 1,000 WTGs and 30 OSSs to the Affected Environment. Collectively, the presence of structures associated with offshore wind activities would increase navigational complexity in the Affected Environment, resulting in an increased risk of collisions and allisions, which could result in personal injury or loss of life from a marine casualty, damage to boats or turbines, and oil spills. The presence of structures associated with offshore wind activities could also affect demand for and types of resources associated with USCG SAR operations. Cumulative impacts on navigation and vessel traffic due to presence of structures would be long term and appreciable.

Vessel traffic: Site characterization and site assessment of planned offshore wind project areas (outside the Affected Environment) is estimated to generate a lower volume vessel traffic comparable to that of each of the five representative projects. Nevertheless, if the five representative projects were under construction at the same time, construction vessel traffic could operate at the same time as the Oregon WEA site characterization and site assessment vessel traffic, although the likelihood of intersecting vessel routes is small (predicted within approaches to Humboldt Bay only). Total project vessel volume would depend on the availability of the specialized vessels required for the work. After the construction phase of either one representative project in each WEA or the five representative projects and the characterization and assessment of the Oregon WEAs and in the context of reasonably foreseeable environmental trends, the five representative projects would result in an incremental increase in vessel traffic that would be additive to the baseline vessel traffic in the Affected Environment and vessel traffic associated with other ongoing and planned activities. Impacts on navigation and vessel traffic would be long term and noticeable.

3.4.7.4.4 Conclusions

Impacts of Alternative B. Port upgrades for offshore wind development would contribute to baseline traffic levels. Impacts on vessels not associated with developed wind lease areas include changes in navigation routes, delays in ports, degraded radar signals, and increased difficulty of offshore SAR or surveillance missions in each of the lease areas, all of which would increase navigational safety risks. Commercial deep-draft vessels would choose to avoid the lease areas altogether, leading to potential funneling of vessel traffic along the lease area borders. In addition, increased potential for marine accidents, which may result in injury, loss of life, and property damage, could produce disruptions for ocean users.

Cumulative Impacts of Alternative B. Alternative B in combination with other ongoing and planned non-offshore wind activities (such as the designation of the Chumash Heritage National Marine Sanctuary or unrelated cable installation) would increase navigational complexity, resulting in an increased risk of collisions and allisions that could result in personal injury or loss of life from a marine casualty, damage to boats or turbines, and oil spills. In context of reasonably foreseeable environmental trends, the incremental impacts on navigation and vessel traffic contributed by Alternative B would be undetectable or noticeable (in the case of cable damage) for anchoring, noticeable for vessel traffic and cable installation, and appreciable for presence of structures and port utilization.

3.4.7.5 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Navigation and Vessel Traffic

Alternative C, the Proposed Action, is the prospective adoption of mitigation measures intended to avoid or reduce Alternative B's potential impacts. Accordingly, this analysis considers the change in impacts relative to Alternative B. Appendix E, *Mitigation*, identifies the mitigation measures that make up the Proposed Action. Table 3.4.7-5 summarizes mitigation relevant to navigation and vessel traffic.

Table 3.4.7-5. Summary of mitigation measures for navigation and vessel traffic

Measure ID	Measure Summary
MM-32	This measure encourages lessees to coordinate transmission infrastructure among projects by using, for example, shared intra- and interregional connections, meshed infrastructure, or parallel routing, which may minimize potential impacts from offshore export cables.

3.4.7.5.1 Impacts of One Representative Project in Each WEA

Alternative C would affect impacts on navigation and vessel traffic associated with cable installation and maintenance and vessel traffic. Impacts for the anchoring, presence of structures, and port utilization IPFs would remain the same as described under Alternative B.

Cable installation and maintenance: MM-32 could reduce cable routes and prevent excessive simultaneous construction activity because shared transmission infrastructure could limit the number of cable corridors within a single representative project from two to one or from eight to six, reducing the displacement of routine vessel operations in the vicinity of cable routes. However, because this mitigation measure only encourages lessees to use shared transmission infrastructure where practicable and there is not an explicit requirement or enforcement mechanism, it is unknown to what extent lessees would adopt a shared transmission system. Impacts related to shared transmission infrastructure would need to be evaluated once project-specific information is known. Although implementation of MM-32 could reduce impacts of cable installation and maintenance on navigation and vessel traffic.

Vessel traffic: MM-32 could reduce cable routes and prevent excessive simultaneous construction activity for one representative project in each WEA. Routine vessel operations would still be affected by cable installation and maintenance activities, but there would be less cable corridors, thus, reducing the frequency of disruptions. Since at this time BOEM cannot know to what extent lessees would adopt a shared transmission system, the effectiveness of this mitigation in avoiding/reducing this impact is uncertain.

3.4.7.5.2 Impacts of Five Representative Projects

Alternative C would affect impacts on navigation and vessel traffic associated with cable installation and maintenance and vessel traffic. Impacts for anchoring, presence of structures, and port utilization would remain the same as described under Alternative B.

Cable installation and maintenance: MM-32 would result in the consolidation of export cables from the projects in each WEA into a reduced number of cable corridors. As stated under Alternative B, impacts from cable installation on navigation would be most pronounced if cables from the five representative projects each used different corridors to different landfalls, requiring cable-laying vessels to be spread out over multiple different cable routes and affecting a larger geographic area. Consolidating cables into a shared transmission system would reduce these impacts, including a reduction in the risk of collisions with other vessels and spills, especially where the cables cross traffic lanes, navigation channels, or anchorages where impacts on navigation would be most pronounced. However, because this mitigation measure only encourages lessees to use shared transmission infrastructure where practicable and there is not an explicit requirement or enforcement mechanism, BOEM does not know to what extent lessees would adopt a shared transmission system. Impacts related to shared transmission infrastructure would need to be evaluated once project-specific information is known for each of the five representative projects. As with one representative project, impacts for cable installation and maintenance remain the same as described under Alternative B.

Vessel traffic: The effect of MM-32 on vessel traffic impacts is not quantifiable at the programmatic level for the same reasons as listed for one representative project. This information would be identified in lessees' COPs and analyzed at the project level in the future.

3.4.7.5.3 Cumulative Impacts of Alternative C

Under Alternative C, the same ongoing and planned activities (including offshore wind) as those under Alternative B would contribute to impacts on navigation and vessel traffic. The construction, O&M, and decommissioning for five representative projects with mitigation measures would still cumulatively affect navigation and vessel traffic across the Affected Environment the same as without mitigation measures, but some impacts could be lower if determined through project-level analysis.

3.4.7.5.4 Conclusions

Impacts of Alternative C. The construction and decommissioning of Alternative C would continue to have impacts as full avoidance would not be possible. Mitigation under Alternative C could reduce impacts associated with cable installation and maintenance and vessel traffic pending further analysis of project-level detail.

Cumulative Impacts of Alternative C. BOEM anticipates that the cumulative impacts on navigation and vessel traffic in the Affected Environment from one representative project or up to five representative projects combined with ongoing and planned activities would vary depending on the IPF. Mitigation under Alternative C could reduce overall impacts pending further project-specific analysis. In context of reasonably foreseeable environmental trends, the incremental impacts on navigation and vessel traffic contributed by Alternative C would be undetectable or noticeable (in the case of cable damage) for anchoring, noticeable for vessel traffic and cable installation, and appreciable for presence of structures and port utilization.

3.4 Socioeconomic Conditions and Cultural Resources

3.4.8 Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)

This section discusses potential impacts not addressed in other portions of this Draft PEIS—marine minerals, national security and military use, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys—that would result from the Proposed Action, alternatives, and ongoing and planned activities in the Affected Environment. Figure 3.4.8-1 shows the Affected Environment (by topical area), which encompasses locations where BOEM anticipates impacts associated with construction, O&M, and decommissioning could occur.

- **Marine minerals**: Areas within 0.25 mile (0.4 kilometer) of the Humboldt and Morro Bay WEAs (Figure 3.4.8-1).
- **Aviation and air traffic, military and national security, and radar systems**: Areas within 10 miles (16.1 kilometers) of the Humboldt and Morro Bay WEAs.
- **Cables and pipelines**: Areas within 1 mile (1.6 kilometers) of the Humboldt and Morro Bay WEAs.
- **Scientific research and surveys**: Same as the Affected Environment for fishes, invertebrates, and essential fish habitat (Section 3.3.5, *Fishes, Invertebrates, and Essential Fish Habitat*; Figure 3.3.5-1), an area that encompasses the Washington, Oregon, and most of the California coastline.

3.4.8.1 Description of the Affected Environment and Baseline Conditions

3.4.8.1.1 Marine Minerals Extraction and Ocean Disposal Sites

BOEM's Marine Minerals Program has not identified any marine mineral resources along the West Coast; however, USGS is working with BOEM and the California Ocean Protection Council to evaluate sand and gravel resources in federal and state waters for potential use in future beach nourishment projects (USGS 2021).

USEPA Region 9 is responsible for designating and managing ocean disposal sites in the Affected Environment, except for disposal of dredged material, for which USACE is responsible. The Affected Environment includes the following historic, active, and inactive ocean disposal sites (ERDC 2023).

- **Humboldt Bay Harbor (SF-3)**: 0.02 square nm (a circle with a 148-meter radius), closed.
- **Humboldt Nearshore Disposal Site**: 0.17 square nm (a polygon, 5.83×10^5 meters squared), closed.
- **Humboldt Open Ocean Disposal Site**: 1 square nm (a polygon, 3.43×10^6 meters squared), active.
- **Los Angeles/Long Beach (LA-2)**: 0.77 square nm (a circle with a 917-meter radius), active.
- **Newport Beach (LA-3)**: 0.77 square nm (a circle with a 917-meter radius), active.

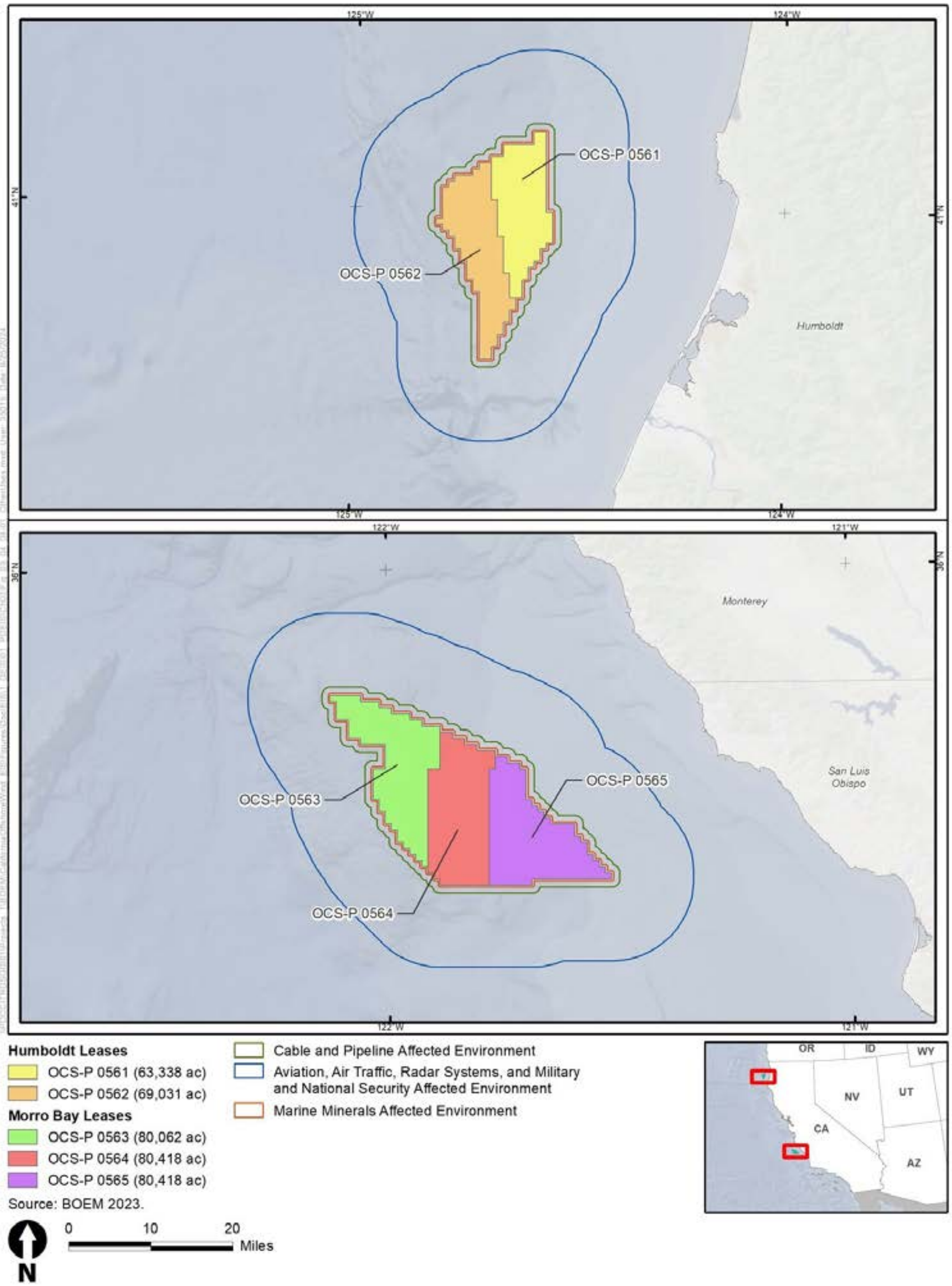


Figure 3.4.8-1. Affected Environment for marine minerals, national security and military use, aviation and air traffic, cables and pipelines, and radar systems

Because the Affected Environment does not include any marine mineral resource sites and the limited ocean disposal sites can be avoided though standard coordination with USEPA and USACE, this Draft PEIS does not further discuss marine mineral extraction and ocean disposal sites.

3.4.8.1.2 National Security and Military Use

As shown in Figure 3.4.8-2, the USCG, U.S. Navy, and U.S. Air Force each have a significant presence in and around the Affected Environment.

- The USCG Eleventh Coast Guard District Commander (based in Alameda) and subordinate units exercise jurisdiction for USCG authorities off the California coast. Eleventh Coast Guard District units support coastal and offshore USCG operations and missions (maritime safety and security and environmental stewardship) in and near the Affected Environment (33 CFR Part 3, Subpart 3.55).
- Camp Roberts (San Miguel, California) facilitates the training, mobilization, and security of the California National Guard, Army Reserve, and Active Component units.
- Located in Kings County, Naval Air Station Lemoore is the U.S. Navy's master air station for the West Coast.
- Fort Hunter Liggett is a U.S. Army base primarily used for combat support and combat service support training.
- Vandenberg Space Force Base is home to the U.S. Air Force's 30th Space Wing, which manages space and missile testing for the Department of Defense (DoD). This launch facility places satellites into polar orbit for the Air Force, DoD, and NASA.[1]
- Naval Base Ventura County comprises three operating facilities: Point Mugu, Port Hueneme, and San Nicolas Island. The installation is a major aviation shore command and a Naval construction force mobilization base, providing airfield, seaport, and base support services to fleet operating forces and shore activities.[1]
- The Los Angeles Air Force Base Space and Missile Systems Center (El Segundo, California) is responsible for launch operations, developmental testing, and sustainment and maintenance of military satellite constellations and other DoD space systems.[1]
- Joint Forces Training Base Los Alamitos operates two military runways.[1]
- Naval Weapons Station Seal Beach and its detachments provide weapons storage and loading, maintenance, and assessment support to the Pacific Fleet, as well as support for USCG vessels and U.S. Marine Corps units stationed afloat and ashore.[1]
- U.S. Marine Corps Base Camp Pendleton (San Diego County) provides training for marines and sailors preparing to deploy overseas, including combined arms training using naval assets with fixed and rotary wing aircraft in direct support of ground operations.[1]

There is a high density of offshore military activity surrounding the Morro Bay WEA and potential offshore export cable corridors to the Port of Los Angeles and Port of Long Beach. Airspace warning

[1] Not shown in Figure 3.4.8-2.

areas are designated by the FAA to warn non-participating pilots of potential danger from hazardous activities (such as military training and testing). Airspace warning areas W-285, W-289, W-290, W-532, W-537, and W-412 are in the Affected Environment (Figure 3.4.8-2). The Morro Bay WEA is within warning areas W-285 and W-532, which are used daily for aviation and at-sea training, supporting strike-fighter wing squadrons based at Naval Air Station Lemoore and Navy and Marine Corps training out of Fort Hunter Liggett (BOEM 2022). W-532 is part of the Point Mugu Sea Range, a Major Range Test Facility Base that is primarily chartered for research, development, testing, and evaluation efforts (BOEM 2022). Potential offshore wind export cable corridors from the Morro Bay WEA to the Port of Los Angeles and Port of Long Beach fall within the Point Mugu Sea Range.

The Humboldt WEA does not overlap any airspace warning areas but is entirely within the Pacific Northwest Ocean Surface/Subsurface Operating Area used for testing and training operations that support the U.S. Navy fleet readiness and naval special warfare training (DoD 2012; Figure 3.4.8-2).

UXO and discarded military munitions that could pose an explosive hazard may be present in the Affected Environment. These UXO and former defense sites are primarily associated with military testing and training in the region and are found near the Vandenberg Space Force Base, Santa Barbara Municipal Airport, Point Mugu Sea Range, and Port of Long Beach (USACE 2021).

The Affected Environment includes several danger zones and restricted areas, where general use by the U.S. government may limit public access (Figure 3.4.8-2). The largest restricted area is offshore Vandenberg Space Force Base and comprises nine danger zones. Except in Zone 4 where loitering or stopping is prohibited at all times, general navigation and fishing is permissible in the danger zones outside of scheduled launch operations where there is a risk of missile debris strikes (48 FR 19025). The danger zone at the Naval Weapons Station at San Miguel Island is open to general navigation outside of scheduled firing and bomb drop periods (47 FR 4990). A restricted area where vessel traffic is prohibited is located within Port Hueneme Harbor near the Naval Base Ventura County (69 FR 20545). Two danger zones and one restricted area, used daily as a naval small arms firing range, are adjacent to the Naval Base Ventura County Point Mugu, extending about 2 miles offshore at Point Mugu and about 3 miles offshore at Laguna Point (28 FR 4785).

The U.S. Army, National Guard, and USCG use a danger zone near San Pedro as a practice firing range (33 CFR 165.1184). Details about the danger zones and restricted areas are provided in 33 CFR Part 334.

Routine and non-routine military activities are anticipated to continue in both onshore and offshore areas in the Affected Environment.

3.3.1.1.1 Aviation and Air Traffic

Public and private-use airports within 20 miles of the Humboldt and Morro Bay WEAs include Rohnerville Airport, Murray Field Airport, California Redwood Coast–Humboldt County Airport, Oak Country Ranch Airport, and San Luis Obispo County Regional Airport (Figure 3.4.8-3).

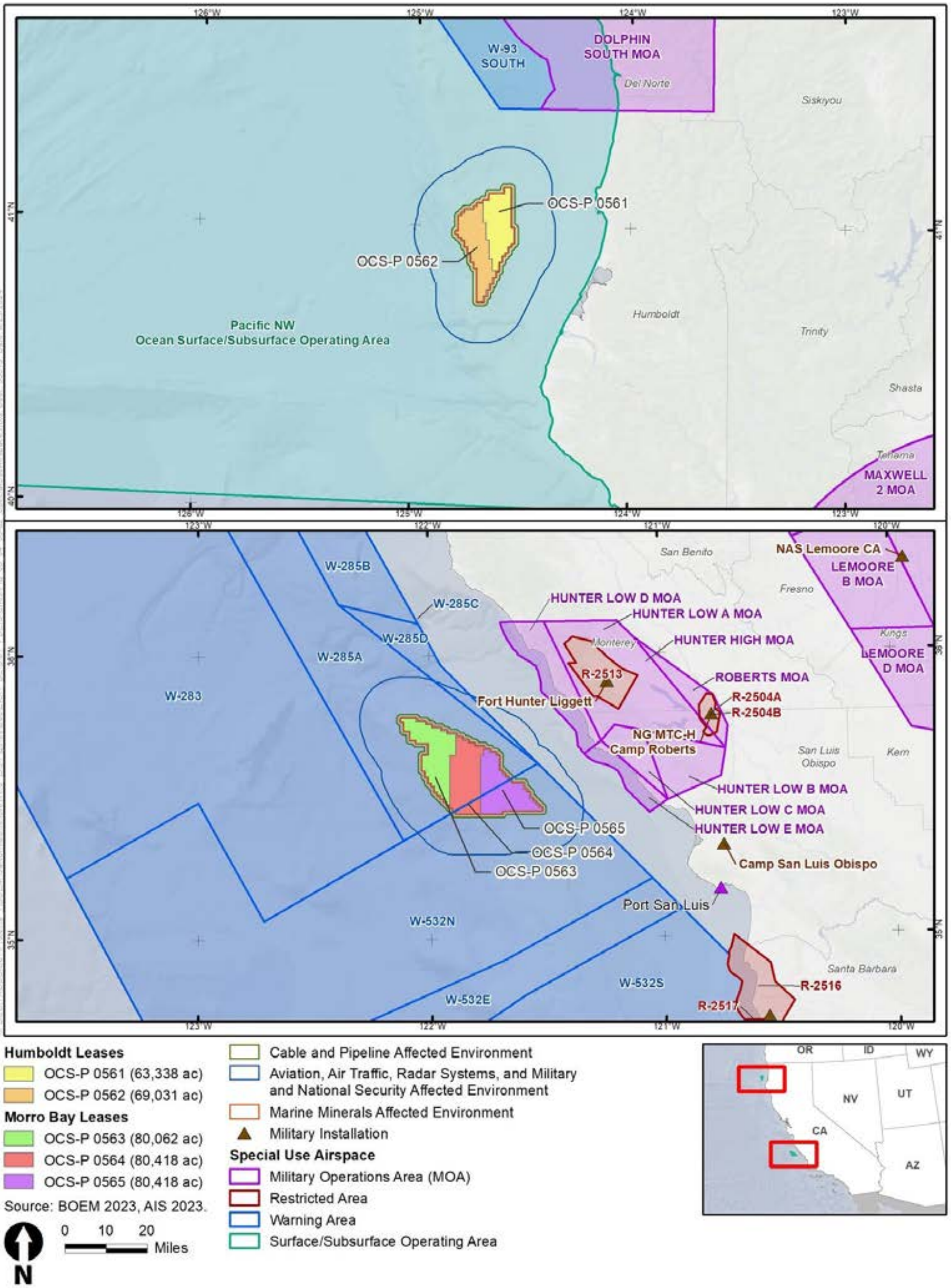


Figure 3.4.8-2. National security, military use, and warning areas

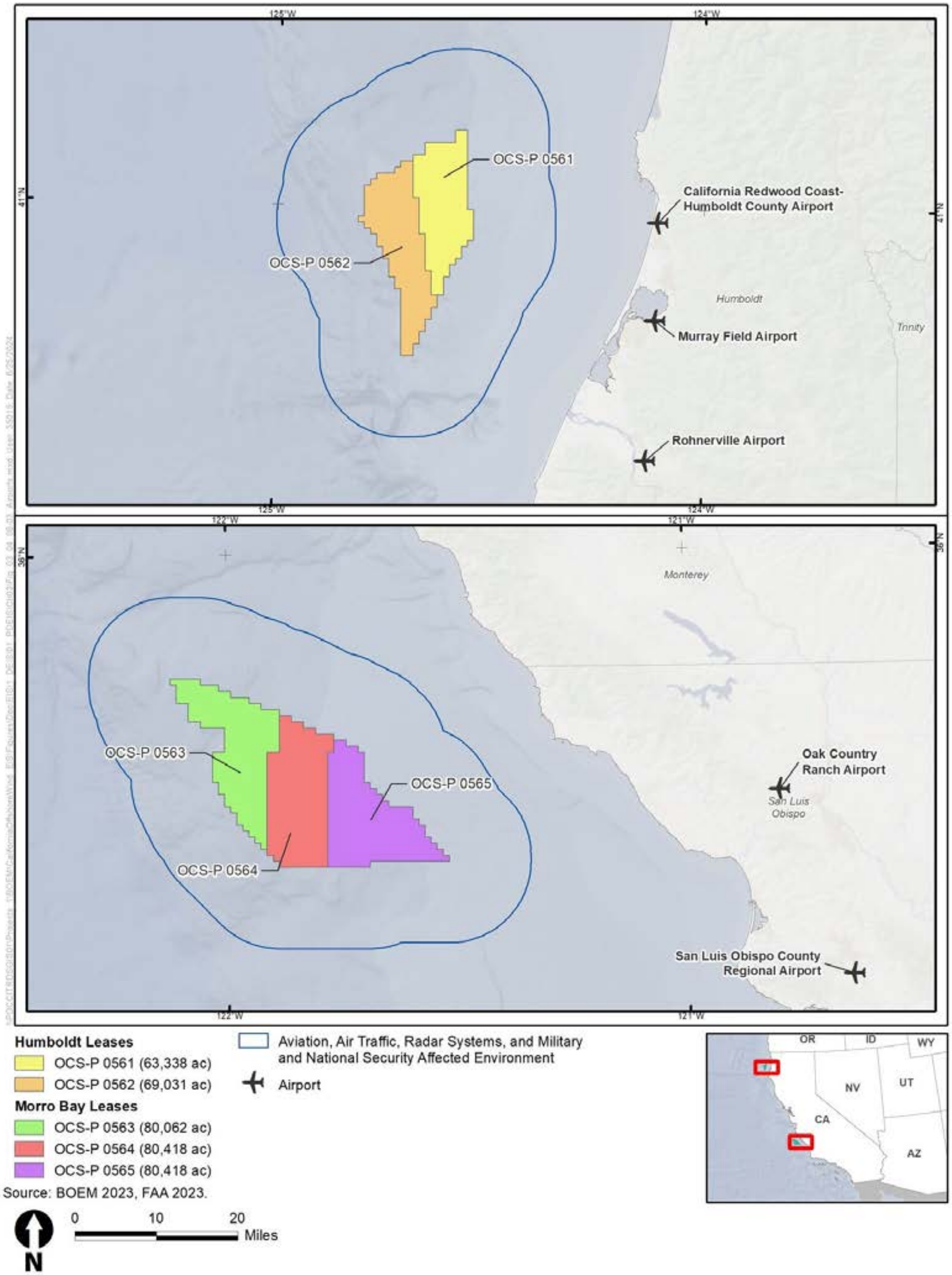


Figure 3.4.8-3. Airports

3.3.1.1.2 Cables and Pipelines

There are 22 cables (20 active and 2 out of service) offshore near the Humboldt and Morro Bay WEAs (NASCA 2023) (Figure 3.4.8-4). Multiple submarine cables including fiber-optic cables and trans-Pacific cables exist south of the Morro Bay WEA, including some within the Chumash Heritage National Marine Sanctuary with landfalls near Grover Beach/Oceano (NASCA 2023).

In Humboldt Bay, the Echo Cable System is a private fiber-optic submarine cable system connecting the United States with Singapore, Guam, and Indonesia. The first segment of the system extends almost due west from Eureka, crossing the southern portion of Humboldt WEA (Figure 3.4.8-4). Cable landing stations are in Arcata, California; Guam; Indonesia; and Singapore (Submarine Cable Networks 2024).

Offshore oil and gas pipelines tend to be located closer to the shore. While no offshore pipelines overlap the Humboldt or Morro Bay WEAs, there are 10 oil and gas pipelines in the potential offshore export cable corridor for the Morro Bay WEA. No offshore pipelines are present within or near the Humboldt WEA or offshore export cable corridor (BOEM 2023).

3.3.1.1.3 Radar Systems

Commercial air traffic control, national defense, and weather radar systems currently operate in the Affected Environment, including those that support air traffic control, military surveillance, high-frequency coastal radars, and weather monitoring (Table 3.4.8-1).

Table 3.4.8-1. Radar systems in the Affected Environment

System Name	Radar Type	Closest Wind Energy Area
Eureka (Bunker Hill)	NEXRAD WSR-88D	Humboldt Bay
Rainbow Ridge	ARSR-4	Humboldt Bay
Garden Grove	Airport Surveillance Radar-9 (ASR-9)	Morro Bay
LAX North	Airport Surveillance Radar-9 (ASR-9)	Morro Bay
Los Angeles	NEXRAD WSR-88D	Morro Bay
Paso Robles	ARSR-4	Morro Bay
Santa Ana Mountains	NEXRAD WSR-88D	Morro Bay
Santa Maria Public Airport	Airport Surveillance Radar-11 (ASR-11)	Morro Bay
Vandenberg Space Force Base	ARSR-4	Morro Bay
Vandenberg Space Force Base	NEXRAD WSR-88D	Morro Bay

ARSR = Air Route Surveillance Radar; LAX = Los Angeles International Airport; NEXRAD WSR-88D = Next Generation Weather Radar Weather Surveillance Doppler Radar, 1988 Doppler

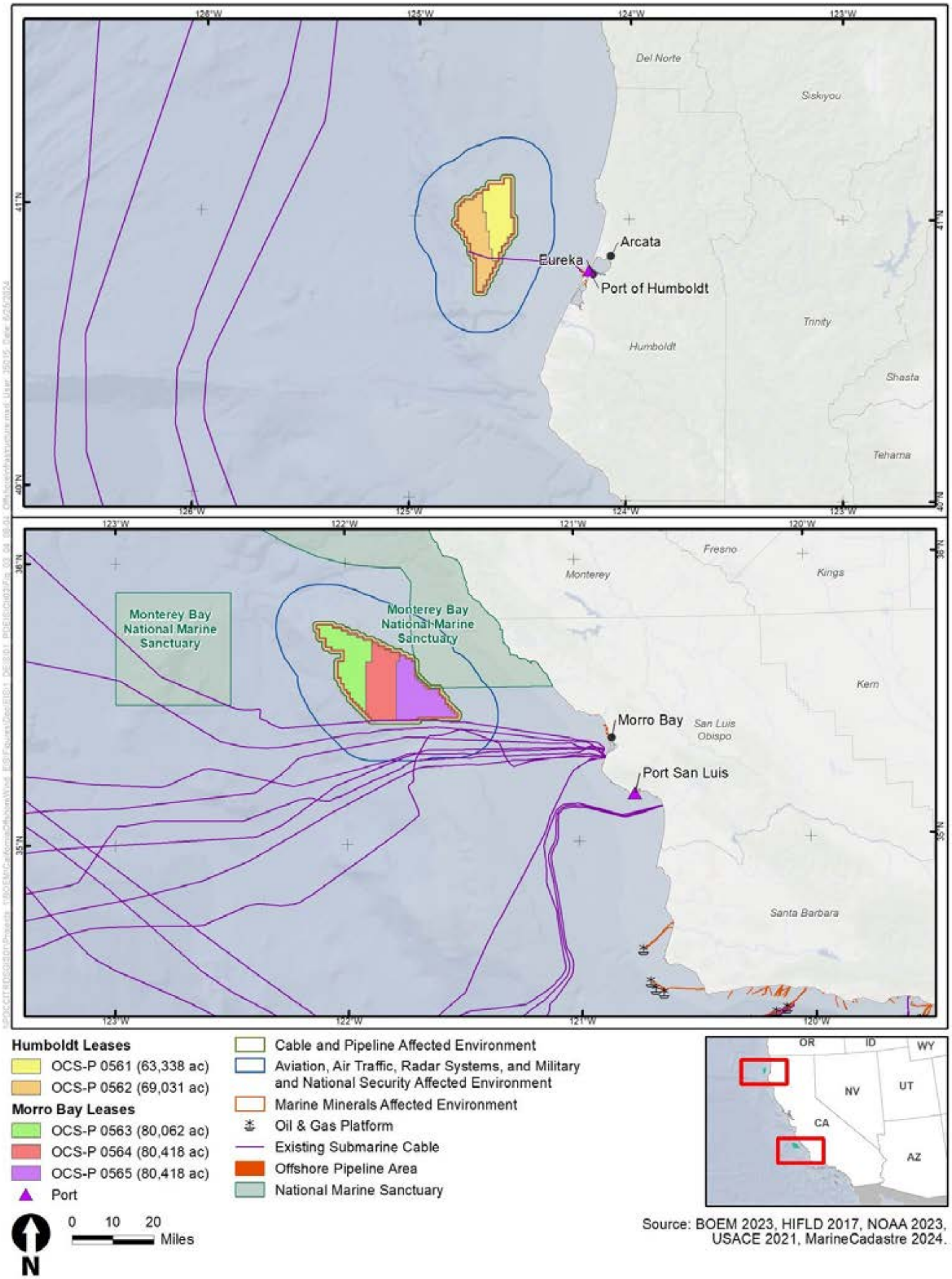


Figure 3.4.8-4. Offshore infrastructure, cables, and pipelines

Several SeaSonde high-frequency radar stations, listed below, are in the Affected Environment as part of regional and local high-frequency networks (California Ocean Observing Systems Data Portal 2023). The NOAA IOOS uses SeaSonde high-frequency radars as part of NOAA's Surface Currents Program. The USCG Search and Rescue Optimal Planning System, a decision-support tool that uses ocean observations to narrow search areas, then uses the collected data.

- Point St. George (PSG1)
- Trinidad (TRIN)
- Humboldt Bay, Samoa (SMOA)
- Point Estero (ESTR)
- Diablo Canyon Standard Range (DCSR)
- Diablo Canyon Long Range (DCLR)
- Point San Luis (LUIS)
- FallBack22, Point Sal (FBK1)
- Point Arguello (AGL1 and ARG1)
- Point Conception (PTC1)
- Refugio State Beach (RFG1)
- Coal Oil Pt (COP1)
- Summerland Sanitary District (SSD1)
- Santa Cruz Island (SCI1)
- Mandalay Generating Station (MGS1)
- Point Mugu (PTM1)
- Nicholas Canyon (NIC1)
- Dan Blocker (SCDB)
- Dockweiler Headquarters (SCDH)
- Torrance Beach (SCTB)
- Point Fermin (SCPF)

Existing radar systems would continue to provide weather, navigational, and national security support to the region. Because no publicly noticed plans were found for the construction of any new radar systems, the number of radars and their coverage areas are anticipated to remain at current levels for the foreseeable future.

3.4.8.1.3 Scientific Research and Surveys

Research in the Affected Environment includes oceanographic, biological, geophysical, and archaeological surveys focused on the OCS and nearshore environments. Federal and state agencies, educational institutions, and environmental non-governmental organizations participate in ongoing offshore research in the surrounding waters, including aerial and ship-based scientific surveys.

Current fisheries and protected-species management and ecosystem monitoring surveys would overlap with offshore wind lease areas in the Affected Environment. Surveys are conducted by NMFS's Northwest Fisheries Science Center and Southwest Fisheries Science Center. NMFS surveys include the following.

- West Coast Groundfish Bottom Trawl Survey
- Integrated Ecosystem and Pacific Hake Survey
- West Coast Pelagic Fish Survey, also known as the California Current Ecosystem Survey
- West Coast Marine Mammal Survey
- Pacific Orcinus Distribution Surveys
- Rockfish Recruitment and Ecosystem Survey
- Trinidad Head Line
- California Cooperative Oceanic Fisheries Investigations Survey
- Northern California Current Ecosystem Survey

NMFS conducts several large-scale scientific surveys along the U.S. West Coast to monitor and assess the populations of fishery stocks, marine mammal stocks, and threatened and endangered species, as well as their habitats, in the California Current Large Marine Ecosystem. These surveys support the management of these resources, West Coast fisheries, and numerous other science products produced by NMFS, including ecosystem and climate assessments. NMFS completes these surveys as frequently as monthly, with most occurring seasonally or annually. In any one year, NMFS conducts approximately 8 to 12 large-scale surveys.

3.4.8.2 Impact Background for Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)

Anchoring, presence of structures, and traffic are contributing IPFs to impacts on other uses. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.4.8-2.

Table 3.4.8-2. Issues and indicators to assess impacts on other uses

Issue	Impact Indicator	IPFs
Military and National Security Uses (land, sea, air): Reduction in the military's ability to access and use the site due to construction vessel traffic and WTG construction; reduction in air surveillance and national defense operations	Level of interruption to military exercises and national security operations	Anchoring, presence of structures, traffic
Aviation and Air Traffic: Risk to aviation traffic	Qualitative assessment of impacts from risk to flight vectors to regional airports	Presence of structures
Radar Systems: Impacts on land-based radar (air traffic control, airspace surveillance, weather, high-frequency ocean observation radar)	Qualitative assessment of system-specific impacts from potential wind turbine radar interference	Presence of structures
Cables and Pipelines: Impacts on any proposed/approved pipelines or electricity/telecom transmission lines	Qualitative assessment of impacts from potential exclusions of or damage to other undersea cables and pipelines	Anchoring, presence of structures
Scientific Research and Surveys: Impacts on scientific research and surveys	Quantitative assessment of impacts from interactions of offshore wind development (both project-level and cumulative effects) on NMFS fisheries independent surveys, ecosystem surveys, and protected-species surveys; assessment of impacts for each project should be conducted in consultation with NMFS fisheries and protected-species survey leads or other points of contact	Presence of structures

3.4.8.3 Impacts of Alternative A – No Action – Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)

When analyzing the impacts of the No Action Alternative on other uses, BOEM considers the impacts of ongoing activities on the baseline conditions for other uses.

The cumulative impact analysis considers impacts of the No Action Alternative on existing baseline trends, including other planned activities, which are described in Appendix C, *Planned Activities Scenario.*

3.4.8.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, military and national security uses, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys described in Section 3.4.8.1, *Description of the Affected Environment and Baseline Conditions,* are expected to continue to follow current regional trends, such as traffic, warming and sea-level rise caused by climate change, and port improvement and dredging projects. The ongoing activities in the Affected Environment that would contribute to impacts on other uses would generally be associated with climate change impacts and commercial fishing, which has the potential to affect ongoing research and surveys in the Affected Environment. There are no ongoing offshore wind projects on the West Coast.

3.4.8.3.2 Cumulative Impacts of the No Action Alternative

The cumulative impact analysis considers the impacts of the No Action Alternative on existing baseline trends, including other planned activities (without the five representative projects in the Humboldt and Morro Bay lease areas). Reasonably foreseeable activities in the region include the late 2024/early 2025 designation of the Chumash Heritage National Marine Sanctuary off the Central Coast and anticipated site characterization and assessment activities for the Oregon WEAs.

The following subsection summarizes the potential impacts of ongoing and planned activities on other uses in the Affected Environment. Ongoing and planned activities have the potential to have continuing impacts on military and national security uses, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys primarily through anchoring, presence of structures, and vessel traffic that introduce navigational complexities and radar interference.

National Security and Military Use

Presence of structures: Existing stationary facilities are limited to dock facilities along the coastline and meteorological buoys operated for offshore wind farm site assessment in the Humboldt and Morro Bay lease areas. No reasonably foreseeable offshore development has been identified in the Affected Environment, excluding the Proposed Action (Appendix C).

Traffic: Military and national security vessels may experience congestion and delays in ports due to the increase in vessel traffic at and near ports as a result of construction of planned activities such as port expansion or infrastructure improvement projects (Appendix C). Within the Chumash Heritage National Marine Sanctuary, some types of vessel traffic could be restricted but ongoing activities conducted or approved by DoD would be exempted and not subject to prohibitions on use (NOAA 2023). Cumulative impacts from vessel traffic could occur if multiple large-scale projects used the same port facilities at the same time. The Oregon WEAs may contribute to increased vessel traffic near the Humboldt lease areas depending on the timing of the site characterization and site assessment activities in Oregon. Impacts from survey vessels near the Humboldt WEA would be staggered over time and, for most of the journey, substantial areas of open ocean would separate existing vessel traffic from survey vessel traffic. Accordingly, cumulative impacts on national security and military use are not anticipated.

Aviation and Air Traffic

Presence of structures: Existing stationary facilities in the Affected Environment are limited to dock facilities near shore and meteorological buoys in the OCS. All stationary structures would have aviation and navigational marking and lighting in accordance with FAA, USCG, and BOEM requirements and would adhere to established guidelines for minimizing and mitigating impacts on air traffic. BOEM assumes that any planned projects would coordinate with aviation interests to avoid or minimize impacts on aviation activities and air traffic. Cumulative impacts on aviation and air traffic are not anticipated.

Radar Systems

Presence of structures: Structures that are near, in the direct line of sight of, or over the horizon coverage area of land-based radar systems can interfere with radar signals, causing shadows or clutter in the received signal. Existing stationary facilities in the Affected Environment are limited to dock facilities near shore and meteorological buoys in the OCS. As no planned activities to construct structures on the OCS in the Affected Environment have been identified, impacts of the No Action Alternative would be expected to follow current trends in the region. Cumulative impacts on radar systems are not anticipated.

Cables and Pipelines

Presence of structures: Depending on the water depth, submarine cables are either buried under or laid across the ocean floor. When placed in waters deeper than 6,561 feet (2,000 meters), cables are generally not buried because they are less susceptible to potentially harmful interactions with living marine resources (Oregon Fishermen's Cable Committee 2000). In waters shallower than 6,561 feet (2,000 meters), cables are generally buried 2 to 5 feet (0.6–1.5 meters) beneath the substrate to prevent interactions with the cable. In most circumstances, the presence of existing submarine cables in the Affected Environment would not prohibit the installation of additional cables and pipelines.

The proposed Chumash Heritage National Marine Sanctuary would establish a prohibition on disturbing the seabed and leaving structures on or in the seabed, which would affect new cable and pipeline installation within sanctuary boundaries; however, the proposed regulations include provisions by which the NOAA Office of National Marine Sanctuaries could approve seabed disturbance associated with the installation, maintenance, and repair of subsea electrical transmission cables, as well as their continued presence on or beneath the seabed (NOAA 2023). While details of individual permits or authorizations would be project-specific, future subsea cable projects would either need to be routed around the sanctuary or project proponents would need to coordinate a permitting approach with NOAA.

Ongoing and reasonably foreseeable projects would impact the Affected Environment around the Morro Bay WEA, particularly if new cables are permitted to route through the Chumash Heritage National Marine Sanctuary. Near the Humboldt WEA, ongoing and reasonably foreseeable projects could result in impacts but conflicts with existing cables and pipelines could be avoided using industry-standard crossing techniques.

Scientific Research and Surveys

Presence of structures: Permanent offshore structures would create additional navigational obstructions for sea- and air-based scientific studies, creating an increased risk of allision and could require modifications to survey methods to avoid structures. Existing and planned stationary facilities in the Affected Environment include dock facilities near shore and meteorological buoys in the OCS for the Humboldt and Morro Bay WEAs, and up to six meteorological (metocean) buoys in or near each Oregon lease area. BOEM assumes that any planned projects would coordinate with NOAA to minimize impacts on scientific research and surveys. Designation of the Chumash Heritage National Marine Sanctuary is not anticipated to result in impacts on scientific research and surveys, because scientific surveys used to inform stock assessments and fishery management plans would be allowed to continue (NOAA 2023).

3.4.8.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, other uses would continue to be affected by existing environmental trends and activities. Existing operations near shore and on the OCS could increase vessel traffic and navigational complexity of the region.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, planned activities expected to occur in the Affected Environment would include increasing vessel traffic; continued residential, commercial, and industrial development onshore and along the shoreline; site characterization and assessment activities within the Oregon WEAs; the Chumash Heritage National Marine Sanctuary; and possible continued development of FAA-regulated structures such as communications towers. No planned stationary structures or cables and pipeline development were identified in the offshore portion of the Affected Environment. Any issues with aviation routes or radar systems would be resolved through coordination with FAA, DoD, or NOAA, and through marking of structures according to FAA, USCG, and BOEM navigational requirements.

3.4.8.4 Impacts of Alternative B – Development with No Mitigation Measures – Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)

3.4.8.4.1 Impacts of One Representative Project in Each WEA

National Security and Military Use

Presence of structures: Construction and operation of a single representative project in each WEA would increase the risk of allisions for national security and military vessels, including USCG SAR operations, during the project lifespan, particularly in bad weather or low visibility. The presence of offshore wind infrastructure (up to 200 WTGs and 6 OSSs in each WEA) would change navigational patterns and add to the navigational complexity for military vessels and aircraft operating in the Affected Environment, especially since there are currently no permanent structures in the OCS. For further discussion, refer to Section 3.4.7, *Navigation and Vessel Traffic*. Generally, deep-draft military vessels are not anticipated to transit outside of navigation channels unless necessary for SAR operations or other non-typical activities. Smaller-draft vessels moving within or near the lease areas would have a higher risk of allision with offshore wind structures. Project structures would be marked as a navigational hazard per FAA, BOEM, and USCG regulations and guidelines, and WTGs and OSSs would be visible on military and national security vessels and aircraft radar, minimizing the potential for allision.

Military and national security aircraft that use the low-altitude and sea space that overlaps the representative project and transit corridors from ports would be affected by the presence of tall equipment needed for offshore wind facility construction, such as stationary lift vessels and cranes. Military activities would need to be modified to avoid the lease areas while ensuring that military training requirements were met (DoD 2022). These modifications would require investments in onshore infrastructure to continue to support at-sea activities; increase the distance traveled to avoid the representative project, resulting in increases in additional fuel and maintenance costs; and increase the risk of training completion delays.

The presence of offshore wind infrastructure has the potential to hinder USCG SAR activities due to increased navigational complexity in the Affected Environment and safety concerns of operating among the WTGs. Changing navigational patterns could also concentrate vessels within and around the Affected Environment, potentially causing space-use conflicts in these locations or reducing the efficiency of SAR operations. USCG may need to adjust its SAR planning and search patterns to accommodate the WTG layout, potentially leading to a less optimized search pattern.

Navigational hazards would be eliminated as structures are removed during decommissioning. Anticipated coordination with agencies would avoid or reduce overall impacts on military and national security uses from offshore wind structures.

Traffic: Vessel traffic related to a representative project in each WEA would peak during construction and decommissioning activities. Although construction and operation vessel traffic is expected to be minimal compared to existing vessel traffic, it could increase collision risk with military and national security vessels and potentially result in port congestion or delays. Overall, impacts would be greatest during construction and reduced during operations. Vessel traffic and navigation impacts are further discussed in Section 3.4.7.

Aviation and Air Traffic

Presence of structures: A single representative project would install up to 200 WTGs with a total turbine height of up to 1,100 feet (335 meters) and up to 6 OSSs, which would increase navigational complexity and change aircraft navigational patterns over involved lease areas. These changes could compress lower-altitude aviation activity into a limited airspace, leading to airspace conflicts or congestion and increased collision and allision risks for low-flying aircraft.

Navigational hazards would exist for the lifespan of the project and would gradually be eliminated during decommissioning as offshore WTGs are removed. WTGs and OSSs would comply with FAA and USCG lighting and marking regulations to minimize and mitigate impacts on air traffic. Due to their size, WTGs would also be visible on aircraft radars. Impacts on aviation and air traffic would be localized and long term.

Radar Systems

Presence of structures: During the O&M phase of a representative project with up to 200 WTGs and 6 OSSs, air traffic control, national defense, weather, and oceanographic radar within the line of sight may be affected. Radar impacts include unwanted radar returns (i.e., clutter) that obstruct primary target detection and weather detection and produce false primary target detections and weather indications. Oceanographic high-frequency radars could lose ocean surface current data and wave measurements in the area within and surrounding the representative project.

Cables and Pipelines

Anchoring: Anchoring associated with floating WTGs for a single representative project would result in a seafloor contact area of up to 15,000 acres (6,070 hectares), plus additional contact for OSSs. Because new cables and pipelines would not be able to cross WTG anchors and any associated scour protection, project infrastructure would preclude new cable and pipeline placement within the seafloor footprint estimated in the RPDE. New subsea cables and pipelines would have to be routed around WTG anchoring to avoid conflicts.

Presence of structures: A representative project would install up to 2,160 nm (3,200 kilometers) of offshore export cables from each WEA to the onshore landfall locations. Crossing existing cables or pipelines along the offshore export cable corridor would likely be necessary but could be achieved using industry-standard crossing methodologies. Cable crossings and in-service pipeline crossings would require a physical separation, such as a concrete mattress or an exterior protection product installed on the export cable. During decommissioning, the removal of export cables would eliminate impacts on submarine cables and pipelines.

Project structures including WTGs and OSSs, and the stationary lift vessels used during construction of offshore wind energy project infrastructure, may pose allision/collision risks and navigational hazards to vessels conducting maintenance on existing cables and pipelines. Risk to cable maintenance vessels would be limited due to the infrequent submarine cable maintenance required. Navigational hazard markings per FAA, BOEM, and USCG requirements and guidelines would help mitigate allision risks. Allision risk would decrease to zero after decommissioning.

Impacts on cables and pipelines as a result of a single representative project in each WEA would be localized and long term.

Scientific Research and Surveys

Presence of structures: Scientific research and surveys, particularly NOAA surveys supporting commercial fisheries and protected-species research programs, could be affected during the construction and operation of a representative project in each WEA. The WTGs and OSSs would exclude vessel and aircraft survey sampling, which would affect the random-stratified statistical design that is the basis for assessments, advice, and analysis. Additionally, WTGs and OSSs would alter benthic and pelagic habitats and airspace in and around the lease area, which would require new methods to sample habitats. Combined, the presence of structures would reduce sampling productivity through navigation impacts on aerial and vessel surveys. If stock or population changes, biomass estimates change, or other environmental parameters differ within the offshore wind lease areas but cannot be observed by surveys, the resulting survey indices could be biased and unsuitable for monitoring stock status. Offshore wind facilities would disrupt survey sampling statistical designs, such as random-stratified sampling, which would impact region-wide surveys.

NOAA’s Office of Marine and Aviation Operations has determined that the NOAA Ship Fleet would not conduct survey operations for facilities with a 1-nautical mile (1.9-kilometer) or less separation between turbine foundations. WTGs for the representative project in each WEA would have a minimum spacing of 0.5 nautical mile (920 meters) between WTGs, which means survey operations in the lease area would likely be curtailed. Survey vessels would be required to navigate around the representative project to access survey locations, leading to a decrease in survey precision and operational efficiency.

Where aerial survey tracks for cetacean and sea turtle abundance surveys overlap the lease area, minimum survey altitudes would need to be increased to avoid the 1,100-foot (335-meter) WTGs. The increased altitude necessary for safe survey operations could result in lower chances of detecting marine mammals and sea turtles, especially smaller species. Agencies would need to expend resources to update scientific survey methodologies due to the presence of offshore wind structures, as well as to evaluate these changes on stock assessments and fisheries management, resulting in impacts for scientific research and surveys.

The NOAA Fisheries and BOEM Federal Survey Mitigation Strategy–Northeast U.S. Region (Hare et al. 2022), although specific for the Northeast U.S. Region, is intended to be applicable to other regions. The strategy commits to tracking new survey technology development, mitigating impacts of offshore wind energy development on existing survey methodologies, and ongoing communication of the Northeast Federal Survey Mitigation Program (Hare et al. 2022). Efforts to collect, catalog, and understand the impacts of OSW development on fisheries and fisheries management and data collection are ongoing (Hogan et. al. 2023; Lipsky et. al 2024). The development of alternative survey designs to accommodate offshore wind farms is in early stages in the United States (Methratta 2020).

3.4.8.4.2 Impacts of Five Representative Projects

The same IPFs (anchoring, presence of structures, and traffic) as described under the impacts of one representative project would apply to the impacts of five representative projects (two in the Humboldt WEA, three in the Morro Bay WEA). The presence of structures and increased traffic associated with five representative projects would increase interference with military and national security, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys, because multiple projects would affect larger areas within the Humboldt and Morro Bay WEAs. Installation of offshore export cables would increase the potential for conflicts with existing cables and pipelines. The addition of up to 1,000 WTGs and up to 30 OSSs from the construction of five representative projects would add to navigational complexity and increase allision risk for military and national security uses, aviation and air traffic, and scientific research and surveys. However, even after all five representative projects would be constructed, there would still be open sea and airspace available surrounding the lease areas. Additionally, the WTGs from the construction of five representative projects would incrementally decrease the effectiveness of individual radar systems if the field of WTGs expands within a radar system's coverage area.

Should the construction of five representative projects occur at the same time, impacts would be greater, widespread, and long term due to consistent interference with existing operations. Staggered construction of five representative projects would reduce the impacts, as construction would result in more localized impacts. Overall, BOEM anticipates the five representative projects would likely contribute to greater impacts on all other uses.

3.4.8.4.3 Cumulative Impacts of Alternative B

The addition of new structures on the OCS as a result of ongoing and planned activities, including Alternative B, would incrementally create new navigational complexity in the Affected Environment. Additionally, vessel traffic related to five representative projects could result in congestion and delays in ports, especially if there is overlap with port construction activities or site assessment and characterization activities for the Oregon WEAs.

Similarly, the addition of new structures on the OCS would create navigational complexity within the airspace above the lease areas. Because existing stationary facilities in the Affected Environment are limited and no ongoing or planned activities were expected to impact aviation and air traffic, the anticipated cumulative impact is a result of impacts associated with representative project infrastructure under Alternative B.

Because the northern boundary of the final alternative for the Chumash Heritage National Marine Sanctuary will be located substantially further south of the Morro Bay lease areas than earlier alternatives considered, cable and pipeline impacts are not anticipated. Near the Humboldt WEA, the addition of offshore export cables would result in minor impacts on cables and pipelines.

Development of offshore wind projects could incrementally decrease the effectiveness of individual radar systems if the field of WTGs expands within the radar system's coverage areas. Large areas of installed WTGs could create a large area of degraded radar coverage that could affect multiple radars.

Cumulatively, Alternative B would result in long-term impacts on scientific research and surveys, particularly for NOAA surveys that support commercial fisheries and protected-species research programs. The entities conducting scientific research and surveys would have to make significant investments to change methodologies to account for areas occupied by metocean buoys in or near the Oregon WEAs and representative project infrastructure (WTGs, interarray cables, and offshore export cables) in the Humboldt and Morro Bay WEAs that are no longer able to be sampled.

3.4.8.4.4 Conclusions

Impacts of Alternative B. The construction and decommissioning of Alternative B, whether one representative project in each WEA or five representative projects, would have impacts on other uses.

- *Military and national security uses:* The construction of WTGs would result in increased navigational complexity and increased allision risk.
- *Aviation and air traffic:* The construction of WTGs would result in increased navigational complexity and increased allision risk.
- *Radar systems:* The presence of WTGs in the line of sight could interfere with radar systems.

- *Cables and pipelines:* The seafloor footprint of WTG anchors and the presence of offshore export cables would impact existing cables and pipelines.
- *Scientific research and surveys:* Scientific research and surveys would be impacted, particularly for NOAA surveys supporting commercial fisheries and protected-species research programs. The presence of structures would exclude certain areas occupied by representative project components (e.g., WTGs, anchoring, and cable routes) from potential vessel and aerial sampling, and could affect survey gear performance, efficiency, and availability.

Cumulative Impacts of Alternative B. Alternative B would contribute to cumulative impacts in the Affected Environment. Scientific research and surveys would be most impacted, with potential long-term and irreversible impacts on fisheries and protected-species research. Lesser impacts would be expected on aviation and air traffic, military and national security uses, and cables and pipelines.

3.4.8.5 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)

Alternative C, the Proposed Action, is the prospective adoption of mitigation measures intended to avoid or reduce Alternative B's potential impacts. Accordingly, the analysis considers the change in impacts relative to Alternative B. Appendix E, *Mitigation*, identifies the mitigation measures that would be included in the Proposed Action. Table 3.4.8-3 summarizes mitigation measures relevant to other uses.

Table 3.4.8-3. Summary of mitigation measures for other uses (marine minerals, military use, aviation, scientific research and surveys)

Measure ID	Measure Summary
MM-32	This measure encourages lessees to coordinate transmission infrastructure among projects by using, for example, shared intra- and interregional connections, meshed infrastructure, or parallel routing with existing infrastructure, which may minimize potential impacts from offshore export cables.
MM-35	This measures requires the lessee to enter into a mitigation agreement with the Surface Currents Program of NOAA's IOOS Office prior to completion of construction or initiation of commercial operations to determine if the lessee's project causes radar interference to the degree that radar performance is no longer within the specific radar systems' operational parameters or fails to meet NOAA IOOS's mission objectives. Where possible, the lessee will adhere to the recommendations for mitigation to marine radar interference from the National Academy of Science: *Wind Turbine Generator Impacts to Marine Vessel Radar* (2022).
MM-40	The lessee must submit to BOEM a survey mitigation agreement. At a minimum, the survey mitigation agreement must describe actions and the means to address impacts on long-term scientific surveys that overlap with wind energy development. The survey mitigation agreement must, where possible, identify activities that will result in the generation of data equivalent to data generated by affected surveys for the duration of the project and address regional-level impacts for the surveys.

3.4.8.5.1 Impacts of One Representative Project in Each WEA

The implementation of mitigation measures under Alternative C could reduce impacts on other uses when compared to those under Alternative B for the presence of structures. Impacts associated with anchoring and traffic would remain the same as described under Alternative B.

Presence of structures:

MM-32 calls for coordinating transmission infrastructure among projects and also with existing infrastructure, therefore it could be applicable to the analysis of one representative project. Since at this time BOEM cannot know to what extent lessees would adopt parallel routing with existing infrastructure, the effectiveness of this mitigation in avoiding/reducing this impact is uncertain.

MM-35 could decrease interference from WTGs on NOAA IOOS radar systems in the Affected Environment. The lessee would be responsible for determining if one representative project in each WEA would cause radar interference to a degree to which radar performance is no longer within the specific radar systems' operational parameters or fails to meet NOAA IOOS's objectives. The mitigation agreement would allow for NOAA IOOS to ensure that any impacts on NOAA IOOS's radar systems are adequately mitigated, thereby reducing impacts on these radar systems. MM-35 would likely decrease radar impacts in the Affected Environment.

MM-40 will account for scientific surveys that could be affected by the presence of wind energy structures (WTGs and OSSs) through an agreement between BOEM and the lessee. Ideally, mitigation activities would generate data equivalent to data generated by affected surveys and address regional-level impacts. By design, MM-40, in concert with the activities put in place by the NOAA Fisheries and BOEM Federal Survey Mitigation Strategy, will result in decreased impacts in the Affected Environment, although the magnitude of those impacts is dependent upon the effectiveness of the agreed-upon mitigation activities.

3.4.8.5.2 Impacts of Five Representative Projects

Offshore export cable installation would be most impactful on existing cables and pipelines in the Affected Environment if each of the five representative projects used different offshore export cable corridors to different landfalls, requiring existing subsea cables to potentially be crossed multiple times. MM-32 would consolidate offshore export cables from five representative projects into a reduced number of cable corridors and, where practicable, apply parallel routing with existing and proposed power and telecommunication cables or pipelines. While MM-32 may reduce the number of existing cables and pipelines affected, offshore export cable corridors are still expected to cross cables and pipelines. Since at this time BOEM cannot know to what extent lessees would share routing among projects or economize routing using existing linear infrastructure, the effectiveness of this mitigation in avoiding/reducing this impact is uncertain.

MM-35 could reduce radar impacts for five representative projects, similar to the reductions described for one representative project in each WEA. However, because of the increased geographic scope of the

WTGs from five representative projects, more radar systems would be mitigated. BOEM anticipates that implementing these mitigation measures for five representative projects would decrease anticipated impacts relative to Alternative B.

MM-40 will reduce scientific research and survey impacts for five representative projects, similar to the reductions described for one representative project in each WEA but across the increased geographic scope.

3.4.8.5.3 Cumulative Impacts of Alternative C

Similar to Alternative B, under Alternative C the same ongoing and planned activities would continue to contribute to impacts on other uses. The cumulative impacts on other uses under Alternative C would decrease when compared to Alternative B; mitigation would lessen impacts on radar systems.

3.4 Socioeconomic Conditions and Cultural Resources

3.4.9 Recreation and Tourism

This section describes the Affected Environment for recreation and tourism and discusses potential impacts from the Proposed Action, alternatives, and ongoing and planned activities in the region. To analyze impacts, the Affected Environment (Figure 3.4.9-1) includes the visual resources Affected Environment plus areas in adjoining counties where port activities are expected (see Section 3.4.10, *Scenic and Visual Resources*, for a detailed viewshed analysis). This encompasses coastal portions of Del Norte, Humboldt, San Luis Obispo, and Monterey Counties, as well as areas in Santa Barbara, Ventura, Los Angeles, and Orange Counties due to potential recreational impacts from port proximity. County-level information is examined at this programmatic stage because lessees have not yet identified locations for any onshore facilities.

3.4.9.1 Description of the Affected Environment and Baseline Conditions

3.4.9.1.1 Overview of Recreation and Tourism Activities and Areas

Recreation involves activities that individuals engage in for enjoyment, relaxation, or health benefits, such as hiking, biking, or fishing. These activities often occur during leisure time and can take place in natural or built environments (World Health Organization 2010). Tourism involves traveling to different locations primarily for pleasure, which often includes visiting natural, cultural, or historic sites. Tourism can significantly contribute to local economies, particularly in regions with natural attractions like national parks or coastal areas (Baloch et. al 2022). Although both offshore and onshore recreation and tourism are analyzed in this section, BOEM only governs the offshore environment.

Visitors travel to California's coastlines to partake in various onshore and offshore marine recreational activities including surfing, wildlife-viewing tours, recreational fishing and boating, beachgoing, hiking, scuba diving, and paddleboarding.

Surfers frequent the Affected Environment counties along the coastline year-round, many of which have shops and events centered around surfing (Lonely Planet 2022; Surf Destinations 2023). Offshore wildlife viewing, particularly bird and whale watching, is popular off the coasts in the Affected Environment, especially in the Morro Bay WEA (Figure 3.4.9-1). Charter boat tours in these coastal regions capitalize on the Pacific Ocean's biodiversity for bird and whale watching experiences (Monterey Bay National Marine Sanctuary 2023; Visit California 2023a; Whale Trail 2021).

California has robust recreational fishing and crabbing activities with multiple operations in the Affected Environment. This section covers private recreational fishing from shore or personal vessels; commercial and for-hire recreational fisheries are discussed in Section 3.4.1, *Commercial Fisheries and For-Hire Recreational Fishing*. The region's varied marine ecosystems attract anglers along rocky shores, bays, and inland waterways. Popular recreational saltwater species in the waters off the lease areas are primarily caught from spring through the fall, with a peak during the warmer summer months. Anglers and crabbers target species like salmon (*Oncorhynchus*), rockfish (*Sebastes*), lingcod (*Ophiodon elongatus*), halibut (*Hippoglossus stenolepis*), and Dungeness crab (*Metacarcinus magister*) and use piers and jetties in the area (CDFW 2023a; NOAA 2022a). The Dungeness crab season is short and typically begins in November (CDFW 2023b), making this crab a popular dish around the Thanksgiving and Christmas holidays.

Beaches are valuable recreational and tourism resources (Barfield and Landry 2019). California beaches are often valued for their natural beauty, which is intrinsically tied to the scenic view of the ocean. Accordingly, recreational beachgoers in the Affected Environment may be particularly sensitive to the visual impacts of offshore wind facilities (Machado and Andrés 2023). There are many beaches in the Affected Environment, some of which are in the line of sight of the lease areas where recreational beachgoers could be impacted by the aesthetic change to the coast (Figure 3.4.9-2 and Figure 3.4.9-3). Refer to Section 3.4.10, *Scenic and Visual Resources,* for an analysis of visual impacts.

Table 3.4.9-1 details the recreational hotspots and activities in the Affected Environment. To provide a holistic baseline of the recreational and tourism environment, the complex and unique characteristics of the Affected Environment are described by county in several subsections below.

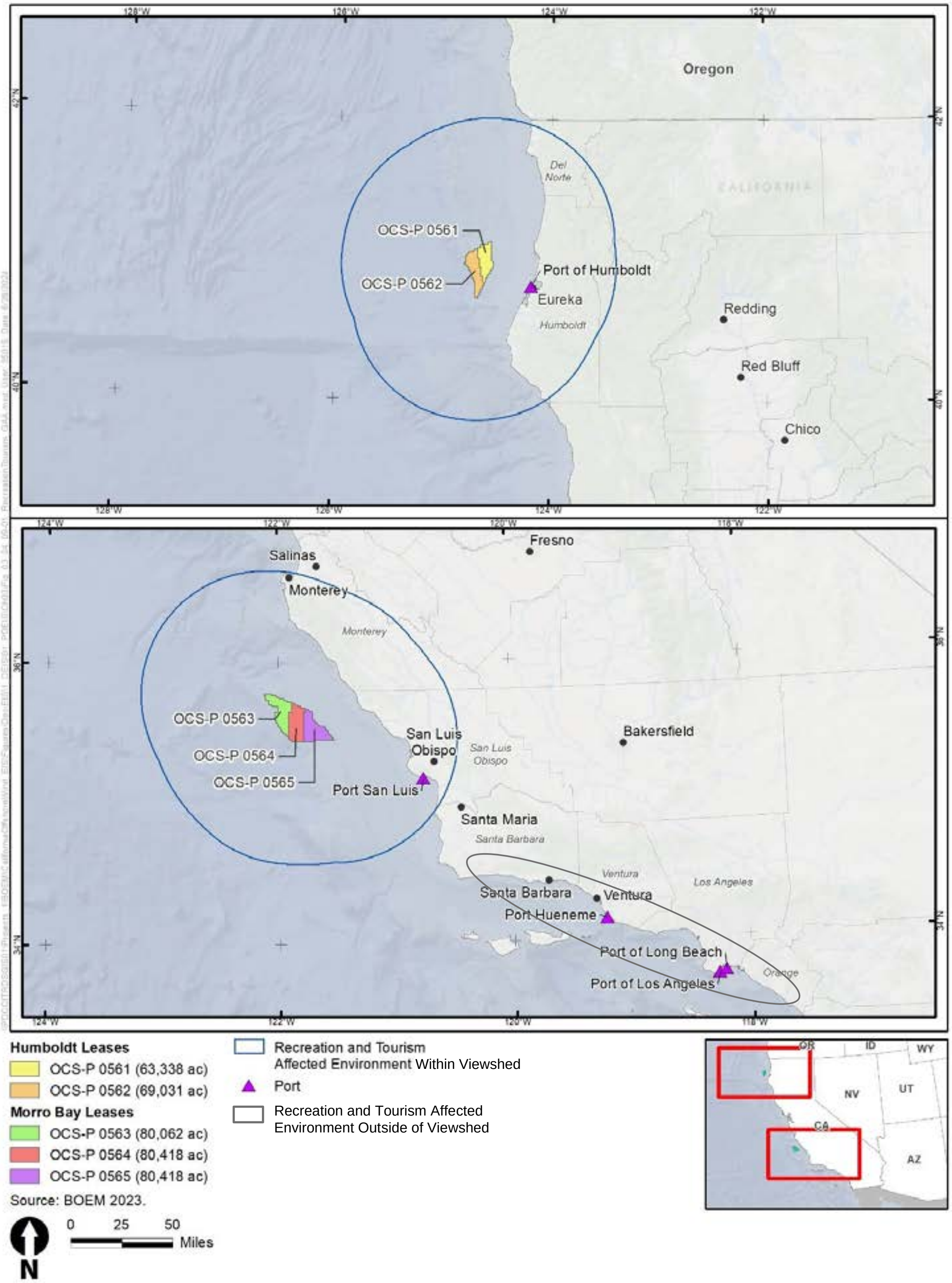
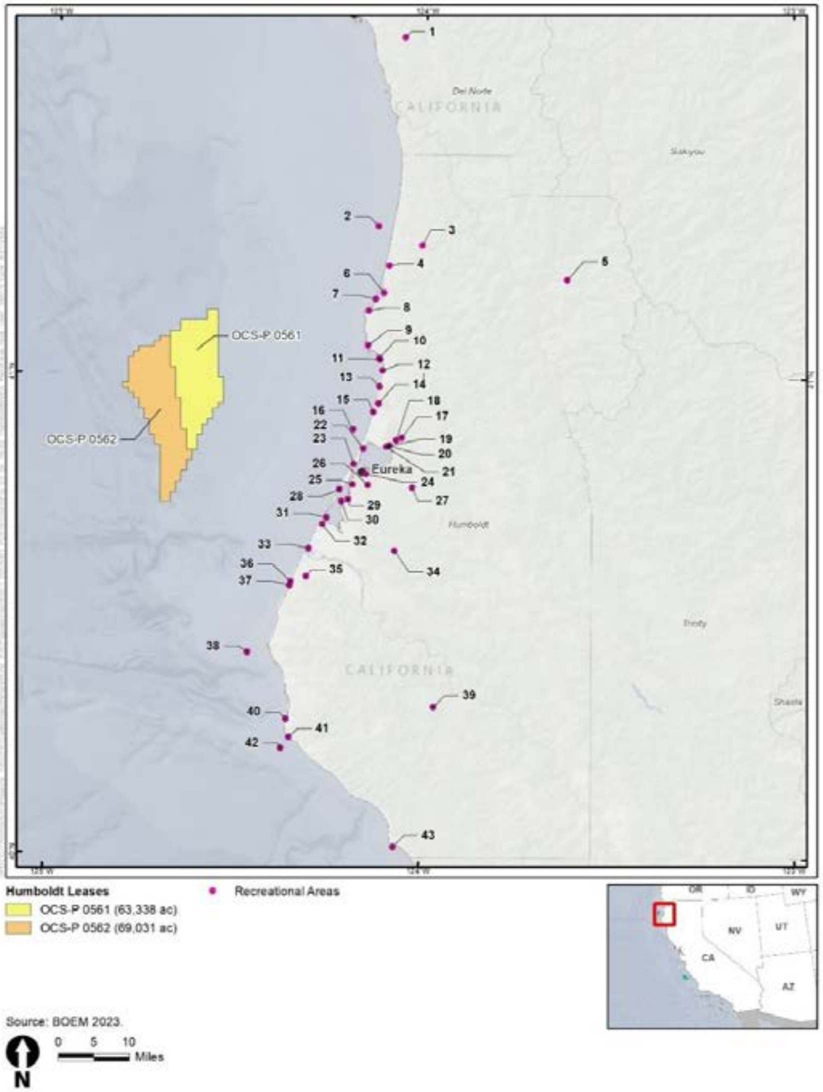


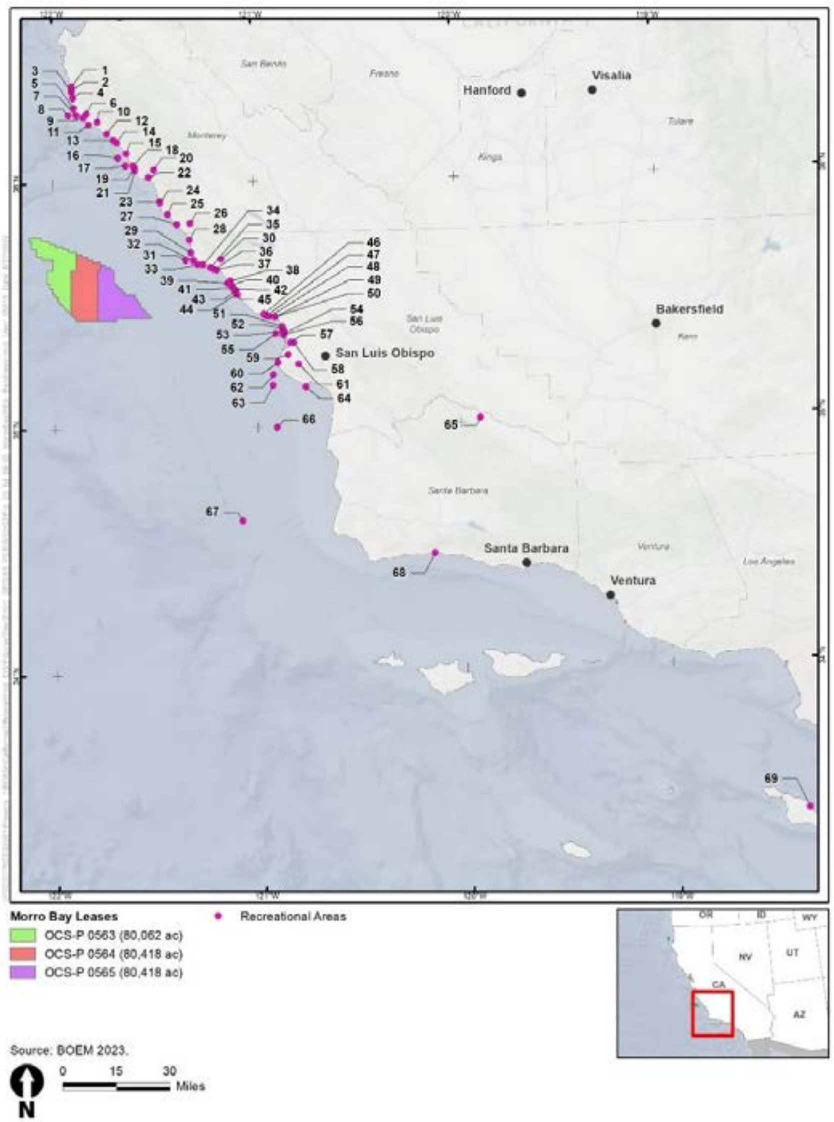
Figure 3.4.9**-**1**. Recreation and tourism Affected Environment**



1. Del Norte Coast Redwoods State Park
2. Reading Rock State Marine Conservation Area
3. Redwood National Park
4. Humboldt Lagoons State Park
5. Six Rivers National Forest
6. Harry A. Merlo State Recreation Area
7. Big Lagoon Park
8. Sue-meg State Park
9. Trinidad State Beach
10. Luffenholtz Beach
11. Houda Point/Camel Rock Beach Park
12. Little River State Beach
13. Clam Beach County Park
14. Hiller Park Playground and Picnic Area
15. Mad River County Park
16. Samoa State Marine Conservation Area
17. Arcata Community Forest
18. Redwood Community Park
19. Arcata Marsh Interpretive Area
20. Arcata Marsh & Wildlife Sanctuary
21. Arcata Bird Sanctuary
22. Manila Community Park
23. Samoa Park
24. Cooper Canyon
25. Fort Humboldt State Historic Park
26. Sequoia Park
27. California Route 1 State Scenic Highway
28. Samoa Dunes State Recreation Area
29. Humboldt Bay National Wildlife Refuge
30. King Salmon Beach
31. South Humboldt Bay State Marine Recreational Management Area
32. Table Bluff Ecological Reserve
33. Crab Park
34. Headwaters Forest Reserve
35. Fern Cottage Historic District
36. Centerville Beach
37. Lost Coast Headlands
38. South Cape Mendocino State Marine Reserve
39. Humboldt Redwoods State Park
40. Mattole Beach
41. Punta Gorda Lighthouse
42. Sea Lion Gulch State Marine Reserve
43. Cape Mendocino Lighthouse

Figure 3.4.9-2. Selected recreational areas within the Affected Environment of the Humboldt WEA

Source: Google Earth



1. Notley's Landing
2. Rocky Creek Bridge
3. Bixby Bridge Vista Point
4. Great Sur Vista Point
5. Point Sur State Historic Park
6. Andrew Molera State Park
7. Point Sur State Marine Reserve
8. Point Sur State Marine Conservation Area
9. Andrew Molera Beach
10. Pfeiffer Big Sur State Park
11. Pfeiffer Beach
12. Seal Beach Overlook
13. Partington Cove
14. Julia Pfeiffer Burns State Park
15. John Little State Reserve
16. Big Creek State Marine Conservation Area
17. Big Creek State Marine Reserve
18. Big Creek Bridge
19. Big Creek Cove Vista Point
20. Cone Peak Lookout
21. Gamboa Point
22. Limekiln State Park
23. Sand Dollar Beach
24. Plaskett Creek Campground
25. California Route 1 State Scenic Highway
26. Silver Peak Wilderness
27. Southern Redwood Botanical Area
28. San Carpoforo Creek Beach
29. Point Sierra Nevada
30. Hearst Castle
31. Piedras Blancas State Marine Conservation Area
32. Piedras Blancas State Marine Reserve
33. Piedras Blancas Light Station
34. Elephant Seal Vista Point
35. Arroyo Laguna Beach
36. Hearst San Simeon State Park
37. William Randolph Hearst Memorial Beach
38. San Simeon Creek Campground
39. Cambria State Marine Conservation Area
40. Leffingwell Cove
41. Moonstone Beach Park
42. Moonstruck Lookout State Park
43. Fiscalini Ranch Preserve
44. Lampton Cliffs County Park
45. Kenneth Norris Rancho Marino Reserve
46. Villa Creek Pullout
47. Estero Bluffs State Park
48. San Geronimo Pullout
49. Cayucos State Beach
50. Cayucos Pier
51. North Point Natural Area
52. Morro Strand State Beach
53. Cloisters Park
54. Morro Strand Beach Day Use Area
55. Estero Bay
56. Morro Rock Beach
57. Morro Bay State Marine Reserve
58. Morro Bay State Park
59. Morro Bay State Marine Recreational Management Area
60. Spooner's Cove
61. Montaña de Oro State Park
62. Point Buchon State Marine Conservation Area
63. Point Buchon State Marine Reserve
64. Point San Luis Lighthouse
65. Los Padres National Forest
66. California Coastal National Monument
67. Chumash Heritage National Marine Sanctuary
68. Arroyo Hondo Beach
69. Moonstone Beach

Figure 3.4.9-3. Selected recreational areas within the Affected Environment of the Morro Bay WEA

Source: Google Earth

Table 3.4.9-1. Recreational hotspots and popular activities in the Affected Environment

County	Notable Cities	Notable Beaches	Other Recreational Hotspots	Popular Activities
Northern California (Lease Area: Humboldt 0561,0562)				
Del Norte	Crescent City	South Beach, Pebble Beach, Kellogg Beach, Crescent Beach, Enderts Beach, Klamath Beach, Hidden Beach	Jedediah Smith Redwoods State Park, Smith River, Del Norte Coast Redwoods State Park, Tolowa Dunes State Park, California Coastal Trail, Pacific Flyway, Smith River National Recreation Area, Lake Earl Wildlife Area, Waukell Creek Wildlife Area, Tolowa Dunes State Park, Point St. George Heritage Area, Samoa State Marine Conservation Area	Beachcombing, surfing, photography, hiking, camping, birdwatching, whale watching, off-highway vehicle riding, fishing, wildlife observation
Humboldt	Eureka, Arcata	Centerville Beach County Park, Clam Beach County Park, Samoa Dunes Beach, Trinidad State Beach, Moonstone Beach, Agate Beach, Gold Bluffs Beach State Park, Black Sands Beach, Luffenholtz Beach, Houda Point/Camel Rock Beach Park, Little River State Beach, King Salmon Beach, Centerville Beach, Mattole Beach	Del Norte Coast Redwoods State Park, Reading Rock State Marine Conservation Area, Redwood National Park, Humboldt Lagoons State Park, Six Rivers National Forest, Harry A. Merlo State Recreation Area, Sue-meg State Park, Houda Point/Camel Rock Beach Park, Arcata Community Forest, Redwood Community Park, Arcata Marsh Interpretive Area, Arcata Marsh & Wildlife Sanctuary, Arcata Bird Sanctuary, Manila Community Park, Samoa Park, Cooper Canyon, Fort Humboldt State Historic Park, Sequoia Park, California Route 1 State Scenic Highway, Humboldt Bay National Wildlife Refuge, Table Bluff Ecological Reserve, Crab Park, Headwaters Forest Reserve, Fern Cottage Historic District, Lost Coast Headlands, Humboldt Redwoods State Park, Punta Gorda Lighthouse, Cape Mendocino Lighthouse, Lost Coast Trail (King Range Conservation Area), Trinidad Head, Eel River, Richardson Grove State Parks, The Lost Coast, Humboldt Bay, Humboldt Wildlife Management Area, Eel River Wildlife Area, Mad River Slough Wildlife Area, Ma-le'l Dunes Cooperative Management Area, South Spit Humboldt Bay Wildlife Area	Hiking, beachcombing, wildlife observation, birdwatching, kayaking, canoeing, fishing, camping, cultural exploration in historic towns

County	Notable Cities	Notable Beaches	Other Recreational Hotspots	Popular Activities
Central California (Lease Area: Morro Bay 0563, 0564, 0656)				
Monterey	Moss Landing, Monterey, Big Sur, Salinas, Carmel-by-the-Sea, Pacific Grove	Carmel Beach, Monterey State Beach (Del Monte Beach), Asilomar State Beach, Lover's Point Beach, Spanish Bay Beach, Pacific Grove Beaches, Moss Landing State Beach, Carmel River State Beach, Pfeiffer Beach, Garrapata State Beach, Andrew Molera Beach, Sand Dollar Beach	Big Sur (California State Route 1), McWay Falls Trail, Julia Pfeiffer Burns State Park, Point Lobos State Natural Reserve, San Simeon and Hearst Castle, Ventana Wilderness, Los Padres National Forest, Monterey Bay, Monterey Bay Aquarium, Pebble Beach area, Pebble Beach Golf Links, Moss Landing Wildlife Area, Elkhorn Slough National Estuarine Research Reserve, Fort Ord National Monument, Garrapata State Park, Ventana Wilderness (within Los Padres National Forest), Pinnacles National Park, Salinas River National Wildlife Refuge, Notley's Landing, Rocky Creek Bridge, Bixby Bridge Vista Point, Great Sur Vista Point, Point Sur State Historic Park, Andrew Molera State Park, Point Sur State Marine Reserve, Partington Cove, John Little State Reserve, Big Creek State Marine Reserve, Big Creek Bridge, Big Creek Cove Vista Point, Cone Peak Lookout, Gamboa Point, Limekiln State Park, Seal Beach Overlook, Plaskett Creek Campground, California Route 1 State Scenic Highway, Silver Peak Wilderness, Big Creek SMCA, Point Sur SMCA	Hiking, beachcombing, wildlife observation, scuba diving, whale watching, kayaking, sailing, golfing, cultural exploration in historic towns, camping
San Luis Obispo	San Luis Obispo, Paso Robles, Morro Bay, Pismo Beach	San Carpoforo Creek Beach, Arroyo Laguna Beach, William Randolph Hearst Memorial Beach, Moonstone Beach Park, Fiscalini Ranch Preserve, Lampton Cliffs County Park, Cayucos State Beach, Morro Strand State Beach, Cloisters Park, Morro Strand Beach Day Use Area, Morro Rock Beach, Spooner's Cove, Avila Beach, Pismo Beach, Shell Beach, Morro Bay State Park, Montaña	Southern Redwood Botanical Area, Point Sierra Nevada, Hearst Castle, Piedras Blancas State Marine Reserve, Piedras Blancas Light Station, Elephant Seal Vista Point, Hearst San Simeon State Park, San Simeon Creek Campground, Cambria State Marine Conservation Area, Leffingwell Cove, Moonstruck Lookout State Park, Kenneth Norris Rancho Marino Reserve, Villa Creek Pullout, Estero Bluffs State Park, San Geronimo Pullout, Cayucos Pier, North Point Natural Area, Estero Bay, Montaña de Oro State Park, Point Buchon State Marine Reserve, Point San Luis Lighthouse, Morro Rock, Morro Bay, Santa Lucia Mountains, Los Padres National Forest, Oso	Hiking, beachcombing, off-road vehicle riding, wildlife observation, horseback riding, mountain biking, rock climbing, wine tasting and vineyard tours, visiting historic missions, birdwatching

County	Notable Cities	Notable Beaches	Other Recreational Hotspots	Popular Activities
		de Oro State Park (including Spooner's Cove), San Simeon State Beach, Oceano Dunes State Vehicular Recreation Area, Los Osos State Beach, Pirates Cove, Grover Beach	Flaco Lake Natural Area, Sweet Springs Nature Preserve, Morro Bay State Marine Reserve, Point Buchon SMCA, Cambria SMCA/SMP, Piedras Blancas SMCA	
Santa Barbara	Santa Barbara, Goleta, Carpinteria, Santa Maria	Guadalupe Dunes and Beach, Paradise Beach, Point Sal State Beach, Jalama Beach, Gaviota Beach, Refugio Beach, El Captain Beach, Goleta Beach, Sands Beach, Isla Vista Beach, Leadbetter Beach, East Beach, Carpinteria Beach	Santa Ynez Valley, Santa Maria Valley, Santa Ynez Mountains, Los Padres National Forest, Channel Islands National Park, Burton Mesa Ecological Reserve, Goleta Slough Ecological Reserve, Guadalupe-Nipomo Dunes National Wildlife Refuge	Hiking, camping, rock climbing, wildlife observation, beachgoing, surfing, snorkeling, sailing, whale watching, scuba diving, kayaking, birdwatching, nature observation, photography
Southern California				
Ventura	Ventura, Oxnard, Thousand Oaks, Simi Valley, Camarillo, Moorpark, Fillmore, Port Hueneme	Rincon Point, La Conchita Beach, Hobson Beach, Faria Beach, Mondos Beach, Solimar Beach, Emma Wood State Beach, San Buenaventura Beach, McGrath State Beach, Oxnard Beach, Hueneme Beach, Point Mugu State Park	Ventura Pier, Oxnard Beach Park, Los Padres National Forest, Santa Monica Mountains, Ventura Botanical Gardens, Channel Islands National Park, Ventura Harbor, Upper Las Virgenes Canyon Open Space Preserve, Channel Islands National Park	Beachcombing, sunbathing, surfing, kayaking, hiking, biking, nature walks, exploration, birdwatching, wildlife viewing, island exploration, boating
Los Angeles	Los Angeles, Long Beach, Glendale, Pasadena, Santa Clarita, Lancaster, Palmdale, Pomona, Torrance	Carrillo State Park Beaches, Zuma Beach, Point Dume Beaches, Will Rogers Beach, Santa Monica Beach, Venice Beach, Dockweiler Beach, Manhattan Beach, Hermosa Beach, Redondo Beach, Palos Verdes Beaches, Royal Palms Beaches, Cabrillo Beach, Long Beach, Malibu Beach	Santa Monica Pier, Marina del Rey, Fisherman's Village, Santa Monica Mountains, San Gabriel Mountains, Griffith Observatory, Runyon Canyon, Hollywood Walk of Fame, Getty Center, Los Angeles County Museum of Art, Castaic Lake State Recreation Area, Santa Monica Mountains National Recreation Area, Angeles National Forest, Topanga State Park, Eaton Canyon Natural Area	Beachcombing, sunbathing, surfing, kayaking, hiking, biking, sailing, boating, walking, cycling, picnicking, horseback riding, wildlife viewing, fishing, swimming, camping, climbing, skiing, studio tours, film festivals, museum visits

County	Notable Cities	Notable Beaches	Other Recreational Hotspots	Popular Activities
Orange	Anaheim, Santa Ana, Irvine, Huntington Beach, Garden Grove, Fullerton, Orange, Costa Mesa, Mission Viejo	Bolsa Chica Beach, Huntington Beach, Newport Beach, Corona Del Mar Beach, Crystal Cove Beach, Laguna Beach, Salt Creek Beach, Doheny Beach, San Clemente Beach	Dana Point, Crystal Cove State Park, Aliso and Wood Canyons Wilderness Park, Irvine Ranch Open Space, Disneyland Resort, Knott's Berry Farm, Pelican Hill Golf Club, Orange County National Golf Center, Mission San Juan Capistrano, Bowers Museum, Orange County Museum of Art, South Coast Plaza, Fashion Island, Bolsa Chica Ecological Reserve, Coal Canyon Ecological Reserve, Laguna Laurel Ecological Reserve, Upper Newport Bay Ecological Reserve, Crystal Cove State Park, Aliso and Wood Canyons Wilderness Park, Irvine Ranch Natural Landmarks, Ronald W. Caspers Wilderness Park	Swimming, picnicking, surfing, sailing, dolphin and whale watching, boating, paddleboarding, hiking, horseback riding, mountain biking, theme parks, golfing, wildlife viewing, nature tours, shopping, dining, wildlife hunting, deer hunting, fishing, kayaking, canoeing, biking, equestrian use, camping, birdwatching, scenic viewing, entertainment, museum visits

3.4.9.1.2 *Economic Overview*

Recreation and Tourism Economy

In addition to contributing to the Affected Environment's character and identify, recreation and tourism are economically significant. With over 2.5 million individuals employed and a contribution of $143 billion in GDP, ocean-based tourism and recreation plays a crucial role in the economic health of many coastal communities (Table 3.4.9-2; NOAA 2020a). Coastal and ocean amenities serve as key drivers for recreation and tourism businesses. Recreational by-product businesses, such as food, security, water safety, housing, and entertainment, further support these activities (NOAA 2020a).

The state of California is the second-highest contributing state to the U.S. GDP from marine-based recreation and tourism at 441,000 workers and $26 billion GDP (NOAA 2018b, 2020a). In 2022, travel spending in California reached $134.4 billion and supported 1.09 million jobs (Visit California 2023b). The leisure and hospitality sectors of the economy accounted for an average of 6 percent of the total GDP of Affected Environment counties (Table 3.4.9-2; NOAA 2020a). Further economic details are provided below (Section 3.4.9.1.4 and Table 3.4.9-11).

Table 3.4.9-2. Recreation GDP in Affected Environment counties (2020$)

County	Leisure and Hospitality GDP ($)	Total GDP ($)	% of Total GDP
Del Norte	61,390,000	829,000,000	7.4%
Humboldt	287,300,000	5,000,000,000	5.8%
Monterey	1,570,000,000	24,000,000,000	6.5%
San Luis Obispo	878,710,000	15,000,000,000	5.9%
Santa Barbara	1,710,000,000	28,000,000,000	6.1%
Ventura	1,830,000,000	47,000,000,000	3.9%
Los Angeles	45,610,000,000	745,000,000,000	6.1%
Orange	12,530,000,000	262,000,000,000	4.8%
State of California	134,400,000,000	3,590,000,000,000	3.7%

Source: NOAA 2020a; Visit California 2023b.

Recreational Fishing Economy

In 2019, California reported approximately 3 million recreational fishing trips, contributing an estimated $507 million to the state's economy (NOAA 2022b). CDFW issued approximately 1.6 million recreational fishing licenses in 2023 for ocean and inland fishing, with a total value of approximately $71.6 million. The most common license sold was the Ocean Enhancement Validations, required for fishing in ocean waters south of Point Arguello (CDFW 2024a, 2024b). Recreational anglers primarily targeted bottom-fish species, including rockfish, lingcod, California scorpionfish (*Scorpaena guttata*), and ocean whitefish (*Caulolatilus princeps*), accounting for over half of all recreational fishing trips (CDFW 2024a).

NOAA's social indicator tool estimates how much the economy of a coastal community relies on recreational fishing (NOAA 2020b). Recreational fishing engagement and reliance are two key metrics used to assess fishing's role in communities. Engagement measures overall fishing activities, with a higher rank indicating more involvement (NOAA 2021). Reliance, on the other hand, gauges the importance of fishing relative to the community's population size, with a higher rank showing greater dependence. Communities with high reliance and engagement would be most impacted by any effects on fishing. NOAA also evaluates a community's resilience to disturbances like regulatory changes, extreme weather, oil spills, and sea level rise using these indicators (NOAA 2021). While most communities in the Affected Environment have low fishing reliance, some in Del Norte, Monterey, Santa Barbara, and Orange Counties have medium reliance. Figure 3.4.9-4 shows ports along the West Coast that may support offshore wind development and nearby communities' fishing reliance. Avila Beach in San Luis Obispo County has high reliance (NOAA 2020b).

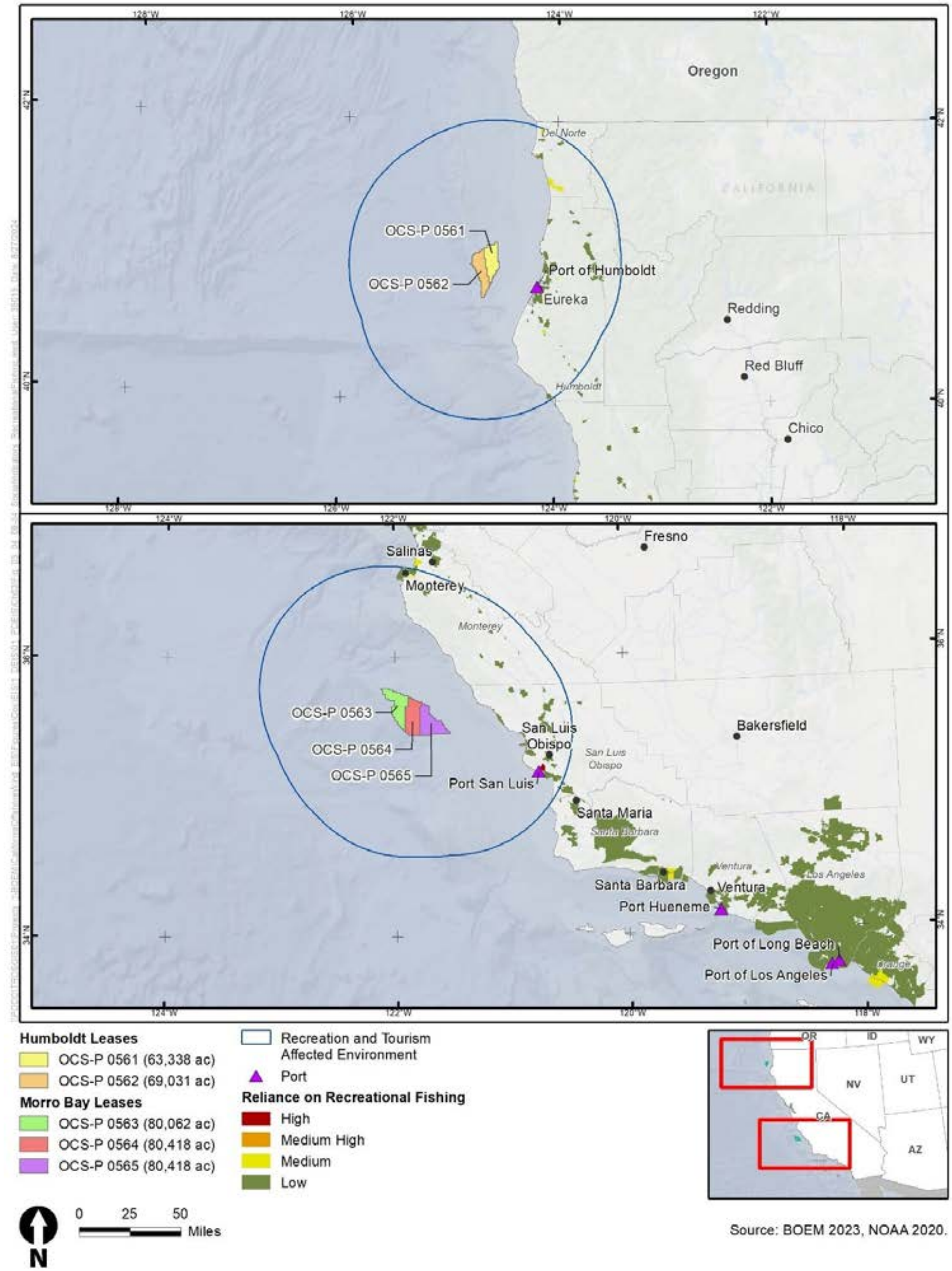


Figure 3.4.9-4. Economic reliance on recreational fishing in the Affected Environment

Source: NOAA 2020b

3.4.9.1.3 Recreation and Tourism Activities and Areas at the County Level

Del Norte County, California

Del Norte County, in California’s northwest corner, offers a diverse range of recreational activities and natural areas favored by outdoor enthusiasts. The county’s coastal landscapes make it a destination for beachcombers, surfers, and photographers. Both coastally and further inland, the county features extensive redwood forests, with Redwood National and State Parks being highlights. The Smith River, known for its pristine waters and excellent fishing, is popular for hiking, swimming, and camping. Additionally, Del Norte Coast Redwoods State Park and Tolowa Dunes State Park offer more opportunities for hiking, birdwatching, and wildlife observation (particularly elk [*Cervus canadensis*]). Camping and recreational vehicle (RV) enthusiasts can find numerous campgrounds and RV parks throughout the county. Birdwatching is also a popular activity, with Del Norte County being part of the Pacific Flyway (Audubon Society No date). Table 3.4.9-3 lists wildlife management areas used for recreation.

Table 3.4.9-3. Recreational wildlife management areas in Del Norte County

Wildlife Management Area	Acreage	Description
Smith River National Recreation Area	305,337	This area includes parts of Del Norte County and is managed by the U.S. Forest Service. It provides habitat for various wildlife species and includes the Smith River. Many recreational activities are offered here, including camping, hiking, hunting, four-wheeling, off-highway vehicles, biking, horseback riding, and wildlife watching (USDA 2019).
Lake Earl Wildlife Area	6,100	This wildlife area is managed by CDFW and includes Lake Earl and Lake Talawa, providing critical habitat for migratory birds and other wildlife. It is the largest coastal lagoon on the West Coast. Recreational opportunities include fishing, boating, hiking, birdwatching, and waterfowl hunting (CDFW 2023c).
Waukell Creek Wildlife Area	28	This wildlife area in Del Norte County is managed by CDFW. It provides essential habitat for various wildlife species and is used for conservation and recreational purposes, such as wildlife viewing, birdwatching, and waterfowl hunting (CDFW 2023d).
Tolowa Dunes State Park	4,000	This park on the coast of Del Norte County provides habitat for a variety of wildlife, including shorebirds, waterfowl, and other coastal species. Trails for hiking and horseback riding are offered here (California State Parks 2023a).
Point St. George Heritage Area	340	This coastal area near Crescent City is managed by the Redwood Parks Conservancy and offers opportunities for wildlife viewing, shoreline views, and surfing (Outdoor Project 2023).

Humboldt County, California

Humboldt County's coastline extends for over 100 miles and is known for its rugged terrain, cliffs, and beaches. Much of the southern coast of Humboldt County is undeveloped, where the Lost Coast Trail within the King Range Conservation Area offers backcountry camping and hiking opportunities. Trinidad

State Beach and nearby Trinidad Head along with Sue-Meg State Park are popular seaside destinations along the rocky coast north of Arcata. Richardson Grove State Parks and Humboldt Redwoods State Park are home to some of the world's tallest and oldest redwood trees and feature hiking trails and campgrounds. Humboldt Bay National Wildlife Refuge serves as an essential habitat for migratory birds, making it a popular destination for birdwatchers. The Eel River is a prominent waterway attracting kayakers, canoeists, and anglers in pursuit of salmon and steelhead. Cultural and historical experiences are also available, with towns like Eureka and Arcata showcasing Victorian-era architecture and a vibrant arts scene. Museums, art galleries, and theaters provide opportunities for cultural exploration. Humboldt Bay is suitable for boating, paddleboarding, and sailing. Campgrounds are abundant throughout the county, accommodating both tent and RV campers. Wildlife management areas used for recreation in Humboldt County are listed in Table 3.4.9-4.

Table 3.4.9-4. Recreational wildlife management areas in Humboldt County

Wildlife Management Area	Acreage	Description
Humboldt Wildlife Management Area	37,140	This wildlife management area in Humboldt County is managed by CDFW. It serves as an important site for wildlife conservation and provides various habitats for local and migratory species. It is also used for recreational hunting, fishing, and camping.
Humboldt Bay National Wildlife Refuge	4,000	Managed by USFWS, this refuge includes a variety of habitats, including tidal wetlands, dunes, and forested uplands. It provides important habitat for migratory birds and other wildlife. It is also used for recreational hiking and wildlife viewing (USFWS No date a).
Eel River Wildlife Area	2,600	This area, managed by CDFW, includes diverse habitats such as freshwater wetlands and riparian zones. It is used for wildlife conservation and recreational activities such as fishing, wildlife viewing, birdwatching, hiking, and hunting (CDFW 2023e).
Mad River Slough Wildlife Area	587	Also managed by CDFW, this area encompasses a range of habitats along the Mad River, providing valuable habitat for waterfowl and other wildlife, as well as recreational activities such as wildlife viewing, birdwatching, and hunting (CDFW 2023f).
Ma-le'l Dunes Cooperative Management Area	444	This cooperative management area, overseen by several agencies and organizations, includes coastal dune habitat and is open to walking and biking on trails (BLM No date).
Headwaters Forest Reserve	7,472	Managed by the Bureau of Land Management, this reserve protects a portion of the last significant stand of old-growth redwood forest in private hands, providing habitat for a variety of species. Two trails in the reserve are open to the public (BLM 2022a).
Arcata Marsh and Wildlife Sanctuary	225	This site features a system of constructed wetlands managed by the City of Arcata. It is a popular spot for birdwatching, wildlife observation, and views of Arcata Bay (Visit Redwoods 2023).
South Spit Humboldt Bay Wildlife Area	598	Managed by CDFW, this wildlife area includes tidal marshes and dunes, offering critical habitat for various bird species and other wildlife. Recreational activities include fishing, wildlife viewing, hiking, and hunting (CDFW 2023g).

Monterey County, California

Monterey County's coastline is famous for its scenic beauty, featuring rugged cliffs, sandy beaches, and dramatic coastal landscapes. Notably, Big Sur offers numerous coastal views and hiking opportunities, including the renowned McWay Falls Trail. Point Lobos State Natural Reserve offer scenic trails with up-close views of marine life. The Ventana Wilderness and Los Padres National Forest provide extensive hiking and camping options. Monterey Bay itself is a hub for aquatic activities, including whale watching, kayaking, and sailing. The Monterey Bay Aquarium is renowned for its marine exhibits and research, making it a notable attraction for those interested in marine biology. The Pebble Beach area is known worldwide for its golfing, with four coastal courses. Monterey County is also renowned for its rich cultural heritage, embodied in places like Monterey, Carmel-by-the-Sea, and Pacific Grove. Camping is available in various state parks, campgrounds, and wilderness areas throughout the county. Table 3.4.9-5 lists wildlife management areas used for recreation.

Table 3.4.9-5. Recreational wildlife management areas in Monterey County

Wildlife Management Area	Acreage	Description
Moss Landing Wildlife Area	872	Located in Moss Landing along Monterey Bay, this wildlife area is managed by CDFW. It includes a variety of habitats, such as tidal wetlands and mudflats, and is an important site for birdwatching and wildlife observation. Recreational activities include waterfowl hunting and wildlife viewing (CDFW 2023h).
Elkhorn Slough National Estuarine Research Reserve	1,700	Just inland from Moss Landing, this reserve, managed in partnership with CDFW and the NOAA, protects a significant portion of the Elkhorn Slough estuary. It is a vital habitat for migratory birds, marine mammals, and other wildlife. Wildlife viewing, hiking, and nature tours are offered here (CDFW 2023i).
Fort Ord National Monument	14,000	Managed by the Bureau of Land Management, this monument encompasses diverse habitats, including grasslands and oak woodlands. It provides opportunities for wildlife viewing and outdoor recreation, with 86 miles of trails for hiking, biking, and horseback riding (BLM 2022b).
Garrapata State Park	2,939	This coastal state park offers a variety of habitats, including rugged cliffs, coastal redwood forests, and sandy beaches. It is an important area for wildlife and offers scenic beauty. Hiking and wildlife watching is offered here (California State Parks 2003).
Ventana Wilderness	Undefined	While not a specific wildlife management area, the Ventana Wilderness within Los Padres National Forest offers extensive wilderness and natural landscapes, serving as vital habitat for a range of wildlife species, as well as opportunities for hiking and camping (USDA No date a).
Pinnacles National Park	26,000	This national park, while known for its unique rock formations, also provides habitat for several species, including the California condor (Gymnogyps californianus) and various other wildlife. It contains over 26,000 acres that are available for hiking, rock climbing, caving, and camping (NPS 2020).
Salinas River National Wildlife Refuge	367	Managed by USFWS, this refuge encompasses riparian habitats along the Salinas River and supports numerous bird species and other wildlife. Hunting, fishing, and wildlife watching take place here (USFWS No date b).

San Luis Obispo County, California

San Luis Obispo County offers a diverse range of outdoor recreational activities and natural attractions. Its picturesque coastline showcases both rugged coastal landscapes and sandy beaches, with Montaña de Oro State Park offering excellent hiking and beachcombing opportunities. Morro Rock, protected as a state reserve and inaccessible for hiking, is a prominent feature of the coastal landscape and is considered by nearby Tribes to be a sacred site. Pismo and Avila Beaches are recognized for their expansive shorelines and activities such as off-road vehicle riding. Sam Simeon and Hearst Castle State Park provide sweeping natural views and historic architecture. Inland, the county's varied terrain includes the Santa Lucia Mountains and Los Padres National Forest, providing numerous options for outdoor recreation. San Luis Obispo County is particularly noted for its vineyards and wineries, making it a desirable destination for wine tasting and vineyard tours, with such activities centered around Paso Robles and San Luis Obispo. Cultural attractions are abundant, including historic missions, art galleries, and the coastal towns of Cambria, Cayucos, and Morro Bay, each of which are visitor-serving hubs. Camping facilities can be found in numerous state parks, campgrounds, and wilderness areas, catering to both tent and RV campers. Table 3.4.9-6 lists wildlife management areas used for recreation.

Table 3.4.9-6. Recreational wildlife management areas in San Luis Obispo County

Wildlife Management Area	Acreage	Description
Morro Bay State Park	2,700	This coastal park offers diverse habitats, including salt marshes, dunes, and tidal estuaries. It is a nationally recognized site for birdwatching, wildlife observation, and outdoor recreation (California State Parks 2017).
Montaña de Oro State Park	8,000	This park contains over 8,000 acres, including 7 miles of shoreline, rugged coastal cliffs, canyons, and coastal sage scrub habitats. It provides opportunities for wildlife viewing and outdoor activities such as hiking, biking, and horseback riding (California State Parks 2012).
Oso Flaco Lake Natural Area	800	This natural area includes a coastal lagoon and dune habitat and is managed by the California State Parks system. It is home to various bird species and is a prime spot for birdwatching. Other activities include hiking, fishing, nature study, and other non-motorized uses (California State Parks 2023b).
Sweet Springs Nature Preserve	32	Located in Los Osos, this nature preserve is owned and managed by the Morro Coast Audubon Society. It is known for its birdwatching and features wildlife habitats, including wetlands and tidal areas (Morro Coast Audubon Society 2017).
Morro Bay Wildlife Area	1,300	This area offers various recreational activities, including birdwatching, wildlife viewing, and waterfowl hunting. It is known for its tidal marshes and mudflats, which provide excellent habitat for numerous bird species (CDFW No date a).
Morro Dunes Ecological Reserve	286	This reserve is primarily focused on the conservation of sensitive habitats and species. Recreational activities may be limited to low-impact uses such as wildlife observation and hiking on designated trails to protect the delicate ecosystem (CDFW No date b).
San Luis Obispo Wildlife Area	448	This grassland area is managed for wildlife conservation and open space buffer. It is closed to visitors except for use as a public shooting range (CDFW No date c).

Santa Barbara County, California

Santa Barbara County is known worldwide for its coastal landscapes, wineries, agricultural areas, and the historic city of Santa Barbara (County of Santa Barbara No date). Vandenberg Space Force Base covers a large land area within the county, and the surrounding area is sparsely populated. The agricultural expanses in the area contain many vineyards and wineries, particularly in the Santa Ynez and Santa Maria Valleys (Santa Barbara No date a). The region's diverse topography includes the Santa Ynez Mountains and Los Padres National Forest. In addition, smaller communities such as Solvang, Los Olivos, and Buellton feature historic architecture, quaint streets, and bustling arts communities.

The county's coastline contains sandy beaches, cliffsides, and expansive ocean views, with popular spots like East Beach and Leadbetter Beach providing ample opportunities for beachgoing, surfing, snorkeling, and sailing (Santa Barbara No date a). Additionally, Channel Islands National Park, containing unique flora and fauna, is accessible by boat. Whale watching, scuba diving, hiking, kayaking, birdwatching, camping are all popular activities on and off the islands (Santa Barbara No date b). Table 3.4.9-7 lists wildlife management areas used for recreation.

Table 3.4.9-7. Recreational wildlife management areas in Santa Barbara County

Wildlife Management Area	Acreage	Description
Burton Mesa Ecological Reserve	5,368	Near the city of Lompoc in northern Santa Barbara County, this reserve protects a unique and sensitive habitat, including vernal pools and a variety of plant species. It offers opportunities for hiking and nature observation (CDFW No date d).
Goleta Slough Ecological Reserve	440	Located in the Goleta area, adjacent to the University of California, Santa Barbara, this reserve encompasses wetland habitats, including estuarine and tidal areas. It offers birdwatching, hiking, and wildlife observation (CDFW No date e).
Guadalupe-Nipomo Dunes National Wildlife Refuge	20,000	This refuge is located along the central coast of California, partially within northwestern Santa Barbara County. The refuge is known for its expansive sand dunes, coastal ecosystems, and diverse wildlife and is recognized for its cultural and historical significance. The refuge offers wildlife viewing, birdwatching, hiking, and photography. There are designated trails and overlooks (USFWS No date c).

Ventura County, California

Ventura County's coastline, featuring Ventura Pier and Oxnard Beach Park, provides accessible areas for activities such as beachcombing, sunbathing, surfing, and kayaking. Inland areas of Ventura County, characterized by scenic valleys and rolling hills, provide an extensive network of hiking and biking trails. Numerous mountain ranges (including the Santa Monica and Topatopa Mountains) offer panoramic vistas and opportunities for nature walks and exploration. The region's agricultural landscape is showcased through thriving vineyards and wineries. Wildlife enthusiasts can explore the Ventura Botanical Gardens and the Channel Islands National Park, accessible by boat from Ventura Harbor. These locations offer opportunities for birdwatching, wildlife viewing, and island-based exploration. Ventura

County's communities, including Ventura, Oxnard, and Thousand Oaks, feature historic sites, museums, and cultural events, with many boating opportunities in Ventura Harbor. Port Hueneme, one of the busiest commercial shipping ports in the United States, does not directly serve recreational purposes, but there are surrounding waterfront parks and beaches that are open to the public. Table 3.4.9-8 lists wildlife management areas used for recreation.

Table 3.4.9-8. Recreational wildlife management areas in Ventura County

Wildlife Management Area	Acreage	Description
Upper Las Virgenes Canyon Open Space Preserve	5,600	Located in the Simi Hills, spanning Los Angeles and Ventura Counties, this open space preserve offers diverse habitats, including grasslands, oak woodlands, and chaparral. It provides an extensive trail network for hiking, mountain biking, and horseback riding. The preserve also features scenic vistas of the surrounding landscape (Mountains Recreation & Conservation Authority 2024).
Santa Clara River Preserve	1,000	This area is located on the Santa Clara River and provides key river and wetland habitat for a variety of wildlife species. It is open to the public for outdoor education, community gatherings, wildlife viewing and hiking (The Nature Conservancy 2024).
Ventura River Preserve	1,600	The preserve is located along the Ventura River, near the city of Ojai, providing a large expanse of protected natural habitat. The preserve features over 10 miles of trails for hiking, wildlife viewing, horseback riding, and biking (Ojai Valley Land Conservancy 2023).

Los Angeles County, California

Los Angeles County is known worldwide as a diverse hub for recreation and tourism. Its extensive coastline features destinations like Santa Monica Pier and Malibu, known for expansive beaches and world-renowned surfing (Visit California 2023c). Marina del Rey is a primary center of coastal aquatic activities. Visitors can enjoy boating, waterfront dining, and exploring Fisherman's Village (Marina Del Rey Tourism Board 2024). The Port of Los Angeles, a busy industrial port, provides limited recreational options, but nearby waterfront parks and bike paths offer walking and cycling with ocean views (Port of Los Angeles 2024).

Inland, the Santa Monica Mountains and the San Gabriel Mountains feature large trail networks, attracting hikers, bikers, and nature enthusiasts. Within hilly Griffith Park, the Griffith Observatory offers expansive cityscape views and serves as an educational center. Runyon Canyon, in the Hollywood Hills, serves as a popular hiking spot with panoramic views of the city skyline. The Los Angeles River revitalization projects underscore the county's commitment to transforming urban spaces for recreational purposes. Plans along a 51-mile connected open space include green corridors, parks, and bike paths along the river, fostering outdoor opportunities (LA River Master Plan 2024).

Recreation in Los Angeles County extends beyond outdoor activities. As the global epicenter of the entertainment industry, Hollywood draws tourists with the Walk of Fame, studio tours, and film festivals. The county's museums, including the Getty Center and the Los Angeles County Museum of Art, contribute to its cultural richness, hosting extensive art collections. With over 2.75 million overseas visitors annually, Los Angeles is the fourth-most popular tourist destination in the United States (International Trade Administration 2023). Table 3.4.9-9 lists wildlife management areas used for recreation.

Table 3.4.9-9. Recreational wildlife management areas in Los Angeles County

Wildlife Management Area	Acreage	Description
Castaic Lake State Recreation Area	12,658	Located in the rolling hills of the Sierra Pelona Mountains, this area encompasses a reservoir offering a range of water-based activities. Visitors can enjoy boating, kayaking, fishing, and swimming, while the surrounding parkland provides opportunities for picnicking, hiking, biking, camping, horseback riding, and wildlife viewing (Los Angeles County Parks and Recreation No date a).
Santa Monica Mountains National Recreation Area	153,075	The Santa Monica Mountains National Recreation Area contains diverse landscapes, including rugged mountains, canyons, and coastal areas. Popular for hiking, biking, horseback riding, climbing, camping, and wildlife viewing, it provides a natural retreat close to urban areas (NPS 2021).
Angeles National Forest	700,000	Northeast of Los Angeles, this vast forested area in the San Gabriel Mountains is renowned for its extensive trail system. The forest provides opportunities for hiking, camping, skiing, picnicking, and scenic drives amid mountainous terrain, dense forests, and sweeping vistas (USDA No date b).
Topanga State Park	11,525	In the Santa Monica Mountains, Topanga State Park is a scenic wilderness area near Los Angeles. The park offers a 36-mile network of trails for hiking, wildlife observation, horseback riding, and camping (California State Parks 2023c).
Eaton Canyon Natural Area	198	Situated in the San Gabriel Mountains, this natural area supports local flora and fauna and features a nature center, hiking and equestrian trails, and picnic areas (Los Angeles County Parks and Recreation No date b).

Orange County, California

Orange County features a coastline extending over 40 miles, offering Huntington, Laguna, and Newport Beaches for activities such as swimming, picnicking, and surfing. Harbors like Dana Point and Newport facilitate recreational maritime activities such as sailing, dolphin and whale watching, boating, and paddleboarding. Hikers can explore parks such as Crystal Cove State Park and Aliso and Wood Canyons Wilderness Park, known for their trails and diverse ecosystems. Inland areas such as Irvine Ranch Open Space offer opportunities for outdoor activities like horseback riding and mountain biking. Theme parks like Disneyland Resort in Anaheim and Knott's Berry Farm in Buena Park contribute to the area's entertainment sector. Golfers have access to Pelican Hill Golf Club and the Orange County National Golf Center. Cultural attractions include historical sites like the Mission San Juan Capistrano and institutions like the Bowers Museum and Orange County Museum of Art. Additionally, commercial districts such as South Coast Plaza and Fashion Island provide retail and dining options. Orange County's recreational landscape is characterized by a balanced mix of coastal amenities, cultural offerings, and outdoor activities, catering to a diverse range of interests. Table 3.4.9-10 lists wildlife management areas used for recreation.

Table 3.4.9-10. Recreational wildlife management areas in Orange County

Wildlife Management Area	Acreage	Description
Bolsa Chica Ecological Reserve	1,300	Located along the coast, this coastal estuary is known for its wetlands and serves as a critical habitat for various bird species. Hiking, wildlife viewing, and nature tours are offered here (CDFW No date f).
Coal Canyon Ecological Reserve	956	Within the Santa Ana Mountains, the Coal Canyon Ecological Reserve property features diverse habitats such as chaparral and coastal sage scrub. Wildlife viewing, hiking, and deer hunting are permitted (CDFW No date g).
Laguna Laurel Ecological Reserve	76	This reserve in the foothills of Orange County contributes to the preservation of ecological diversity, including waterbodies and riparian habitat. Wildlife viewing and hiking are permitted within the reserve (CDFW No date h).
Upper Newport Bay Ecological Reserve	752	This ecological reserve is a significant coastal wetland and estuary. It provides critical salt marsh and marine habitat for migratory birds, including endangered species, and supports a rich array of marine life in its tidal waters. Many recreational activities take place here, including wildlife viewing, fishing, hiking, visiting the Science Center, kayaking, canoeing, birdwatching, and biking (CDFW No date i).
Crystal Cove State Park	2,400	Crystal Cove State Park includes 2,400 acres of marine habitats, coastal canyons, and beaches with 3.2 miles of coastline. The park is home to several notable features, including a federally listed Historic District, the Moro Canyon, and a marine protected area. Hiking, biking, and equestrian use are permitted on trails, and camping is also offered (Crystal Cove State Park 2024).
Aliso and Wood Canyons Wilderness Park	4,500	Located in the San Joaquin Hills, this wilderness park contains canyons, vast open space, and riparian woodlands. It has over 30 miles of trails, and biking, hiking, bird watching, horseback riding, picnicking, and scenic viewing are offered (Orange County Parks 2024a).
Irvine Ranch Natural Landmarks	50,000	These landmarks include a vast collection of areas of preserved open space, making up nearly 50,000 acres, including Limestone Canyon and Whiting Ranch Wilderness Park. Hiking, biking, and equestrian use are permitted on trails, and wildlife viewing and yoga classes are also offered in the area (Irvine Ranch Natural Landmarks 2024).
Ronald W. Caspers Wilderness Park	8,000	This protected wilderness preserve in the Santa Ana Mountains features diverse ecosystems, including oak woodlands and riparian areas, supporting a variety of wildlife. Nature walks, hiking, biking, naturalist programs, bird watching, camping, horseback riding, and scenic viewing all occur in the park (Orange County Parks 2024b).

3.4.9.1.4 Recreation and Tourism Economy at the County Level

This section summarizes the economic impact of accommodation, food services, arts, entertainment, and recreation establishments within Affected Environment counties. Each county has unique contributions to the tourism economy, reflected in the number of establishments and the annual payroll generated. Table 3.4.9-11 shows the diversity and scale of the tourism industry across different regions, from smaller counties like Del Norte County to major hubs like Los Angeles and Orange Counties. Table information was sourced from 2021 U.S. Census Bureau data, the most current at the time this analysis was prepared. Census data limitations include a reliance on self-reported figures, which may not account for all small or informal establishments. Additionally, the data reflect economic conditions in 2021 and may not capture subsequent economic fluctuations or trends.

Table 3.4.9-11. Recreational and tourism economy at the county level (2021$)

County	Accommodation and Food Service Establishments	Annual Payroll for Accommodation and Food Services	Arts, Entertainment, and Recreation Establishments	Annual Payroll for Arts, Entertainment, and Recreation
Del Norte	59	$14,951,000	6	$8,625,000
Humboldt	382	$116,886,000	58	$14,408,000
Monterey	1,077	$582,982,000	161	$144,058,000
San Luis Obispo	1,003	$443,666,000	143	$33,718,000
Santa Barbara	1,206	$694,569,000	268	$98,396,000
Ventura	1,665	$749,622,000	586	$141,304,000
Los Angeles	23,781	$10,830,506,000	20,972	$10,758,474,000
Orange	1,597	$2,133,458,000	8,523	$4,275,289,000

Source: U.S. Census Bureau 2021

3.4.9.1.5 Recreational Fishing at the County Level

This section summarizes notable recreational fishing locations and fish species in each county, sourced from various local and state agencies, including CDFW information, county tourism websites, and county government reports. The information highlights the rich diversity of fishing opportunities and the different species that attract anglers to these regions, though it may not reflect potential seasonal variations, changes in fish populations, and specific regulations that may affect fishing activities in each area. For a more in-depth analysis of fish species and fishing activities in the Affected Environment, please refer to Section 3.4.1.

Del Norte County, California

Del Norte County provides exceptional habitat for various aquatic species, attracting anglers and crabbers to the area. The Klamath River is particularly known for its salmon runs, while the coastal waters of the Pacific Ocean offer opportunities for saltwater fishing and crabbing. The seasonal patterns in Del Norte County vary, with salmon runs peaking in the summer and early fall (CDFW 2023j).

Humboldt County, California

Humboldt County’s diverse aquatic ecosystems, which include the Pacific Ocean coastline, the estuarine areas within Humboldt Bay, and the rivers and streams, offer a rich network of opportunities for anglers and crabbers. Humboldt County is known for its salmon runs, particularly in the Klamath and Trinity Rivers. The county's coastal waters offer saltwater fishing and Dungeness crabbing.

Monterey County, California

Monterey County is renowned for its marine biodiversity and significant populations of salmon and rockfish, making it a sought-after destination for sport fishing enthusiasts. Monterey Bay is known for its charter services and diverse marine species. Additionally, Dungeness crabbing is prevalent along the coastal stretches.

San Luis Obispo County, California

From the waters of the Pacific Ocean to the estuaries and river systems, San Luis Obispo County is characterized by a diverse range of aquatic environments and attracts many anglers and crabbers. As noted in Section 3.4.9.1.2, the community of Avila Beach within the county has a high level of reliance on recreational fishing, likely due to its small population and the popularity of recreational fishing as a form of tourism, which is the main industry in the community (NOAA 2020b; Visit Avila Beach 2024). This area provides ample opportunities for sport fishing, with salmon, rockfish, and various other species populating the coastal waters. Dungeness crabbing is also a popular activity.

Santa Barbara County, California

Coastal fishing along the extensive shoreline of Santa Barbara County provides the opportunity to catch species such as surfperch (*Embiotocidae*), halibut, and various types of rockfish. Additionally, the region's proximity to wildlife management areas like the Goleta Slough Ecological Reserve and Guadalupe-Nipomo Dunes National Wildlife Refuge allows anglers to explore unique habitats, potentially encountering species like steelhead trout (*Oncorhynchus mykiss*) and various waterfowl. Inland, Cachuma Lake supports largemouth (*Micropterus salmoides)* and small mouth bass (*Micropterus dolomieu*), crappie (*Pomoxis nigromaculatu*), bluegill (*Lepomis macrochirus*), red-ear sunfish (*Lepomis microlophus*), channel catfish (*Ictalurus punctatus*), and rainbow trout (*Oncorhynchus mykiss*) (County of Santa Barbara 2023).

Ventura County, California

The county's extensive coastline provides opportunities for anglers to target a variety of coastal species, including surfperch, halibut, and various rockfish. Anglers boating from harbors like Dana Point and Newport can engage in offshore fishing adventures, targeting pelagic species such as tuna (*Thunnini*) and yellowtail (*Seriola lalandi*). Additionally, the Upper Las Virgenes Canyon Open Space Preserve offers freshwater fishing opportunities, with various species found in its water reservoir (Visit Ventura 2022).

Los Angeles County, California

Santa Monica Pier and Malibu Beach provide coastal access to a variety of species, including surfperch, halibut, and a range of rockfish. The region's marinas, such as those in Marina del Rey, offer opportunities for offshore fishing, targeting pelagic species like yellowtail and white seabass (*Atractoscion nobilis*). Inland areas, including Castaic Lake State Recreation Area, provide freshwater fishing opportunities for species such as largemouth bass, catfish, and rainbow trout (Los Angeles County Department of Beaches and Harbors 2021).

Orange County, California

Huntington, Laguna, and Newport Beaches offer shore fishing for species like surfperch, corbina (*Menticirrhus undulatus*), and surfperch. Dana Point and Newport harbors also offer opportunities for anglers to target various coastal species, including sand bass (*Morone chrysops*) and calico bass (*Paralabrax clathratus*). Inland areas like the Upper Newport Bay Ecological Reserve provide estuarine fishing opportunities for bass, catfish, and other various species (CDFW No date i).

3.4.9.2 Impact Background for Recreation and Tourism

Anchoring, cable installation and maintenance, land disturbance, lighting, noise, presence of structures, port utilization, invasive species, and traffic may affect recreation and tourism (Table 3.4.9-12).

Beneficial impacts on recreation and tourism are described using the definitions described in Section 3.1.2, *Impact Terminology*.

Table 3.4.9-12. Issues and potential impacts on recreation and tourism

IPF	Impact Indicator	Recreational Activities Potentially Affected	Areas Potentially Affected
Anchoring	Loss or damage to fishing gear[2]	Fishing	Lease areas, exposed array and export cables
	Disruption of seafloor habitats[2]	Fishing, scuba diving	Anchorages
	Navigational hazards for boaters[2]	Fishing, boating	Lease areas, involved ports
	Exclusion areas for weighted trolling or drifting hook-and-line gear due to risk of entanglement[2]	Fishing	Lease areas
Cable installation and maintenance	Disruption of marine habitats[2]	Boating, fishing, scuba diving, sailing, kayaking, canoeing	Lease areas, involved ports
	Loss of fishing access due to restricted areas[2]	Fishing	Lease areas
	Navigational hazards for boaters[2]	Fishing, boating	Lease areas, involved ports
	Gear entanglement or loss/damage[2]	Fishing	Lease areas
Land disturbance	Changes to coastal landscapes[1]	Hiking, scenic viewing, birdwatching, wildlife viewing, sailing, kayaking, canoeing, onshore recreational businesses	Onshore coastal areas within viewshed of lease areas
Lighting[1]	Light pollution and visual impact	Scenic viewing, birdwatching, boating, sailing, kayaking, canoeing	Onshore coastal areas within viewshed of lease areas, lease areas
Noise	Disturbance to marine life and habitats[2]	Fishing, boating, scuba diving, sailing, kayaking, canoeing	Lease areas
Presence of structures	Changes to visual aesthetics of coastal skyline[1]	Scenic viewing, beachgoing, birdwatching, photography, sailing, kayaking, canoeing	Onshore coastal areas within viewshed of lease areas
	Fish aggregation around structures[2]	Fishing	Lease areas
	Navigational hazards for boaters[2]	Fishing, boating	Lease areas, involved ports
	Allisions	Boating	Lease areas, involved ports
	Disturbance to marine life and habitats[2]	Fishing, boating, scuba diving, sailing, kayaking, canoeing	Lease areas
	Gear entanglement or loss/damage[2]	Fishing	Lease areas
	Space-use conflicts[2]	Fishing, boating, scuba diving, sailing, kayaking, canoeing	Lease areas, involved ports
	Search and rescue	Fishing, boating, scuba diving, sailing, kayaking, canoeing	Lease areas, involved ports

IPF	Impact Indicator	Recreational Activities Potentially Affected	Areas Potentially Affected
Vessel and vehicle traffic	Navigation disruption and safety risks[2]	Boating, fishing, sailing, kayaking, canoeing	Lease areas, involved ports
	Displacement of fishing grounds[2]	Fishing	Lease areas
	Delays or reduced access to port services[2]	Fishing, boating	Involved ports
Port utilization	Vessel traffic congestion and reduced access to high-demand port services and higher costs for such services; displacement to other primary or landing ports	Fishing, boating	Involved ports
Invasive species	Unanticipated release of invasive species into receiving waters (e.g., vessels, ballast water, etc.)	Fishing, scuba diving	Lease areas, involved ports

[1] See Section 3.4.10 for additional analysis on existing visual conditions and impacts from visual components of the Proposed Action.

[2] See Section 3.4.1 for additional analysis on existing fisheries and impacts on fishing from the Proposed Action, and Section 3.4.7, *Navigation and Vessel Traffic,* for additional analysis on waterways and boat traffic.

3.4.9.3 Impacts of Alternative A – No Action – Recreation and Tourism

When analyzing the impacts of the No Action Alternative on recreation and tourism, BOEM considers the impacts of ongoing activities, including ongoing non-offshore wind activities, on the baseline conditions for recreation and tourism. The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative on existing baseline trends, including other planned activities, described in Appendix C, *Planned Activities Scenario*.

3.4.9.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for recreation and tourism described in Section 3.4.9.1, *Description of the Affected Environment and Baseline Conditions*, would continue to follow current regional trends (Appendix C). These ongoing activities would affect recreation and tourism through anchoring, land disturbance, lighting, cable installation and maintenance, noise, presence of structures, invasive species, and vessel traffic.

These activities would contribute to periodic disruptions to recreation and tourism activities; however, they are currently a part of daily life along the California coastlines and would not substantially affect recreational enjoyment in the Affected Environment.

Other ongoing impacts include changes in species distribution and natural events due to climate change. Impacts on recreation from climate change would occur primarily through ocean acidification, ocean warming, sea level rise, and increases in both the frequency and magnitude of storms, which could lead to altered habitats, altered fish migration patterns, changes in species abundance and distribution, increases in marine animal disease frequency, and safety issues for conducting fishing and offshore recreational operations. The introduction and spread of invasive species, facilitated by these changes and by human activities, can further disrupt ecosystems and recreational experiences. Local impacts from climate change are likely to be incremental and difficult to discern from effects of ongoing activities. Visitors are expected to be able to continue to pursue activities that rely on other coastal and ocean environments, scenic qualities, natural resources, and establishments that provide services to recreation and tourism.

3.4.9.3.2 Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative on existing baseline trends, including other planned activities in the Affected Environment (Appendix C). The Chumash Heritage National Marine Sanctuary off the coast of San Luis Obispo and Santa Barbara Counties and the planned West Harbor Port of Los Angeles could affect recreational fishing and tourism by attracting recreationists and tourists and providing some benefits to fishing from protection of fishery resources and habitat. No restrictions to fishing above or beyond currently established MPAs are expected for the proposed sanctuary. However, discharge of sewage or graywater within the sanctuary boundaries would be prohibited, which may adversely affect vessels lacking sewage holding tanks. Recreational vessels lacking proper holding tanks may have to travel well outside sanctuary boundaries to legally discharge sewage or graywater (NOAA 2023).

As discussed in Section 3.4.1, potential decommissioning of oil and gas structures would impact recreational fishing. Removal of these structures in the Affected Environment would benefit recreational fishing due to clearing of seafloor obstructions that would reduce space-use conflicts and potential for snagging losses in a small area of the Affected Environment. Conversely, areas where platforms are currently located may become less desirable for recreational fishing after platform removal due to the reduced habitat structure. It is likely that this would result in a partial shift of recreational fishing efforts to other areas, such as nearby natural reef habitats. Although the change in fishing conditions at platform locations would be essentially permanent, the affected area represents a very small proportion of nearby natural reef and rocky outcrop habitat available for recreational fishing.

BOEM expects planned activities to affect recreation and tourism through the following IPFs.

Land disturbance: Planned shoreline developments can provide long-term benefits by creating community spaces and recreational draws; however, the construction phases can temporarily disrupt landscapes. The 42-acre West Harbor Port of Los Angeles is a planned development that will add a 30-foot-wide promenade 1 mile along the port's main channel to create a community space, with completion expected by spring 2025 (Daily Breeze 2023; Port of Los Angeles 2023). The land disturbance disruptions associated with the construction periods of shoreline developments would be localized and temporary for the No Action Alternative.

Lighting: Planned activities would add new sources of light, including fixed lighting on onshore structures. However, recreational activities that involve coastal views such as hiking and beachgoing are primarily daytime activities and would not be affected by additional lighting. Refer to Section 3.4.10 for additional analysis on existing visual conditions and impacts from visual components of the No Action Alternative.

Because the lighting impacts would only occur at night, lighting from the No Action Alternative is not anticipated to have a substantial effect on recreation. Light from planned activities, such as the West Harbor Port of Los Angeles, would largely blend in with the surrounding developed area, with no measurable impact on recreation and tourism.

Noise: Noise generated by the operation of construction equipment and vehicle or vessel traffic associated with planned activities has the potential to affect recreation and tourism. Noise from onshore construction near beaches, parklands, recreation areas, or other areas of public interest may temporarily disrupt the peaceful atmosphere of these sites, particularly in more remote or undeveloped locations where quiet is expected. Similarly, offshore construction noise would intrude upon the natural sounds of the marine environment.

Anthropogenic noise sources may temporarily affect recreational fishing by directly affecting species (Popper and Hastings 2009). However, available information does not indicate broad-scale negative effects on fishery resources as a result of construction or operational noise of the planned activities (English et al. 2017). Therefore, significant fishery-level impacts are unlikely in this scenario. Section 3.3.5, *Fishes, Invertebrates, and Essential Fish Habitat*, provides additional details on potential impacts from different noise sources on fish.

Due to the temporary nature of the interruptions and the continued ability for the public to use recreational spaces during construction, the impact from the No Action Alternative would be temporary and intermittent.

Presence of structures: Structures considered under the No Action Alternative include buoys, shoreline developments, and offshore oil and gas platforms. However, recreational activities would continue despite added visual structures in some areas. Planned activities may increase recreation and tourism in the area and result in visual impacts due to additional structures. While construction activity may be disruptive to the surrounding recreational environment, the construction period is temporary and will occur in an urban environment where construction and development is typical. After the construction period, the added development will contribute positively to recreation in the long term by improving aesthetics, walkability, and access to spaces for entertainment. Refer to Section 3.4.10 for additional analysis on impacts from visual components of the No Action Alternative.

The presence of offshore structures as a result of planned activities involves increased risks of allisions; fishing gear loss, damage, or entanglement; and navigational hazards for recreational boating. Space-use conflicts may lead to temporary or permanent reductions in fishing activities and recreational boating, especially for displaced vessels unable to fish in alternative grounds.

Traffic: Planned activities, such as the West Harbor Port of Los Angeles, would generate temporary onshore traffic increases during the construction period. Planned projects would generate a small increase in vessel traffic, with the highest volume occurring when construction of multiple projects overlap. If this occurs for offshore planned activities, recreational boating and fishing activities would need to make necessary adjustments in response to the presence of vessels and the establishment of safety zones, although these adjustments are expected to be of limited spatial and temporal nature. It is possible that tourists might experience slightly longer transit times in certain situations, but these instances would be confined in both space and time.

Port utilization: Vessel visits and sizes of vessels have increased at major ports in the United States, and port utilization is expected to increase over the next 35 years. Ports are also going through continual upgrades and maintenance, including dredging. Multiple ports in California (e.g., Ports of Los Angeles, Long Beach, Hueneme, San Luis, and Humboldt) are investing in expanding and modifying port facilities to accommodate increasing demand (Appendix C). Port expansion and modification could include dredging, deepening, and new berths and could have localized, temporary impacts on recreational fishing vessels in ports used for both fishing and other projects. Some displacement of available dockage during construction activities may occur. The expected level of port utilization and related activities (e.g., dredging) would contribute to cumulative impacts on recreational fishing. Specific ports and expansions will be further discussed in project-specific COPs and COP NEPA analyses.

Invasive species: Biofouling and ballast water discharge from increased vessel traffic can contribute to the introduction of invasives, and planned offshore construction activities could disturb habitats, making them susceptible to colonization by invasive species (GloFouling Partnerships 2019; International Maritime Organization 2019; NOAA 2010; University of Florida 2021). Furthermore, physical structures from offshore construction can create new habitats for invasive species, allowing them to establish and proliferate, disrupting local ecosystems (Andriana et al. 2020). Invasive species can outcompete native species and harm local ecosystems, potentially reducing catch rates for recreational fishing and impacting livelihoods (CDFW No date j). They can also damage the aesthetic value, affecting activities like scuba diving. Although planned activities will only incrementally increase the cumulative risk of invasive species, existing mitigation measures and practices are intended to avoid/reduce the severity of such impacts (CDFW No date j).

3.4.9.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, recreation and tourism would continue to be affected by existing environmental trends and ongoing activities, but most of these are currently occurring along the California coastline, have occurred in the past, and do not substantially affect visitor use or experience. The extent of impacts on recreational fisheries would vary by fishery due to different target species, gear type, and location of activity. Impacts primarily would stem from climate change, with fisheries-management agencies expected to adjust to shifting distributions and other climate-related factors. These findings are further explored in Section 3.4.1.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue. Designation of the Chumash Heritage National Marine Sanctuary could expand and/or enhance recreation and tourism activity south of the Morro Bay WEA.

3.4.9.4 Impacts of Alternative B – Development with No Mitigation Measures – Recreation and Tourism

Alternative B considers future offshore wind development in the Humboldt and Morro Bay lease areas but without the application of any mitigation measures that could avoid, minimize, mitigate, or monitor impacts associated with such development. ESA Section 7 consultation with NMFS would be conducted for each project, and it is assumed that the Letter of Authorization would include mitigation requirements that would reduce impacts.

There are a number of ongoing efforts to assess the impact of offshore wind facilities on recreational fishing on the West Coast (BOEM 2023; California Coastal Commission 2022; California Ocean Protection Council 2023; National Academies 2024; RWE and Vineyard Offshore 2024).

3.4.9.4.1 Impacts of One Representative Project in Each WEA

Anchoring: Construction of a single representative project would involve long-term anchoring of up to 200 WTGs and 6 OSSs. The presence of one representative anchored project in each WEA would cause localized, intermittent, and temporary disruptions to recreational boating activities in the immediate area where anchors and chains contact the seafloor. Anchoring could pose a localized (within a few hundred feet of anchored vessels), temporary (hours to days) navigational hazard to recreational fishing and boating vessels.

Haberlin et al. (2022) noted that mooring structures and interarray cables associated with one representative project in each WEA could affect fishing with mobile gear due to navigation challenges, safety concerns, physical obstruction, and gear snagging. The anchoring of WTGs would vary based on configuration, resulting in seafloor footprints ranging from 0.05 to 75 acres (200–300,000 square meters). Recreational anglers employing weighted trolling or drifting hook-and-line gear would be restricted from the vicinity of the structures and their floating interarray cables. The footprint of each anchoring would be relatively small. Further, many recreational boats stay closer to shore than where the lease areas would be (20–60 miles [32–97 kilometers] offshore); WTG/OSS anchors would be embedded at least 1,600 feet below the water surface, deeper than where most small recreational boats could anchor.

Land disturbance: One representative project in each WEA would necessitate cable landfalls, onshore export cables, potential substations and converter stations, and support service facilities. As this is a programmatic-level analysis, no sites for onshore facilities have been identified. Construction-related impacts associated with the onshore components of one project may arise if construction activities coincide with the tourism high season (typically May through September) and disrupt access to recreational areas due to land disturbance during construction. Potential impacts on recreation and tourism from offshore wind developments could harm supporting businesses in these sectors. Conversely, an increase in labor forces for wind energy projects could benefit these supporting businesses. Slight disruption of recreational activities could also occur as a result of visual impacts. However, land disturbance is generally expected to occur in and near ports and power facilities. These disruptions would be localized and temporary for one representative project in each WEA.

Lighting: One representative project in each WEA would add new sources of light to onshore and offshore areas, including from nighttime vessel lighting, fixed lighting at onshore substations/converter stations, and aviation warning lighting on up to 200 WTGs and up to 6 OSSs. Nighttime vessel lighting could have localized and short-term impacts on scenic areas during construction. Such effects would continue during O&M activities.

Permanent aviation warning lighting on WTGs would be visible from beaches and coastal viewpoints within the Affected Environment (Figure 3.4.9-1). Synchronized flashing strobe lights on the WTGs would result in long-term, varying impacts on sensitive onshore and offshore viewing locations, influenced by factors like viewer distance, angle of view, and atmospheric conditions. An Aircraft Detection Lighting System (ADLS), anticipated as a regulatory requirement of FAA, would help minimize these impacts by only activating the lights when aircraft are detected. Refer to Section 3.4.10 for additional analysis on impacts from visual components of Alternative B.

Recreational activities that involve coastal views such as hiking and beachgoing are primarily daytime activities and would not be affected by additional lighting. Because of the representative project's distance from shore and because the lighting impacts would only occur at night, while coastal recreation typically occurs during the day, lighting from Alternative B is not anticipated to have a substantial effect on views.

Cable installation and maintenance: The development of one representative project in each WEA would cause disturbance to the seafloor due to the installation of interarray and export cables. This cable installation could obstruct the deployment of fixed and mobile fishing gear in specific areas of the Humboldt and Morro Bay WEAs, lasting from a single day to several months if simultaneous laying and burial methods are not employed. This disruption may lead to a loss of access for fishermen if alternative fishing locations are not available. The impacts would be most significant where cables are installed in areas with high recreational fishing activity. Activities involving support vessels, cable installation, and routine or emergency maintenance repairs would temporarily affect access to localized areas where the activities are taking place. In general, cable installation and maintenance would not restrict access to large areas, and the navigational impacts on recreational fishing grounds would be limited to hours or a few days. Cumulative impacts would be locally notable on fishing but less so on recreation and tourism as a whole.

Noise: Noise generated by the operation of construction equipment and vehicle or vessel traffic for one representative project in each WEA has the potential to affect recreation and tourism. Noise from onshore construction near beaches, parklands, recreation areas, or other areas of public interest may temporarily disrupt the peaceful atmosphere of these sites, particularly in more remote or undeveloped locations where quiet is expected. Similarly, offshore construction noise would intrude upon the natural sounds of the marine environment.

Anthropogenic noise sources may temporarily affect recreational fishing by directly affecting species (Popper and Hastings 2009). However, available information does not indicate broad-scale negative effects on fishery resources as a result of construction or operational noise of the project (English et al. 2017). Therefore, significant fishery-level impacts are unlikely in this scenario. Further details on potential impacts from different noise sources on fish are provided in Section 3.3.5.

Due to the temporary nature of the interruptions and the continued ability for the public to use these spaces during construction, the impact from one representative project in each WEA would be temporary and intermittent.

Presence of structures: The added presence of up to 200 WTGs and 6 OSSs in each WEA would have a variety of recreation and tourism impacts. Impacts could include potential benefits including tourist draws and fish aggregation and potential impacts on recreational fishing and boating and visual effects.

Recreation and tourism may benefit from the presence of operational WTGs. Parsons et al. (2020) have documented substantial increases in the number of trips to the shoreline to view offshore wind projects in parts of Europe. Recent studies of the Block Island Wind Farm corroborate positive effects on tourism and the public perception of wind farms (BOEM 2018a; Carr-Harris and Lang 2019; Landscape Performance Series 2019). In a study that observed trends in summer vacation property rentals in areas with visible offshore wind development, researchers at the University of Rhode Island observed a 19 percent increase in summer monthly revenue for Block Island vacation property landlords compared to other regional summer vacation rental destinations such as Narragansett and Westerly (in Rhode Island), and Nantucket, Massachusetts (Carr-Harris and Lang 2019). The researchers hypothesized that this increase suggests tourists may be curious to see the wind farm or that the recreational fishing near the wind farm has improved significantly, thereby increasing interest in visiting the wind farm itself. In a 2018 study, BOEM found that wind farms near shore resulted in a net loss in beach trips; however, wind farms farther from shore (12.5–20 miles) resulted in a net gain in trips due to tourist interest (BOEM 2018a). For the Humboldt WEA, the WTG closest to shore would be approximately 20 miles (32.1 kilometers) from the Samoa State Recreation Area. For the Morro Bay WEA, the closest WTG to shore would be the Piedras Blancas Light Station, at 20 miles (32.1 kilometers). Additionally, recreational activity, including fishing, is known to be most common in areas within 20 miles of shore. Marine species are also highest in presence within 20 miles of shore within the Affected Environment. Therefore, the presence of structures over 20 miles from shore from one representative project could result in reduced or avoided recreational impacts (California Energy Commission 2024).

When offshore wind structures such as offshore floating wind turbines are visible from shore, they are known to have impacts on recreational activities such as beachgoing, wildlife viewing, and coastal hiking due to changes to the visual environment. A literature review by Machado and Andrés (2023) noted that 92 percent of the articles analyzed reveal an impactful or potentially impactful relationship between offshore wind projects and recreation and tourism, with a majority being detrimental (68 percent). Visual impacts were the most common impact leading to public opposition (Machado and Andrés 2023). Studies consistently show that the visual impact of offshore wind facilities is the main factor affecting coastal aesthetics and, consequently, recreational and tourism activities. Acceptance tends to be higher when wind facilities are situated farther from the shore (BOEM 2021).

One representative project would install up to 200 WTGs at a height of up to 1,100 feet (335 meters) and up to 6 OSSs for a maximum of 206 offshore structures. Environmental and atmospheric conditions may intermittently limit the visibility of structures and intensity of impacts. However, recreational activities would continue despite added visual structures 20 miles or more offshore. Therefore, structures associated with one representative project are expected to have localized, long-term, and continuous, impacts on recreational resources, influenced by factors such as distance and visual buffers. Refer to Section 3.4.10 for further visual impact analysis.

As described in Section 3.3.5 and Section 3.4.1*,* the potential expansion of fish habitat and increased prey availability may have a positive impact on recreational fishing in the lease areas (Farr et al. 2021; Haberlin et al. 2022). However, habitat conversion could occur as a result of added structures, which would lead to displacement of fish species targeted by recreational fishermen (BOEM 2018b). Regardless of increased fish activity near structures, interest in visiting the projects may result in more fishing trips originating from California ports (Bidwell et al. 2023).

The presence of structures as a result of one representative project would involve increased risks of allisions; fishing gear loss, damage, or entanglement; and navigational hazards for recreational boating. Space-use conflicts may lead to temporary or permanent reductions in fishing activities and recreational boating, especially for displaced vessels unable to fish in alternative grounds. USCG SAR and emergency response capabilities would be impacted in and around OSW lease sites due to the presence of structures. Further studies to determine impacts are currently being completed by USCG and BSEE.

USCG recommends that BOEM consult with USCG in the promulgation of risk mitigation measures to reduce impacts on SAR (USCG pers. comm.). Although it is not anticipated that the volume of recreationalists or tourists would be affected, this reduction in SAR capabilities could pose safety concerns for recreational boaters and anglers.

Traffic: The development of one representative project in the Humboldt and Morro Bay WEAs would generate a small increase in vessel traffic compared to the No Action Alternative, with the highest volume occurring during the construction phase. During this period, construction support vessels, which may carry assembled WTGs or components for WTGs and OSSs, would navigate the waterways between the project area and the ports used during construction and decommissioning. Ports in the Affected Environment, including Humboldt Port, Port of San Luis, Port Hueneme, Port of Long Beach, and the Port of Los Angeles, would see increased vessel traffic; however, these ports are largely used for commercial purposes. As such, any vessels that experience delays and potential displacement as a result of increased port traffic are unlikely to be recreational vessels.

Recreational boating and fishing activities would need to make necessary adjustments in response to the presence of vessels and the establishment of safety zones, although these adjustments are expected to be of limited spatial and temporal nature. Tourists might experience slightly longer transit times in certain situations, but these instances would be confined in both space and time. Periodic O&M activities in the Humboldt and Morro Bay WEAs would create minimal additional traffic, typically only requiring the transport of staff and occasionally replacement parts.

Port utilization: Port usage as a result of one project per WEA may result in a decrease in available dockage for recreational fishing vessels for a place to sell products, refuel, restock, or dock for bad weather. The additional vessels due to the project could cause delays or reduced access to port services such as fueling and provisioning, potentially causing fishing vessels to use alternative ports. See Section 3.4.1 for an in-depth analysis of commercial and for-hire recreational fishing impacts from port utilization based on port productivity.

Invasive species: As discussed in Section 3.4.9.3.2, *Cumulative Impacts of the No Action Alternative,* increased vessel traffic and offshore structures can lead to the introduction of invasive species, which have the potential to affect recreational activities such as recreational fishing and scuba diving if species that are sought after are threatened by the invasive species. The various phases of an OSW project, from construction to ongoing maintenance, introduce several vectors for invasive species through ballast water discharge, biofouling, and the creation of new hard structures (GloFouling Partnerships 2019; International Maritime Organization 2019; IUCN 2021; NOAA 2010; University of Florida 2021). The infrastructure associated with OSW, such as riprap at anchor sites and other supporting structures, provides new hard surfaces for invasive species to colonize. These artificial habitats can be particularly conducive to the proliferation of invasive species, which often thrive on hard substrates (IUCN 2021). Once established, these species can become new sources of infestation, spreading throughout the WEA network.

As offshore traffic and construction activities already occur within the Affected Environment, increased vessel traffic and offshore structures from one project per WEA will only incrementally increase the potential for invasive species introduction, contributing to a cumulative impact. See Section 3.4.1 for additional analysis on how invasive species may impact the fisheries sector.

3.4.9.4.2 Impacts of Five Representative Projects

The same types of impacts and mechanisms described under one project would also apply to five projects (two representative projects in the Humboldt Bay WEA and three in the Morro Bay WEA), including anchoring, land disturbance, cable installation and maintenance, noise, presence of structures, port utilization, invasive species, and vessel traffic. However, with the presence of five projects simultaneously, there is a greater potential for impacts due to the larger number of developments both offshore and onshore. The analysis of five representative projects includes up to 1,000 WTGs, 30 OSSs, and associated moorings, array cables, and export cables (Chapter 2).

Five representative projects would increase anchoring impacts due to the greater potential for long-term restrictions on recreational anglers throughout both WEAs. Land disturbance would increase compared to one project, but such disturbances would be spatially distributed and temporary. No measurable lighting impacts would occur, as no lighting would be visible during daytime recreation. Noise impacts would be limited to the duration of high-noise activities such as vehicle or vessel traffic and would not impede recreation.

Cable installation and maintenance impacts would increase with five projects due to the simultaneous installation of multiple cables, which could temporarily limit access for recreational fishing vessels and recreational boats. However, the areas used by installation vessels would still be relatively small compared to the available access to other fishing grounds.

Presence of structures impacts would also increase with five projects, with the severity dependent on the specific timing, location, and spacing of project-related structures.

Port utilization impacts would increase with five projects, particularly if all projects were constructed simultaneously, which could increase demand for port dockage and other services, in turn causing recreational fishing vessels to make considerable alterations to their normal port usage.

Impacts from invasive species may occur as a result of vessel traffic and structures required for these projects, which increase the opportunities for invasive species to be transported into the lease areas. The increased presence of hard structures provides more surfaces for invasive species to establish themselves.

Compared to one project, impacts from vessel traffic would increase under five projects due to the higher number of vessels required during construction, O&M, and decommissioning. This increased traffic could lead to tourism charters and recreational fishing vessels altering their travel routes, schedules, or routines, potentially affecting their catch or resulting in increased costs.

3.4.9.4.3 Cumulative Impacts of Alternative B

All phases of offshore wind development would contribute to recreation and tourism impacts through increased risk of collision/allision, fishing gear loss, navigational hazards, port utilization, invasive species, and visual changes. BOEM anticipates that the cumulative impacts would be temporarily disruptive during the construction and decommissioning phases but otherwise would cause limited disruption to recreation and tourism activities in the region. The cumulative impacts would be similar to the impacts discussed for five projects above. If the components under five projects were staggered or geographically dispersed, impacts would be further reduced. The five projects would contribute an undetectable to noticeable increment to cumulative impacts on recreation and tourism from the combination of the five projects and other ongoing and planned activities. Beneficial impacts may also occur due to fish aggregation, the creation of reef-like effects, and tourist draws.

3.4.9.4.4 Conclusions

Impacts of Alternative B. Construction, O&M, and decommissioning of one project would primarily affect recreation and tourism through anchoring, cable installation and maintenance, presence of structures, port utilization, and traffic, with such impacts increasing in frequency/severity under five projects. Beneficial impacts could occur due to fish aggregation and increased tourist draws.

Cumulative Impacts of Alternative B. In context of reasonably foreseeable environmental trends, the incremental impacts on recreation and tourism contributed by five projects would not alter the overall state of recreation and tourism in the Affected Environment.

3.4.9.5 Impacts of Alternative C – Proposed Action (Adoption of Mitigation Measures) – Recreation and Tourism

Alternative C, the Proposed Action, incorporates the implementation of mitigation measures aimed at preventing or minimizing the potential impacts outlined in Alternative B. The analysis for this alternative focuses on the differences in impacts compared to those discussed in Alternative B. These mitigation measures, which are proposed for both one project and five projects in the Humboldt and Morro Bay WEAs, are detailed in Appendix E, *Mitigation*. Table 3.4.9-13 summarizes the mitigation measures designed to prevent or reduce effects on recreation and tourism.

Table 3.4.9-13. Summary of mitigation measures applicable to recreation and tourism

Mitigation Measure	Measure Summary
MM-6	This measure requires post-construction geophysical surveys to assess berms created by plows, jets, or similar methods. If significant berm height changes occur, the lessee must develop and implement a Berm Remediation Plan to restore natural bathymetric contours where feasible.

Mitigation Measure	Measure Summary
MM-11	This measure requires vessels to follow strike avoidance protocols for marine wildlife, avoiding areas with large bird aggregations, and slowing to 4 knots if avoidance is not possible. A 100-meter disturbance zone is required around surface-sitting birds, including endangered species. Vessels must slow down and steer clear of birds in their path, reporting incidents to the authorities.
MM-17	This measure requires the lessee to minimize lighting impacts. Any marine navigation lights used during construction, operations, and decommissioning must comply with USCG and BOEM guidelines, with additional lighting limited and directed downward to reduce intensity and upward illumination. Red-flashing strobe lights must also emit infrared energy to be compatible with Department of Defense night vision equipment.
MM-19	This measure requires lessees to submit a Hard-bottom Avoidance and Anchoring Plan that describes how hard-bottom and sensitive habitat avoidance shall be accomplished during anchoring, mooring (for project buoys), and sediment sampling.
MM-20	This measure requires the lessee to develop and submit a plan to assess marine species and habitats in the water column or on the seafloor that may be impacted by project activities. Sensitive species and habitats must be identified, avoided, and monitored for changes over time to evaluate adverse effects and mitigation efforts.
MM-21	This measure requires that scour and cable-protection methods reflect the pre-existing conditions and that lessees submit a scour and cable-protection plan for review and approval.
MM-22	This measure encourages lessees to establish a compensation process if a project may cause lost income to commercial and recreational fisheries. Compensation may cover gear loss, damage, and lost fishing income.
MM-23	This measure requires lessees to prepare a Fisheries Communication Plan, detailing methods for engaging and sharing project information with the local fishing community and other stakeholders throughout the project.
MM-24	This measure requires lessees to cooperate with commercial and recreational fishing entities to minimize disruptions during construction, operation, and decommissioning. Lessees must notify registered fishermen of project locations and timelines well in advance and provide updates during construction.
MM-27	This measure requires that all static cables be buried below the seabed where feasible and beneficial to the environment. Lessees should avoid installation methods that raise the seabed profile, such as ejecting large rocks or boulders, which could damage fishing gear.
MM-32	This measure encourages lessees to coordinate transmission infrastructure among projects by using, for example, shared intra- and interregional connections, meshed infrastructure, or parallel routing, which may minimize potential impacts from offshore export cables.
MM-33	This measure requires monitoring of cables periodically after installation to determine cable location, burial depths, and site conditions to determine if burial conditions have changed and whether remedial action or additional mitigation measures are warranted.
MM-39	This measure requires the lessee, in coordination with BOEM, to prepare and implement a scenic and visual resource monitoring plan to assess the visual effects of the wind farm during construction and operations.

3.4.9.5.1 Impacts of One Representative Project in Each WEA

Table 3.4.9-13 lists mitigation measures that could mitigate impacts from the Proposed Action on recreation and tourism. The implementation of these mitigation measures could result in slightly reduced impacts on recreation and recreational fishing in the Affected Environment.

Anchoring: Potential impacts on recreation and tourism from anchoring under Alternative C would largely be the same as Alternative B. Application of MM-19 would require detailed anchoring plans to avoid sensitive benthic habitats. This could help maintain the natural underwater landscape, preventing damage to sensitive habitats that are important for recreational fishing. MM-20 would require lessees to reduce or avoid impacts on important environmental resources, such as sensitive habitats and species, to the extent feasible. MM-22 could establish a compensation process if a project is likely to result in lost income to commercial and recreational fisheries. Impacts would likely remain but potentially be reduced depending on the particular anchoring method implemented.

Lighting: The lighting requirements under MM-17 would result in shorter duration night sky impacts and reduce visual impacts during nighttime, preserving the seascape and minimizing disturbances to open ocean, landscape, and viewers, thereby enhancing the overall recreational experience. Because of the representative project's distance from shore and because the lighting impacts would only occur at night (while coastal recreation typically occurs during the day), lighting is not anticipated to have a substantial effect on views.

Cable installation and maintenance: MM-19 and MM-20, as previously described, would reduce or avoid impacts on important environmental resources such as sensitive habitats and species from equipment installation. MM-21 would encourage use of scour and cable-protection methods designed to reflect pre-existing seafloor conditions as a means of reducing the risk of fishery gear snags and marine habitat disruption. MM-22 encourages the establishment of a compensation process for lost income or damaged fishing gear, ensuring that recreational fishermen are fairly compensated for any disruptions.

MM-27 would ensure that static cables are buried below the seabed, preventing obstructions that could damage fishing gear or interfere with boating. MM-6 would require post-construction surveys to ensure that the seabed remains navigable and safe by restoring any significant changes caused by installation. MM-33 requires monitoring programs for the interarray and export cables to gather data that could be used to evaluate impacts and potentially lead to the development of new mitigation measures. This measure would assist in maintaining safe and accessible areas for recreational fishing and boating.

Traffic: MM-11 aims to avoid bird population disturbance from vessel traffic, which is important for activities like birdwatching and ecotourism. Slowing vessels to 4 knots near aggregations of birds minimizes the risk of harm to wildlife and preserves the natural environment for recreation. Additionally, establishing a 100-meter avoidance zone and reporting incidents ensures that wildlife is protected, enhancing the overall experience for tourists and recreational users. As the measure would not mitigate the primary impacts to recreation from vessel traffic disruptions, the impact from one representative project in each WEA would continue to be temporary and intermittent.

Presence of structures: A number of measures would reduce impacts from structures by protecting marine habitats, reducing conflicts with fishing activities, and managing visual impacts. MM-20 requires lessees to develop and submit plans that identify and monitor sensitive marine species and habitats, ensuring they are avoided during OSW construction and operation. By protecting critical areas, such as reefs and essential fish habitats, this measure helps preserve ecosystems that support recreational diving, fishing, and ecotourism. As previously discussed, MM-21 and MM-27 may reduce the risks of fishery gear snags.

MM-22 and MM-23 focus on mitigating the effects of structures on commercial and recreational fishing. MM-22 encourages the establishment of a compensation process for lost income or damaged fishing gear, ensuring that recreational fishermen are fairly compensated for any disruptions. MM-23 requires a Fisheries Communication Plan, ensuring ongoing engagement with the fishing community. This would increase coordination with fishing constituencies, ultimately reducing disruptions to recreational fishing activities from the presence of structures associated with the Proposed Action. Additionally, MM-24 would require lessees to work directly with fishing entities to minimize disruptions during all phases of the project, from construction to decommissioning. By notifying fishermen in advance and coordinating planned activities, this measure would help avoid gear loss and reduce recreational fishing interference.

Lastly, MM-39 addresses the visual impact of structures, requiring lessees to monitor and document the effects on scenic resources and verify the accuracy of the visual simulations. The inclusion of onshore key observation points helps identify specific areas where visual impacts may be most noticed.

These measures, however, are unlikely to change the impact rating of this IPF because long-term impacts from the presence of structures would remain the same and would exist for any structure post-construction. Therefore, these potential impacts are unlikely to differ under Alternative C compared to Alternative B.

Overall, under Alternative C, impacts on recreation and tourism from one project would be the same as identified under Alternative B. While these measures may mitigate some impacts on recreation and tourism, implementation would not reduce the impacts enough to change the determinations from one representative project.

3.4.9.5.2 Impacts of Five Representative Projects

Impacts of five projects under Alternative C would be the same as described for one project under Alternative C. In addition to the measures identified for one representative project, MM-32 would promote shared transmission infrastructure, reducing the overall footprint of OSW projects, and limiting the spatial impact on recreational activities like boating and fishing.

3.4.9.5.3 Cumulative Impacts of Alternative C

Under Alternative C, cumulative impacts on recreation and tourism are anticipated to be the same as described under Alternative B.

3.4.9.5.4 Conclusions

Impacts of Alternative C. The adoption of the mitigation measures outlined in Table 3.4.9-13 would slightly reduce impacts on recreation and recreational fishing by promoting environmental cleanliness and navigational safety, promoting minimal habitat disruption, and minimizing nighttime visual disturbances.

Cumulative Impacts of Alternative C. In context of reasonably foreseeable environmental trends, the combination of Alternative C and other ongoing and planned activities would result in similar cumulative impacts on recreation and tourism as Alternative B, though mitigation would reduce the contribution of offshore wind development to such impacts.

3.4 Socioeconomic Conditions and Cultural Resources

3.4.10 Scenic and Visual Resources

This section discusses potential impacts of the Proposed Action, alternatives, and ongoing and planned activities on open ocean, seascape, and landscape character (and viewers of each) in the scenic and visual resources Affected Environment, as advised in the *Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Developments on the Outer Continental Shelf of the United States* (BOEM 2021a). This analysis is drawn from a desktop study of the preliminary planning of the Humboldt and Morro Bay lease areas (Appendix F, *Seascape, Landscape, and Visual Impact Assessment*).

Figure 3.4.10-1 shows the Affected Environment extending approximately 43.2 miles (70.0 kilometers) offshore and 60 miles (96.6 kilometers) onshore, intended to capture potential views of prospective wind energy developments in the Humboldt and Morro Bay WEAs. A digital elevation model determined the potential visibility of the surrounding seascape and landscape based on a zone of theoretical visibility.[1] The zone of theoretical visibility does not account for potential screening from vegetation, buildings, or other structures and, thus, tends to overstate visibility. The area of potential effect was determined by overlaying the Affected Environment with the visibility buffers of the Humboldt and Morro Bay lease areas. Visibility buffers constitute the maximum theoretical distance a WTG could be visible; these were developed using earth curvature-calculated distances based on the minimum and maximum WTG heights. The Affected Environment includes the coastlines of Northern California from Del Norte Coast Redwoods State Park to Mattole Beach and of Central California from Point Sur Lighthouse to Montaña del Oro State Park, as well as elevated viewpoints of national significance (e.g., Hearst Castle).

Appendix F contains additional analysis of the open ocean, seascape, and landscape character areas (the Seascape and Landscape Impact Analysis [SLIA]) and viewer experiences (the visual impact assessment [VIA]) that could be affected by wind energy development. This section also follows BOEM's visual guidance documents. Visual simulations were used to inform the analysis and are available on BOEM's California Offshore Wind website: https://www.boem.gov/renewable-energy/state-activities/california-visual-simulation.

The impacts on open ocean, seascape, and landscape character and viewers are assessed based on two WTG heights corresponding to the maximum and minimum heights in the RPDE: 850 feet (260 meters) and 1,100 feet (335 meters), leading to an analysis of expected maximum and minimum impacts that may occur. Appendix F includes turbine visibility figures for the minimum and maximum heights.

[1] The impact analysis is based on the digital elevation model, not a surface elevation model verified by field surveys. Surface elevation model data were not available for the analysis.

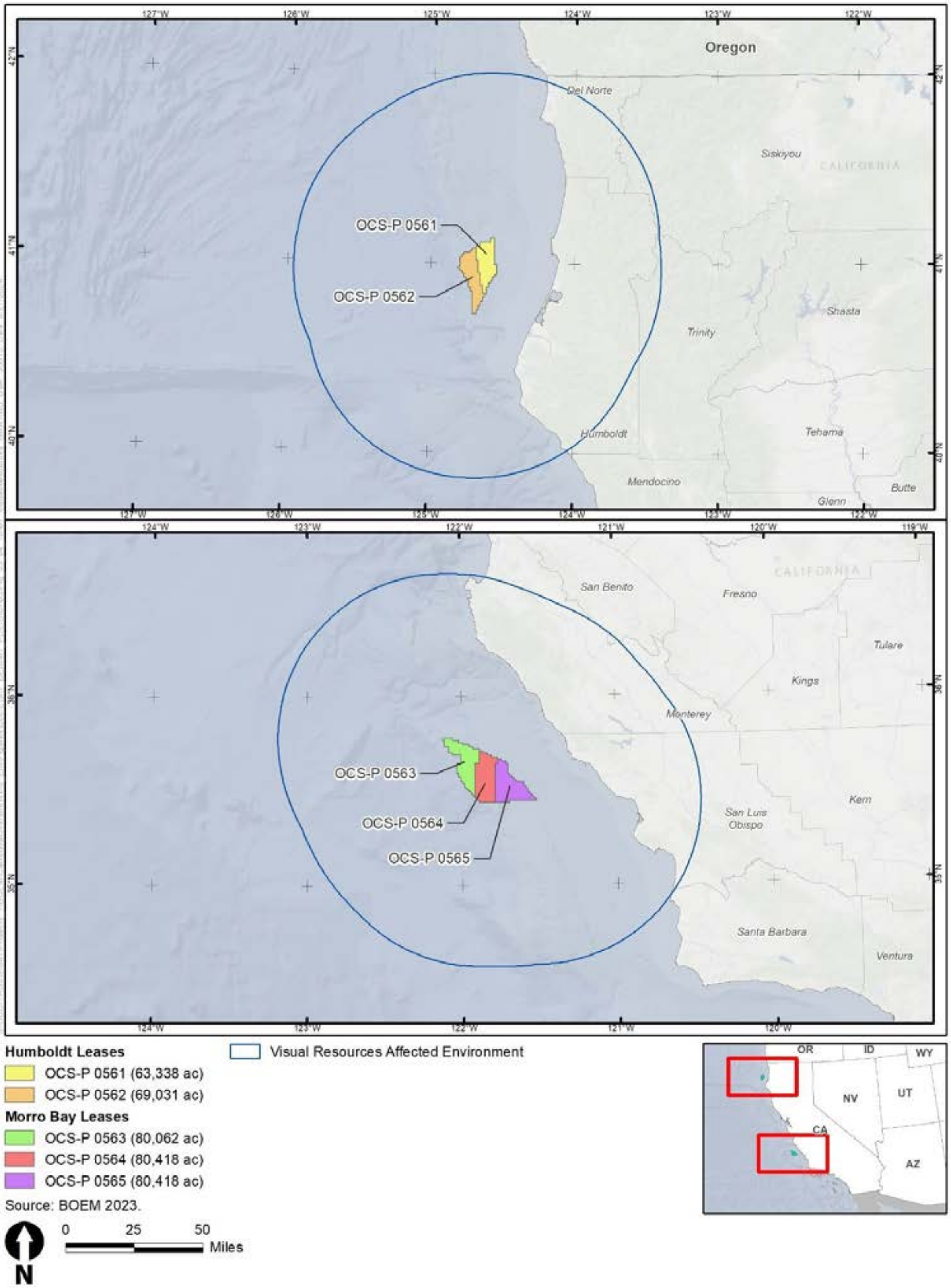


Figure 3.4.10-1. Visual resources affected environment and lease visibility buffers

3.3.1.1 Description of the Affected Environment and Baseline Conditions

The demarcation line between seascape and open ocean is the U.S. state jurisdictional boundary, 3 nm (3.45 statute miles) (5.5 kilometers) seaward from the coastline (U.S. Congress Submerged Lands Act, 1953). This line coincides with the area of sea visible from the shoreline. The line defining the separation of seascape and landscape is based on the juxtaposition of apparent seacoast and landward landscape elements, including topography, water (bays and estuaries), vegetation, and structures.

3.3.1.1.1 SLIA Affected Environment

The Affected Environment is classified by specific open ocean, seascape, and landscape character areas, based on major features and elements in the characteristic landscape that define the Affected Environment's physical character, “feel,” and “experiential qualities.” These include open ocean, shoreline, coast, marsh, bay, and inland areas. Seascape and landscape character areas are defined by these unique features and elements. Open ocean, seascape, and landscape character areas provide a framework to analyze potential visual effects throughout the Affected Environment.

Table 3.4.10-1 outlines landforms, water, vegetation, and built environment structures in the Affected Environment.

Table 3.4.10-1. Landform, water, vegetation, and structures

Category	Landscape Features
Landform	Narrow beaches and high bluffs, rocky headlands, cliffs, mountains, dune-backed shores, marine terraces, estuaries, bays and lagoons, tidal inlets, wetlands, islands, and inland topography.
Water	Ocean, bay, estuary, tidal river, river, and stream water patterns.
Vegetation	Woodlands and forest, shrub communities, herbaceous communities, and agriculture. *Humboldt Vegetation Types:* California Mixed Evergreen Forest and Woodland, Redwood Forest and Woodland, Sitka Spruce Forest, Western Oak Woodland and Savanna, Western Riparian Woodland and Shrubland, and Pacific Coastal Scrub. Grasslands including nonnative annual grasslands, coastal prairie grassland, dune mat vegetation and foredune grasslands. Characteristic species include Douglas-fir (*Pseudotsuga menziesii*), canyon live-oak (*Quercus chrysolepis*), coast redwood (*Sequoia sempervirens*), black oak (*Quercus kelloggii*), Sitka spruce (*Picea sitchensis*), Oregon white oak (*Quercus garryana*), bigleaf maple (*Acer macrophyllum*), red alder (*Alnus rubra*), coyote brush (*Baccharis pilularis*), blue blossom (*Ceanothus thyrsiflorus* var. *thyrsiflorus*),California oatgrass (*Danthonia californica)*, yellow sand verbena (*Abronia latifolia*), silver beachweed (*Ambrosia chamissonis*), and coastal sagewort (*Artemisia pycnocephala*). *Morro Bay Vegetation Types:* Western Oak Woodland and Savanna, California Mixed Evergreen Forest and Woodland, Conifer Oak Forest and Woodland, Central Maritime Chaparral, Pacific Coast Scrub, and Central Dune Scrub. Characteristic species include blue oak (*Quercus douglasii*), coast live-oak (*Quercus agrifolia*), manzanita (*Arctostaphylos* spp.), ceanothus (*Ceanothus* spp.), coyote brush, California sagebrush (*Artemisia californica*), black sage (*Salvia mellifera*), seacliff wild buckwheat (*Eriogonum parvifolium)*, and California golden bush (*Ericameria ericoides*).
Structures	Buildings, plazas, signage, walks, parking, roads, trails, seawalls, jetties, piers, and infrastructure.

Figure 3.4.10-2 through Figure 3.4.10-4 provide an overview of the Affected Environment's seascape and landscape, including key observation point (KOP) locations. Figure 3.4.10-3 shows the extent of visibility of the prospective WTGs for each lease area. Refer to Appendix F for further related mapping.

Table 3.4.10-2 summarizes visual characteristics of the open ocean, seascape, and landscape conditions in the Affected Environment. Open ocean, seascape, and landscape character areas provide specific spatial locations and description of the existing area and provide a framework to systematically analyze potential visual effects throughout the Affected Environment (Appendix F).

Table 3.4.10-3 through Table 3.4.10-4 list the extent of seascape, open ocean, and landscape character areas for all five Humboldt and Morro Bay lease areas at each potential WTG height (850 and 1,100 feet). Refer also to Appendix F, Table F-15 through Table F-18.

At this programmatic stage, lessees have not yet identified precise locations for onshore infrastructure. Once such locations are identified in COPs, project-level analysis under NEPA will follow.

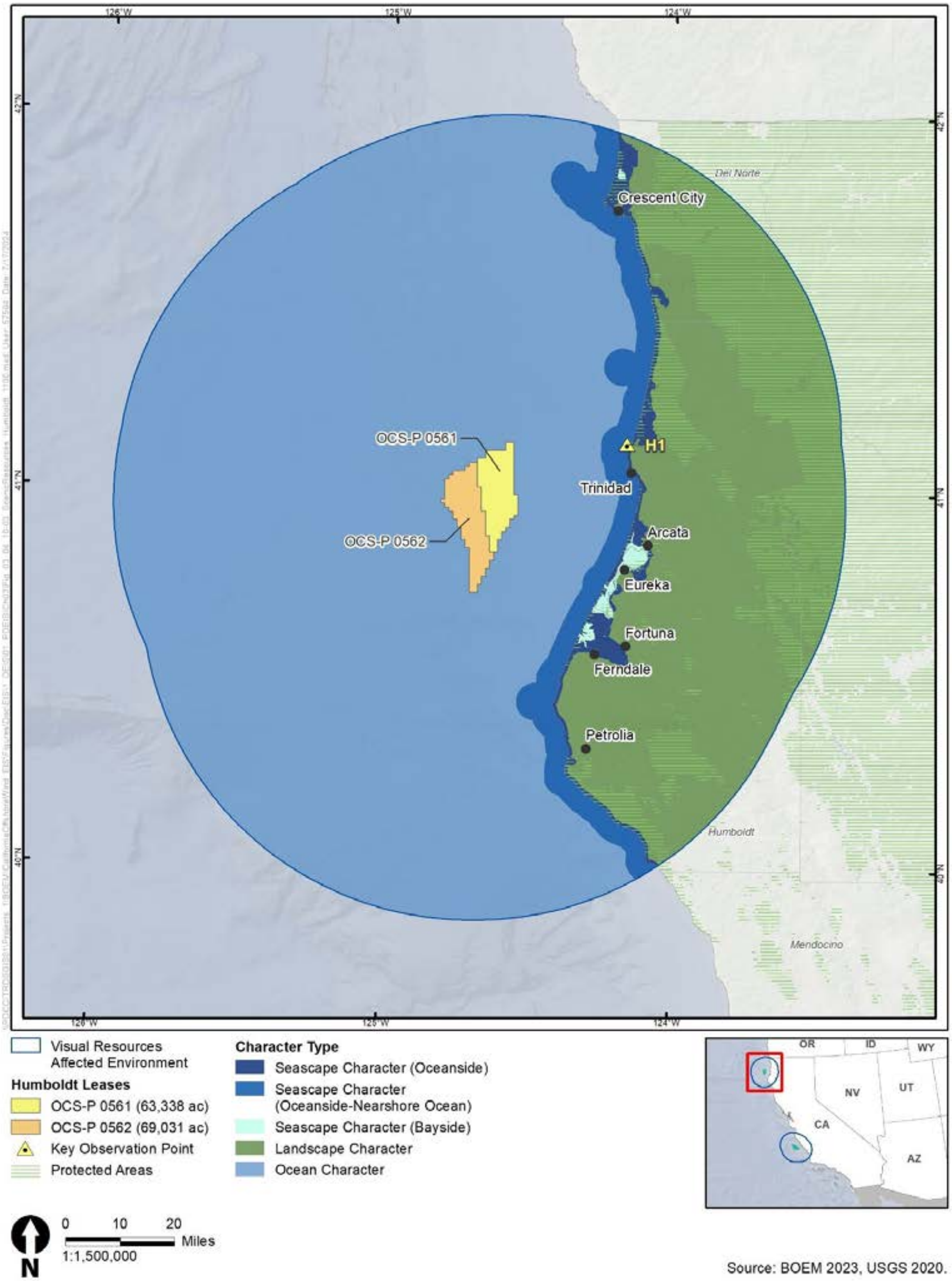


Figure 3.4.10-2. Scenic resources and character area overview map for the Humboldt WEA

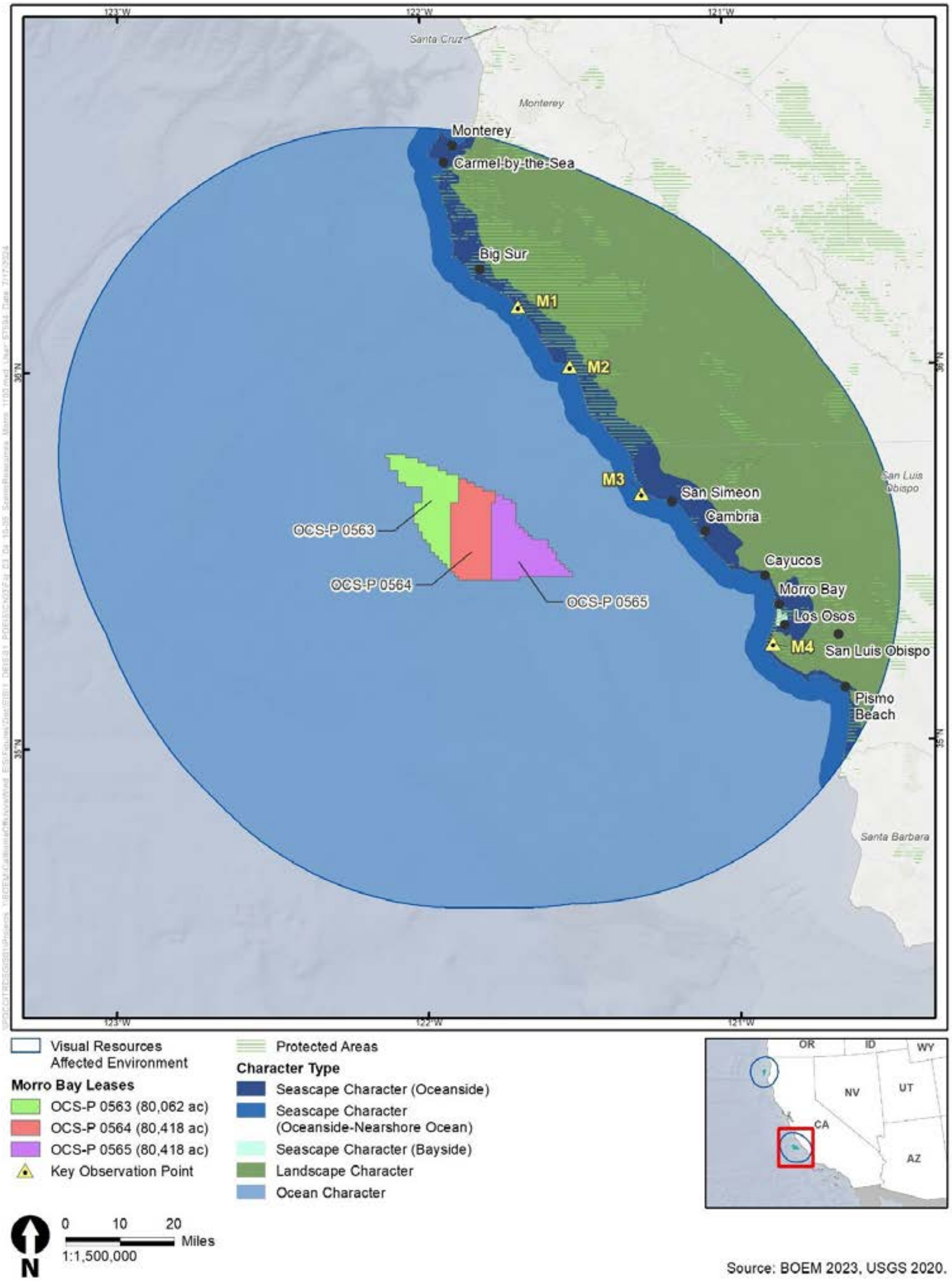


Figure 3.4.10-3. Scenic resources and character area overview map for the Morro Bay WEA

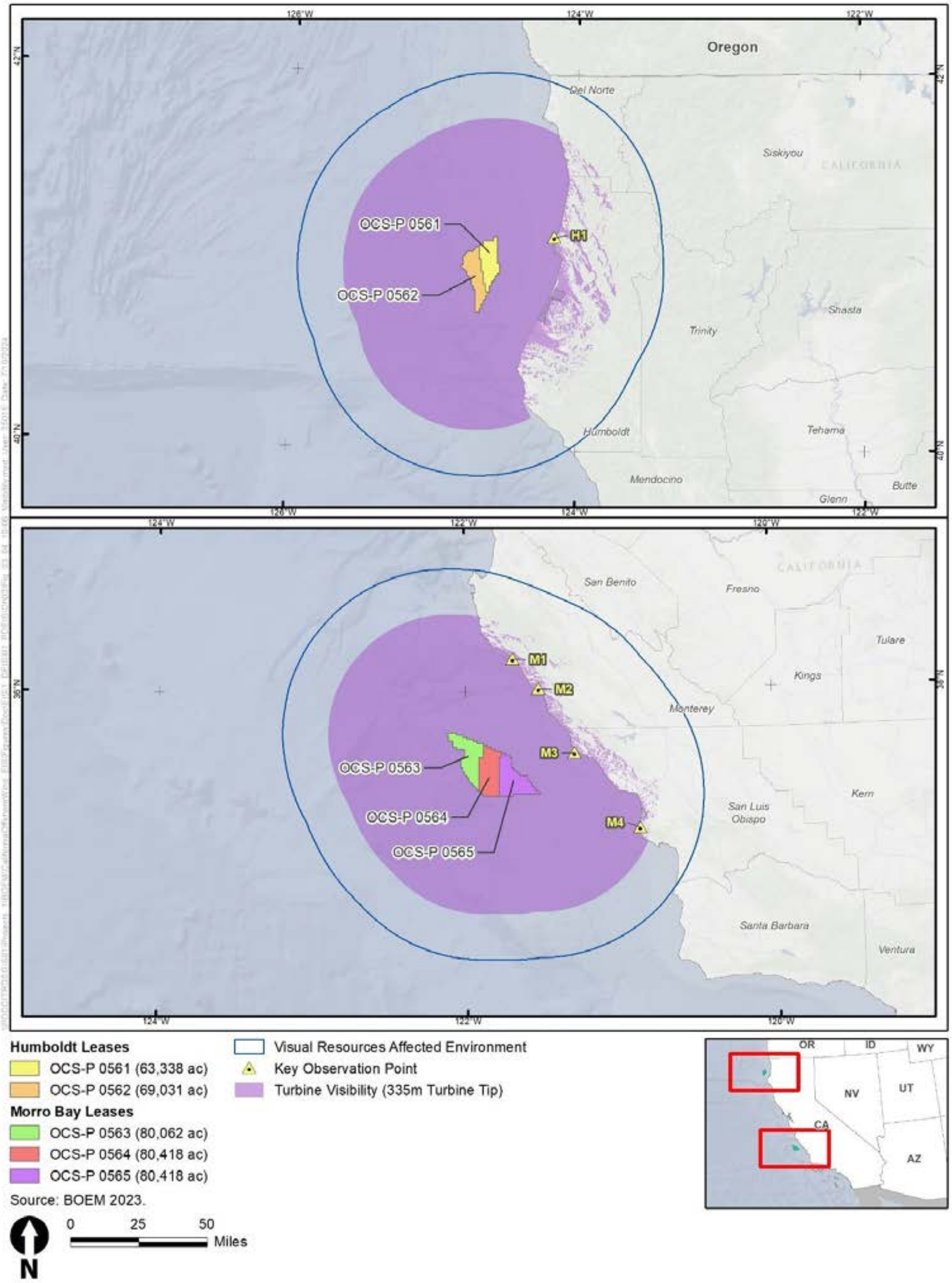


Figure 3.4.10-4. Viewshed map for the Humboldt and Morro Bay WEAs

Table 3.4.10-2. Open ocean, seascape, and landscape conditions

Category	Seascape, Open Ocean, and Landscape
Open Ocean	Intervisibility from seagoing vessels in the open ocean within the 50-mile (80.5-kilometer) offshore Affected Environment, including recreational cruising and fishing boats, commercial "cruise ship" routes, commercial fishing activities, tankers and cargo vessels; and air traffic over and near the WTG array and cable routes.
Open Ocean Features	Physical features range from flat water to ripples, waves, swells, surf, foam, chop, whitecaps, and breakers.
Open Ocean Character	Experiential characteristics range from tranquil, mirrored, and flat to active, rolling, and angular to vibrant, churning, and precipitous. Forms range from horizontal planar to vertical slopes; lines range from continuous and horizontal to fragmented and angular; colors of water, foam, and spray reflect the changing colors of sky, clouds, fog, haze, and the daytime and nighttime textures range from mirrored smooth to disjointed coarse.
Seascape	Intervisibility within coastal and adjacent marine areas within the Affected Environment by pedestrians and boaters.
Seascape Features	Physical features range from built elements, landscape, dunes, and beaches to flat water and ripples, waves, swells, surf, foam, chop, whitecaps, and breakers.
Seascape Character	Experiential characteristics range from built and natural landscape forms, lines, colors, and textures to the foreground water's tranquil, mirrored, and flat; active, rolling, and angular; vibrant, churning, and precipitous. Forms range from horizontal planar to vertical structures, landscapes, and water slopes; lines range from continuous to fragmented and angular; colors of structures, landscape, and the water's foam and spray reflect the changing colors of the daytime and nighttime, built environment, land cover, sky, clouds, fog, and haze; and textures range from mirrored smooth to disjointed coarse.
Landscape	Intervisibility within the adjacent inland areas, seascape, and open ocean; nighttime views diminished by ambient light levels of shorefront development; open, modulated, and closed views of water, landscape, and built environment; and pedestrian, bike, and vehicular traffic throughout the region within the onshore Affected Environment.
Landscape Features	Natural elements: landward areas of barrier islands, bays, marshlands, shorelines, vegetation, tidal rivers, flat to rolling or steep mountainous topography, and natural areas. Built elements: bridges, buildings, gardens, jetties, landscapes, umbrellas, lighthouses, lookouts, parks, piers, roads, highways, trails, single-family residences, commercial corridors, village centers, mid-rise motels, and moderate density residences.
Landscape Character	Tranquil, pristine, and natural, to vibrant and ordered, to chaotic and disordered.
Designated National, State, and Local Parks, Preserves, and Parkways	Humboldt WEA: Del Norte Coast Redwoods State Park, Six Rivers National Forest, Redwood National and State Parks, Reading Rock State Marine Reserve, Humboldt Lagoons State Park, Harry A. Merlo State Recreation Area, Big Lagoon County Park, Sue-Meg State Park, Trinidad State Beach, Luffenholtz Beach, Houda Point Beach/Camel Rock, Moonstone Beach, Little River State Beach, Clam Beach County Park, Hiller Park, Mad River State Beach, Humboldt Bay National Wildlife Refuge, Manilla Community Park, Samoa Beach, Fort Humboldt State Historic Park, Arcata Marsh Interpretive Area, Arcata Marsh Wildlife Sanctuary, Samoa Dunes State Recreation Area, South Humboldt Bay State Marine Recreation Area, Table Bluff County Park, Crab Park, Fern Cottage Historic District, Centerville Beach County Park, Lost Coast Headlands, Arcata Community Forest, Arcata Bird Sanctuary, Redwood Community Park, Sequoia Park, Cooper Canyon, Headwaters Forest Reserve, King Salmon Beach, Cape Mendocino Lighthouse,

Category	Seascape, Open Ocean, and Landscape
	Cape Mendocino Marine Reserve, Mattole Beach, Punta Gorda Lighthouse, Sea Lion Gulch State Marine Reserve, Humboldt Redwoods State Park Morro Bay WEA: Point Sur State Historic Park, Great Sur Vista Point, Notleys Landing Vista Point, Bixby Bridge Vista Point, Rocky Creek Bridge, Point Sur Marine Reserve, Andrew Molera State Park, Andrew Molera Beach, Pfeiffer Big Sur State Park, Pfeiffer Beach, Julia Pfeiffer Burns State Park, Partington Cove, Seal Beach Overlook, John Little State Natural Reserve, Big Creek State Marine Reserve, Big Creek Cove Vista Point, Big Creek Bridge, Gamboa Point, Limekiln State Park, Cone Peak Lookout, Los Padres National Forest, Sand Dollar Beach, Plaskett Creek Campground, Silver Peak Wilderness, Southern Redwood Botanical Area, San Carpoforo Creek Beach, Arroyo Hondo Beach, Point Sierra Nevada, Piedras Blancas State Marine Reserve, Piedras Blancas Light Station, Elephant Seal Vista Point, Arroyo Laguna Beach, William Randolph Hearst Memorial Beach, Hearst Castle, Cambria State Marine Reserve, Hearst San Simeon State Park, San Simeon Creek Campground, Moonstone Beach Park, Leffingwell Cove, Moonstone Beach, Moonstruck Lookout State Park, Fiscalini Ranch Preserve, Lampton Cliffs Park, Kenneth Norris Rancho Marino Reserve, Estero Bluffs State Park, Villa Creek Pullout, San Geronimo Pullout, Estero Bay, Morro Rock Beach, Morro Bay State Park, Montaña de Oro State Park, Point Buchon State Marine Reserve, Morro Bay State Marine Recreational Area, Spooner's Cove, Morro Strand State Beach, Morro Strand Beach Day Use Area, Cayucos Beach, Cayucos Pier, Cloisters Community Park, North Point Natural Area, Point San Luis Lighthouse, Chumash Heritage National Marine Sanctuary, California Coastal National Monument, California Route 1 State Scenic Highway.

Table 3.4.10-3. Area of ocean, seascape, and landscape areas in the zone of potential visual influence for the 1,100-foot wind turbines for the Humboldt WEA

Ocean, Seascape, and Landscape Character Areas	Area in Affected Environment		Area in the Zone of Potential Visual Influence		
	Square Miles	Square Kilometers	Square Miles	Square Kilometers	Percent of Area Affected
Ocean					
Open Ocean	6,735.01	17,443.60	6,674.34	17,286.5	99.1
Seascape					
Bayside Character					
Bayside Character Type	42.02	108.83	39.83	103.2	94.8
Oceanside Character					
Oceanside Character Type	659.70	1,708.81	603.48	1,563.0	91.5
Nearshore Ocean Character Area	491.37	1,272.64	479.64	1,242.3	97.6
Undefined	168.33	435.97	123.84	320.7	73.6
Landscape					
Landscape Character Type	1,717.36	4,447.95	382.78	991.4	22.3

Table 3.4.10-4. Area of ocean, seascape, and landscape areas in the zone of potential visual influence for 850-foot wind turbines for the Humboldt WEA

Ocean, Seascape, and Landscape Character Areas	Area in Affected Environment		Area in the Zone of Potential Visual Influence		
	Square Miles	Square Kilometers	Square Miles	Square Kilometers	Percent of Area Affected
Ocean					
Open Ocean	5,752.46	14,898.81	5,752.42	14,898.7	100.0
Seascape					
Bayside Character					
Bayside Character Type	42.02	108.83	38.80	100.5	92.3
Oceanside Character					
Oceanside Character Type	594.19	1,538.95	552.13	1,430.0	92.9
Nearshore Ocean Character Area	434.42	1,125.14	433.48	1,122.7	99.8
Undefined	159.77	413.81	118.64	307.3	74.3
Landscape					
Landscape Character Type	1,167.63	3,024.14	284.23	736.2	24.3

Table 3.4.10-5. Area of ocean, seascape, and landscape areas in the zone of potential visual influence for the 1,100-foot wind turbines for the Morro Bay WEA

Ocean, Seascape, and Landscape Character Areas	Area in Affected Environment		Area in the Zone of Potential Visual Influence		
	Square Miles	Square Kilometers	Square Miles	Square Kilometers	Percent of Area Affected
Ocean					
Open Ocean	8,328.17	21,569.87	8,237.96	21,336.22	98.9
Seascape					
Bayside Character					
Bayside Character Type	5.71	14.79	2.38	6.2	41.6
Oceanside Character					
Oceanside Character Type	841.69	2,167.96	621.26	1,609.0	73.8
Nearshore Ocean Character Area	436.09	1,129.48	432.54	1,120.3	99.2
Undefined	405.60	1,050.50	188.72	488.8	46.5
Landscape					
Landscape Character Type	1,195.64	3,096.69	58.98	152.8	4.9

Table 3.4.10-6. Area of ocean, seascape, and landscape areas in the zone of potential visual influence for 850-foot wind turbines for the Morro Bay WEA

Ocean, Seascape, and Landscape Character Areas	Area in Affected Environment		Area in the Zone of Potential Visual Influence		
	Square Miles	Square Kilometers	Square Miles	Square Kilometers	Percent of Area Affected
Ocean					
Open Ocean	7,201.71	18,652.35	7,184.10	18,606.7	99.8
Seascape					
Bayside Character					
Bayside Character Type	2.37	6.15	0.16	0.4	6.8
Oceanside Character					
Oceanside Character Type	726.19	1,880.83	571.28	1,479.6	78.7
Nearshore Ocean Character Area	397.14	1,028.60	396.37	1,026.6	99.8
Undefined	329.05	852.24	174.91	453.0	53.2
Landscape					
Landscape Character Type	727.15	1,883.30	42.41	109.8	5.8

Scenic resource susceptibility, value, and sensitivity analyses document the region's world-renowned scenic views, nature, culture, and history. The affected character area extents were calculated through geographic information system (GIS) visibility studies; extents were then reviewed and augmented by expert analysis.

Susceptibility is informed by the overall character of a particular seascape or landscape area, or by an individual element or feature, or by a particular aesthetic, experiential, and perceptual aspect that contributes to the character of the area. Table 3.4.10-7 defines rating criteria for open ocean, seascape, and landscape susceptibility.

Table 3.4.10-7. Susceptibility definitions for rating criteria of open ocean, seascape, and landscape

Region	High	Medium	Low
Open ocean is defined by the susceptibility to impacts from an offshore wind project.	Highly vulnerable to the type of change proposed.	Reasonably resilient to the type of change proposed.	Unlikely to be affected by the type of change proposed.
Seascape character is defined by the susceptibility to impacts from an offshore wind project.	Highly vulnerable to the type of change proposed.	Reasonably resilient to the type of change proposed.	Unlikely to be affected by the type of change proposed.
Landscape character is defined by the vulnerability to impacts from an offshore wind project.	Highly vulnerable to the type of change proposed.	Reasonably resilient to the type of change proposed.	Unlikely to be affected by the type of change proposed.

Value stems from the distinctive nature of a seascape or landscape and where scenic quality, wildness or tranquility, and natural or cultural heritage features contribute to the seascape or landscape. The relative value can be based on special designations (i.e., national parks or monuments, state parks, and local protections). It also considers other key characteristics and qualities of social values such as tourism, local meanings, and cultural and historic values. When examining the perceptual, experiential, and aesthetic qualities of the potentially affected ocean, seascapes, and landscapes, special consideration is given to key components that contribute to distinctive character. Table 3.4.10-8 defines open ocean, seascape, and landscape value rating criteria.

Table 3.4.10-8. Value definitions for rating criteria of open ocean, seascape, and landscape

Region	High	Medium	Low
Open ocean is defined by its visual resources' scenic and social value.	Highly distinctive and highly valued by residents and visitors.	Moderately distinctive and moderately valued by residents and visitors.	Common and unimportant to residents and visitors, or with minimal scenic value.
Seascape character is defined by its visual resources' scenic and social value.	Highly distinctive and highly valued by residents and visitors.	Moderately distinctive and moderately valued by residents and visitors.	Common and unimportant to residents and visitors, or with minimal scenic value.
Landscape character is defined by the visual resources' scenic and social value.	Distinctive and highly valued by residents and visitors, or within a designated scenic or historic landscape.	Moderately distinctive or within a landscape of locally valued scenic quality.	Common and unimportant to residents and visitors, or within a landscape of minimal scenic value.

Sensitivity results from consideration of both susceptibility and value. A higher rating prevails over a lower rating. Table 3.4.10-9 provides sensitivity rating criteria.

Table 3.4.10-9. Sensitivity definitions for rating criteria of seascape, open ocean, and landscape

Region	High	Medium	Low
Open ocean is defined by both the susceptibility to impacts from an offshore wind project and its visual resources' scenic and social value.	Pristine, highly distinctive, and highly valued by residents and visitors	Moderately distinctive and moderately valued by residents and visitors	Common or with minimal scenic value
Seascape character is defined by both the susceptibility to impacts from an offshore wind project and its visual resources' scenic and social value.	Distinctive and highly valued by residents and visitors	Moderately distinctive and moderately valued by residents and visitors	Common and unimportant to residents and visitors
Landscape character is defined by both the vulnerability to impacts from an offshore wind project, and the visual resources' scenic and social value.	Highly distinctive, highly valued by residents and visitors, or within a designated scenic or historic landscape	Moderately distinctive and moderately valued by residents and visitors	Common or within a landscape of minimal scenic value

Cultural and historic resources are considered in the SLIA analysis as they may contribute to seascape and landscape character. Section 3.4.2, *Cultural Resources*, describes the cultural contexts and associated resources that may occur in the Affected Environment. Cultural and historic properties and landscapes may occur within the Seascape and Landscape Character Types and contribute to the region's history, which contributes to its landscape character.

Night skies and natural darkness are also components of seascape and landscape character. The numeric Bortel scale measures the night sky's brightness/darkness. Class 1 represents the darkest skies available on Earth, whereas Class 9 is an urban brilliantly lit sky. In the Humboldt WEA, Humboldt Lagoons State Park, Sue-Meg State Park, and Prairie Creek Redwoods State Park are recognized as dark sky locations with Class 2 Bortle ratings for typical truly dark sky (Go Astronomy 2024). In the Morro Bay WEA, the coastline from Piedras Blancas State Marine Reserve northward to Limekiln and Julia Pfeiffer Burns State Parks, including the community of Gorda, is sheltered from urban lights and is rated Class 2 on the Bortle scale (Clarke 2017; Go Astronomy 2024). The Ventana Wilderness Area and Los Padres National Forest, which comprise most of the protected landscape east of the Morro Bay WEA, are not rated but fall into dark sky zones on the U.S. Light Pollution Map (lightpollutionmap.info 2024).

The sensitivity of the Affected Environment's open ocean, seascape, and landscape character is defined by both the susceptibility to impact from prospective wind energy projects and its visual resources' scenic and social value. Based on the existing natural, undeveloped, highly valued open ocean character, and the type of change proposed by prospective wind energy projects, the open ocean is rated high sensitivity. The Humboldt and Morro Bay lease areas would be an unavoidably dominant, strongly pervasive to clearly visible feature in the view from open water and would change its highly valued character (Appendix F). Table 3.4.10-10 lists the susceptibility, value, and sensitivity ratings for the open ocean, seascape, and landscape character areas. Appendix F provides further descriptions and analysis.

Table 3.4.10-10. Open ocean, seascape, and landscape sensitivity for the Humboldt and Morro Bay WEAs

Open Ocean, Seascape, and Landscape Character Area	Susceptibility	Value	Sensitivity
Ocean			
Open Ocean Character	High	High	High
Seascape			
Bayside Character Type	High	High	High
Oceanside Character Type	High	High	High
Nearshore Ocean Character Area	High	High	High
Undefined Seascape Area[1]	--	--	--
Landscape			
Landscape Character Type	High	High	High

[1] Undefined Oceanside Seascape character areas were quantified but their physical characteristics were not defined. These areas will be characterized and analyzed for visual impacts by lessees.

3.3.1.1.2 VIA Affected Environment

The VIA Affected Environment describes the physical environment in which a project is sited, the visual properties of a project area, and its scenic quality. This section describes the Affected Environment through communities with ocean views, context of the KOPs, and the sensitivity of view receptors. For the Humboldt WEA, the closest-to-shore WTG would be approximately 20 miles (32.2 kilometers) from the Samoa State Recreation Area. For the Morro Bay WEA, the closest WTG to shore would be the Piedras Blancas Lightstation, at 20 miles (32.2 kilometers). Table 3.4.10-11 lists the jurisdictions with ocean beach views and ocean views from an inland landscape, coastal bluffs, bay, estuary, or inland mountain side.

Table 3.4.10-11. Jurisdictions with ocean views

Ocean View	Jurisdiction
Humboldt Bay Region	
Ocean view from a seascape	Crescent City, Big Lagoon, Patrick's Point, Trinidad, Westhaven, Moonstone, Clam Beach, McKinleyville, Manila, Samoa, Fairhaven
Ocean view from a landscape, bay, estuary, coastal bluff, or inland mountain side	Requa, Orick, Patrick's Point, Trinidad, Westhaven-Moonstone, Clam Beach, McKinleyville, Calville, Korblex, Alliance, Arcata, Sunny Brae, Bayside, Fickle Hill, Indianola, Brainard, Eureka, Bayview, Myrtletown, Rosewood, Cutten, King Salmon, Humboldt Hill, Ridgewood, Southport Landing, Beatrice, Table Bluff, Loleta, Fernbridge, Port Kenyon, Arlynda Corners, Ferndale, Capetown, Petrolia
Morro Bay Region	
Ocean view from a seascape	Notley's Landing, Loma Vista, Big Sur, Slates Hot Springs, Lucia, Plaskett, Gorda, Ragged Point, San Simeon, Cambria, Cayucos, Morro Bay
Ocean view from a landscape, bay, estuary, coastal bluff, or inland mountain side	Loma Vista, Big Sur, Cambria, Harmony, Morro Bay, Los Osos, Baywood Park

Figure 3.4.10-5 and Figure 3.4.10-6 show photographs of typical views in the Affected Environment.

KOPs represent individuals or groups of people who may be affected by changes in views and visual amenities. Based on higher viewer sensitivity, viewer exposure, and context photography, BOEM identified five KOPs (Table 3.4.10-12, Figure 3.4.10-4) to provide the locational bases for detailed analyses of the Affected Environment's open ocean, seascape, landscape, and viewer experiences. Two open ocean KOPs are representative and not place-based, to capture viewer experiences from recreational fishing, pleasure, and tour boats and shipping and cruise ship lanes. These are: KOP-A Representative Recreational Fishing, Pleasure, and Tour Boat Area and KOP-B Representative Commercial and Cruise Ship Shipping Lanes.

Figure 3.4.10-5. Elk Head, Trinidad, Humboldt County, California

Figure 3.4.10-6. Big Sur Coastline, Monterey County, California

Table 3.4.10-12. Representative offshore analysis area view receptor contexts and KOPs

Context	KOPs
Vantage Point	KOP-H1 Patrick's Point (daytime and nighttime) KOP-M3 Piedras Blancas Lighthouse (daytime and nighttime) KOP-M4 Valencia Peak Montaña de Oro State Park (daytime and nighttime)
Linear Receptor	California Coastal Trail (Redwood NP) California State Scenic Highway Route 1 – Carmel River to Route 68 KOP-B Representative Commercial and Cruise Ship Shipping Lanes
Scenic Area	KOP-M1 Julia Pfeiffer Burns (daytime and nighttime) KOP-M2 Limekiln State Park (daytime and nighttime) KOP-M4 Valencia Peak Montaña de Oro State Park (daytime and nighttime) KOP-A Representative Recreational Fishing, Pleasure, and Tour Boat Area

Sensitivity is the aggregate measure of human susceptibility to view change and social value. The sensitivity of KOP viewers is determined with reference to view location and activity: (1) review of relevant designations and the level of policy importance that they signify (such as landscapes designated at national, state, or local levels); and (2) application of criteria that indicate value (such as scenic quality, rarity, recreational value, representativeness, conservation interests, perceptual aspects, and artistic associations). Table 3.4.10-13 lists the susceptibility and value indicators and criteria used to assess visual impacts for this PEIS.

Table 3.4.10-13. View receptor susceptibility and value ranking indicators

Ranking	Susceptibility Indicators	Value Indicators
High	Residents with views of prospective wind energy projects from their homes; people with a strong cultural, historic, religious, or spiritual connection to landscape or seascape views; people engaged in outdoor recreation whose attention or interest is focused on the open ocean, seascape, and landscape, and on particular views; visitors to historic or culturally important sites, where views of the surroundings are an important contributor to the experience; people who regard the visual environment as an important asset to their community, churches, schools, cemeteries, public buildings, and parks; and people traveling on scenic highways and roads, or walking on beaches and trails, specifically for enjoyment of views.	Designation as a scenic viewpoint, scenic area, scenic roadway, scenic river, national or state park; association with a historic or culturally important site; appearances in guidebooks, tourist maps, websites, online photo collections, and social media; references to views in literature or art; provision of facilities to enhance view enjoyment (i.e., parking, restrooms, benches, interpretive panels, and telescopes); recommendations of residents, visitor bureaus, tourism service providers, and other local entities.
Medium	People engaged in outdoor recreation whose attention or interest is unlikely to be focused on the landscape and on particular views because of the type of activity but where views and the aesthetic environment create a more desirable and enjoyable experience; people at their places of livelihood, commerce, and personal needs (inside or outside) whose attention is generally focused on that engagement, not on scenery, but where the seascape and landscape setting adds value to the quality of their activity; and, generally, those commuters and other travelers traversing routes that are not dominated	Setting may encompass more modest qualities described for high value; where the scenic quality adds value to the viewer experience or activity but is not the central focus.

Ranking	Susceptibility Indicators	Value Indicators
	by scenic developments, but the overall visual setting adds value to the experience.	
Low	People engaged in outdoor activities whose attention or interest is not focused on the landscape or on particular views because of the type of activity.	The setting is inconsequential and adds little or no value to the viewer experience.

Table 3.4.10-14 is based on BOEM SLVIA guidance for combining receptor susceptibility and value ratings to determine overall viewer sensitivity.

Table 3.4.10-14. Sensitivity matrix

Value Rating	Susceptibility Rating		
	High	Medium	Low
High	High	High	Medium
Medium	High	Medium	Low
Low	Medium	Low	Low

Appendix F provides judgments and narrative explanations for the determinations regarding seascape, landscape, and KOP sensitivity. Table 3.4.10-15 lists KOP viewer sensitivity ratings. All five KOPs have high ratings for susceptibility, value, and sensitivity.

Table 3.4.10-15. Key observation point viewer sensitivity ratings

Key Observation Points	Susceptibility	Value	Sensitivity
High			
KOP-H1 Patrick's Point	High	High	High
KOP-M1 Julia Pfeiffer Burns	High	High	High
KOP-M2 Limekiln State Park	High	High	High
KOP-M3 Piedras Blancas Lighthouse	High	High	High
KOP-M4 Valencia Peak Montaña de Oro State Park KOP-A Representative Recreational Fishing, Pleasure, and Tour Boat Area KOP-B Representative Commercial and Cruise Ship Shipping Lanes	High High High	High High High	High High High
Medium	None	None	Noe
Low	None	None	None

While not designated as representative KOPs, daytime and nighttime aircraft viewers on routes traversing the coast experience a range of viewing situations, from foreground to background, depending on location, elevation, and type of aircraft. Aircraft viewers are more frequently affected by view-limiting atmospheric conditions than are land and ocean receptors. Ocean receptors include the people on recreational and fishing boats, pleasure craft, tour boats, and commercial fishing boats with visibility of prospective WTGs and OSSs in the Humboldt and Morro Bay lease areas out to 43.6 miles (70.2 kilometers), and cruise ships with elevated 63-foot (19.2-meter) visibility out to 50.3 miles (80.9 kilometers).

The Affected Environment and VIAs are based on clear-day and clear-night visibility to evaluate the most impactful scenario. Much of the Affected Environment is rural and ambient light levels and nighttime glare typical of urban areas are minimal, creating high-quality dark-sky environments in portions of both the Morro Bay and the Humboldt WEAs.

Highway 1 from the Carmel River in Monterey County south to the San Luis Obispo County line at Ragged Point (72.3 miles [116.4 kilometers]) and Ragged Point south to San Luis Obispo (56.6 miles [91 kilometers]), are designated State Scenic Highways. These two State Scenic Highways are known as the Big Sur Coast Highway and the San Luis Obispo North Coast Byway, respectively. In the Humboldt region, Highway 101 from the Leggett junction with Highway 1 north to Route 199 in Crescent City is officially eligible for scenic highway designation. The intent of the State Scenic Highway system was to not only add to the pleasure of state residents but encourage the growth of recreation and tourism industries. The statute establishes California's responsibility "for the protection and enhancement of California's scenic beauty… which together with adjacent scenic corridors, require special conservation treatment."

3.3.1.2 Impact Level Definitions for Scenic Resources and Viewer Experience

Table 3.4.10-16 defines adverse impact levels**.**

Table 3.4.10-16. Adverse impact level definitions for scenic and visual resources

Impact Level	Definition for SLIA	Definition for VIA
Negligible	Very little or no effect on seascape/landscape area character, features, elements, or key qualities either because unit lacks distinctive character, features, elements, or key qualities; values for these are low; or project visibility would be minimal.	Very little or no effect on viewers' visual experience because view value is low, viewers are relatively insensitive to view changes, or project visibility would be minimal.
Minor	Prospective wind energy projects would introduce features that may have low to medium levels of visual prominence within the geographic area of an ocean/seascape/ landscape character unit. Project features may introduce a visual character that is slightly inconsistent with the character of the unit, which may have minor to medium negative effects on the unit's features, elements, or key qualities, but the unit's features, elements, or key qualities have low susceptibility or value.	The visibility of projects would introduce a small but noticeable to medium level of change to the view's character; have a low to medium level of visual prominence that attracts but may or may not hold the viewer's attention; and have a small to medium effect on the viewer's experience. The viewer receptor sensitivity/susceptibility/ value is low. If the value, susceptibility, and viewer concern for change is medium or high, then evaluate the nature of the sensitivity to determine if elevating the impact to the next level is justified. For instance, a KOP with a low magnitude of change, but that has a high level of viewer concern (combination of susceptibility/value), may justify adjusting to a moderate level of impact.

Impact Level	Definition for SLIA	Definition for VIA
Moderate	Prospective wind energy projects would introduce features that would have medium to large levels of visual prominence within the geographic area of an ocean/seascape/landscape character unit. The projects would introduce a visual character that is inconsistent with the character of the unit, which may have a moderate negative effect on the unit's features, elements, or the key qualities. In areas affected by large magnitudes of change, the unit's features, elements, or key qualities have low susceptibility or value.	The visibility of the projects would introduce a moderate to large level of change to the view's character; may have a moderate to large levels of visual prominence that attracts and holds but may or may not dominate the viewer's attention; and has a moderate effect on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/value is medium to low. Moderate impacts are typically associated with medium viewer receptor sensitivity (combination of susceptibility/value) in areas where the view's character has medium levels of change; or low viewer receptor sensitivity (combination of susceptibility/value) in areas where the view's character has large changes to the character. If the value, susceptibility, and viewer concern for change is high, then evaluate the nature of the sensitivity to determine if elevating the impact to the next level is justified.
Major	Prospective wind energy projects would introduce features that would have dominant levels of visual prominence within the geographic area of an ocean/seascape/landscape character unit. Projects would introduce a visual character that is inconsistent with the character of the unit, which may have a major negative effect on the unit's features, elements, or key qualities. The sensitivity to change (combination of susceptibility/ value) to the character unit is high.	The visibility of the projects would introduce a major level of character change to the view; will attract, hold, and dominate the viewer's attention; and have a moderate to major effect on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/value is medium to high. If the magnitude of change to the view's character is medium, but the susceptibility or value at the KOP is high, then evaluate the nature of the sensitivity to determine if elevating the impact to major is justified. If the sensitivity (combination of susceptibility/value) at the KOP is low in an area where the magnitude of change is large, then evaluate the nature of the sensitivity to determine if lowering the impact to moderate is justified.

Accidental releases, land disturbance, lighting, presence of structures, and vessel traffic are contributing IPFs to impacts on scenic and visual resources. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.4.10-17.

Table 3.4.10-17. Issues and indicators to assess impacts on scenic and visual resources

Issue	Impact Indicator
Change in scenic quality of the ocean, seascape, and landscape character.	Visual contrast and dominance of project component structures and activities onshore and offshore visible in the viewshed.
Impacts on the physical elements and features that make up an ocean, seascape, or landscape and the aesthetic, perceptual, and experiential aspects of the ocean, seascape, or landscape that contribute to its distinctive character. Impacts on the "feel," "character," or "sense of place" of an area of ocean, seascape or landscape.	Public sensitivity for the settings and tolerance for change: susceptibility to impact, and perceived social value.
Changes to the view from adding wind energy project components into the viewshed as seen from a particular key viewing location and how the change affects people who are likely to be at the viewpoint.	Magnitude of change: the combination of visual contrast, size, and scale of the change to existing conditions caused by the project, the geographic extent of the area subject to the project's effects, and the effects' duration and reversibility.
Changes to the view from adding wind energy project lighting into the viewshed.	Sensitivity to luminance and illuminance from project component lighting sources onshore and offshore visible in the viewshed related to frequency, color, timing, brightness, etc.

3.3.1.3 Impacts of Alternative A – No Action – Scenic and Visual Resources

When analyzing the impacts of the No Action Alternative on scenic and visual resources, BOEM considers the impacts of ongoing activities, including ongoing non-offshore wind activities, on the baseline conditions for scenic and visual resources. The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative on existing baseline trends, including other planned offshore and non-offshore wind activities, as described in Appendix C, *Planned Activities Scenario*.

3.3.1.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for open ocean, seascape, landscape, and viewers would continue to follow current regional trends and respond to ongoing activities, such as onshore development and construction activities, undersea cable installation and maintenance, military use, fishing, and offshore vessel traffic. These activities have the potential to contribute to new structures, traffic congestion, and nighttime light impacts.

3.3.1.3.2 Cumulative Impacts of the No Action Alternative

Relevant planned projects in the region include port improvements and NOAA's late 2024/early 2025 designation of the Chumash Heritage National Marine Sanctuary (NOAA 2023).[2]

Accidental releases: Accidental spills of substances like fuel or hazardous materials could affect the visual appeal of nearby marine and coastal areas. While most spills would be small and cause minor visual disturbances, a large-scale incident like an oil spill could significantly affect these scenic resources. Such spills could also lead to temporary beach closures, limiting viewer experiences. Ongoing and planned activities do not include projects with high propensity for a large spill. Accordingly, overall visual impacts would be negligible to minor.

Lighting (offshore): Ongoing vessel traffic would continue as a source of intermittent anthropogenic light with negligible to minor visual impacts.

Lighting (onshore): Onshore planned and ongoing development activities have the potential to increase nighttime facility lighting, depending on the number of developments, their purpose, and location, which could be visible from unobstructed sensitive viewing locations. Impacts would be negligible to minor, localized and short term.

Traffic (vessel): Ongoing and planned activities have the potential to increase vessel activity, including out of ports such as Humboldt Bay, where a separate effort is considering an expansion project in support of offshore wind generally. Stationary and moving vessels would continue to be present in the Affected Environment. Impacts would be negligible to minor.

3.3.1.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, regional trends and activities would continue; scenic and visual resources would continue to be affected by natural processes and human activities. The coastal landscape's character would change in the short and long terms through natural processes and ongoing activities that would continue to shape onshore features, character, and viewer experience. Ongoing activities in the Affected Environment that contribute to visual impacts include construction activities and vessel traffic, which lead to increased nighttime lighting. Impacts would be **negligible** to **minor.**

Cumulative Impacts of the No Action Alternative. Planned activities, such as dredging and port improvements, military use, marine transportation, and onshore development, when combined with ongoing activities would add new structures, nighttime lighting, and vessel traffic; resultant impacts would be **minor** to **moderate**.

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[2] Site assessment activities associated with the Oregon WEAs would not be directly visible from the Affected Environment for visual resources. Refer to the 2024 EA for more information on impacts of these activities: https://www.boem.gov/renewable-energy/state-activities/commercial-wind-lease-issuance-pacific-outer-continental-shelf

3.3.1.4 Impacts of Alternative B – Development with No Mitigation Measures – Scenic and Visual Resources

Impact levels for this alternative are judged with reference to the sensitivity and the magnitude of change for character areas and people and the intervisibility between KOPs and project features. Impact determinations are described in Table 3.4.10-16; refer to Appendix F for detailed analysis.

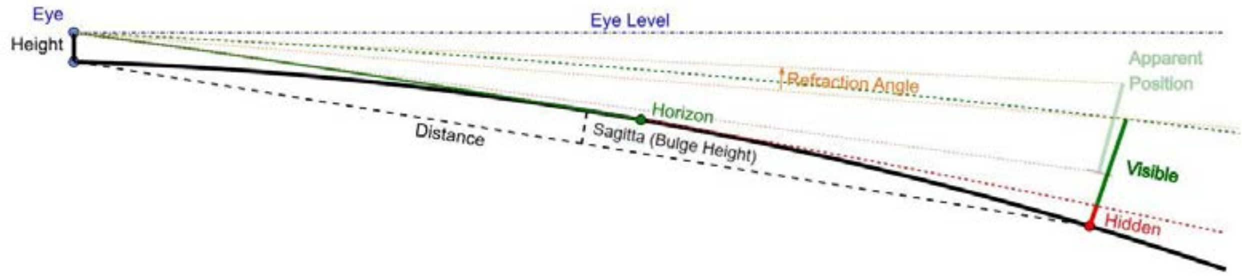
3.3.1.4.1 Impacts of One Representative Project in each WEA

In this section, each of the five lease areas is evaluated as the prospective site of a representative project (up to 200 WTGs and 6 OSSs). Onshore to offshore view distances to the lease areas range from 20 miles (32.2 kilometers) to 40 miles (64.4 kilometers). Table 3.4.10-18 provides a summary of the magnitude of visibility for each lease area based on the nearest respective beach or shoreline view. The table provides a range for onshore to offshore view distances and horizontal and vertical FOV. Horizontal FOV is based on the percentage the project would occupy of the typical human's 124° horizontal FOV. The percent vertical FOV is based on the typical human's 55° vertical FOV as measured at 6.5 feet (2 meters) above highest astronomical tide. This vertical measure also indicates the perceived proportional size and relative height of a wind farm.

Some distances are constant for each lease area. The 1,100-foot WTG's rotor blade tips would be potentially visible out to 40 miles (64.4 kilometers) at 5.9-foot [1.8-meter] eye level above MLLW, which is 0 feet. The 850-foot WTG's rotor blade tips would be potentially visible out to 36.5 miles (58.7 kilometers) from 5.9 feet [1.8 meters] above MLLW, which is 0 feet.

WTG and OSS visibility would be variable throughout the day depending on specific factors. View angle, sun angle, atmospheric conditions, and distance would affect both visibility and noticeability. Visual contrast of WTGs and OSSs would vary throughout daylight hours depending on whether the WTGs and OSSs are backlit, side-lit, or front-lit and based on the visual character of the horizon's backdrop. These variations through the course of the day could result in periods of major visual impacts, while at other times of day would have moderate, minor, or negligible impacts.

Atmospheric refraction of light rays causes fluctuations in the extents and appearances of offshore and onshore facilities. It results from the bending of light rays between viewers and objects due to air temperature, water vapor, and barometric pressure (Bislins 2022). Atmospheric refraction can increase the visibility of objects, making them look larger or taller, depending on conditions. Figure 3.4.10-7 illustrates the effect of Earth's curvature and atmospheric refraction. Atmospheric refraction would increase visibility of the 1,100-foot WTG by as much as 7 to 200 feet (2 to 61 meters) and of the 850-foot WTG by as much as 7 to 155 feet (2 to 47 meters) depending on lease area. Appendix F, Table F-7 provides a summary of increased visibility ranges for viewers at the nearest beach or viewpoint for each lease area and both turbine sizes based on the average sea level refraction calculation coefficient of 0.17 (Bislins 2022) applied to the turbine blade tip viewshed distances. Daytime and nighttime atmospheric refraction-based visibility varies with sea level's continuous increases and decreases in temperature, water vapor, and barometric pressure. In addition, atmospheric influences that increase the refraction phenomena are the same influences that may inhibit longer range views due to atmospheric haze. These variations in atmospheric refraction could result in periods of major visual impacts, while at other times would have moderate, minor, or negligible impacts.



Source: Bislins 2022

Figure 3.4.10-7. The effect of Earth's curvature and atmospheric refraction on visibility of a distant object

Table 3.4.10-18. Magnitude of view summary for all California lease areas to nearest onshore viewpoint for 1,100-foot and 850-foot WTGs

Lease Area and Wind Turbine	Nearest Viewpoint in miles (kilometers)	Visibility			
		Rotor blade tip visibility in miles (kilometers)	Visibility range in miles (kilometers)	Horizontal FOV range near to far miles (km) (% of 124)	Vertical FOV range near to far (% of 55)
OCS-P 0561	Humboldt Samoa Beach (view elevation 24 ft)				
1,100-foot	20.1 (32.4)	43.6 (70.2)	20.1 (32.4)– 43.6 (70.2)	17.3 (27.8) wide 49° (40%)–68° (55%)	0.9° (1.6%)–0.37° (0.7%)
850-foot	20.1 (32.4)	38.7 (62.3)	20.1 (32.4)– 38.7 (62.3)	17.3 (27.8) wide 49° (40%)–64° (52%)	0.39° (0.7%)–0.28° (0.5%)
OCS-P 0562	Waluplh LH Ranch (view elevation 24 ft)				
1,100-foot	20.0 (32.2)	43.6 (70.2)	20.0 (32.2)– 43.6 (70.2)	17.1 (27.5) wide 49° (40%)–68° (55%)	0.9° (1.6%)–0.3° (0.5%)
850-foot	20.0 (32.2)	38.7 (62.3)	20.0 (32.2)– 38.7 (62.3)	17.1 (27.5) wide 49° (40%)–64° (52%)	0.39° (0.7%)–0.26° (0.5%)
OCS-P 0563	St. Martin Scenic Spot (view elevation 235 ft)				
1,100-foot	26.3 (42.3)	43.6 (70.2)	26.3 (42.3)– 43.6 (70.2)	24.6 (39.6) wide 47° (38%)–60° (48%)	0.4° (0.7%)–0.3° (0.5%)
850-foot	26.3 (42.3)	38.7 (62.3)	26.3 (42.3)– 38.7 (62.3)	24.6 (39.6) wide 47° (38%)–56° (45%)	0.3° (0.5%)–0.2° (0.4%)
OCS-P 0564	St. Martin Scenic Spot (view elevation 235 ft)				
1,100-foot	22.3 (35.9)	43.6 (70.2)	22.3 (35.9)– 43.6 (70.2)	20.2 (32.5) wide 48° (39%)–64° (52%)	0.5° (0.9%)–0.3° (0.5%)
850-foot	22.3 (35.9)	38.7 (62.3)	22.3 (35.9)– 38.7 (62.3)	20.2 (32.5) wide 48° (39%)–61° (49%)	0.4° (0.7%)–0.2° (0.4%)

Lease Area and Wind Turbine	Nearest Viewpoint in miles (kilometers)	Visibility			
		Rotor blade tip visibility in miles (kilometers)	Visibility range in miles (kilometers)	Horizontal FOV range near to far miles (km) (% of 124)	Vertical FOV range near to far (% of 55)
OCS-P 0565	Point Piedras Blancas (view elevation 18 ft)				
1,100-foot	19.1 (30.8)	43.6 (70.2)	19.1 (30.8)– 43.6 (70.2)	21.1 (34.0) wide 42° (34%)–64° (52%)	0.41° (0.7%)–0.32° (0.6%)
850-foot	19.1 (30.8)	38.7 (62.3)	19.1 (30.8)– 38.7 (62.3)	21.1 (34.0) wide 42° (34%)–60° (48%)	0.41° (0.7%)–0.3° (0.5%)

Meteorological conditions associated with each WEA were based on a measurement site in the area of the leases, as well as from nearby airport data (Arcata-Eureka and San Luis Obispo County airports). Atmospheric conditions affecting onshore to offshore viewing vary daily and monthly in the lease areas. Table 3.4.10-19 describes considerations of atmospheric visibility conditions between potential shoreline viewing receptors and prospective wind energy developments for each WEA.

Table 3.4.10-19. Atmospheric visibility considerations

Atmospheric Considerations	Humboldt WEA	Morro Bay WEA
Clear conditions (unlimited cloud ceiling height)	Clear conditions occur 38% of daylight hours over the course of the year (about 1 of every 3 days) with seasonal values ranging from 25% in summer to 48% in fall.	Clear conditions occur 59% of daylight hours over the course of the year (about 2 of every 3 days) with seasonal values ranging from 57% in summer to 66% in winter.
Fog	Fog occurs 6% of the time, predominantly in summer.	Fog occurs 3% of the time, predominantly in fall.
Nighttime	Nighttime offers the greatest percentage of clear conditions, occurring 60% of the year (about 2 of every 3 nights) with average visibility of 25 nm (46.3 km).	Nighttime offers the greatest percentage of clear conditions occurring 77% of the year (about 3 of every 4 nights) with average visibility of 25 nm (46.3 km).
Averaged daylight visibility on clear day	Winter: 13 nm (24 km) in winter Spring: 13 nm (24 km) Summer: 11 nm (20.4 km) Fall: 14 nm (25.9 km)	Winter: 15 nm (27.8 km) in winter Spring: 17 nm (31.5 km) Summer: 15 nm (27.8 km) Fall: 18 nm (33.3 km)
Atmospheric haze[1]	<1% of the year but can reduce visibility by 56–78%	<1% of the year but can reduce visibility by 60–70%

Source: ESS Group 2019a and 2019b

[1] Atmospheric haze over the ocean can reduce visibility by as much as 78 percent during springtime to 56 percent in autumn.

Variations in atmospheric conditions throughout the day and year could result in periods of major, moderate, minor, or negligible impacts.

Accidental releases: Accidental releases (e.g., fuel, trash debris) could occur throughout all project phases, potentially affecting nearby seascape, open ocean, and landscape character and viewer experiences. Nearshore accidental releases could temporarily close beaches, potentially limiting viewer experience of affected seascapes, open ocean, and landscapes. The potential for accidental releases would be greatest during construction and decommissioning, with lower but continuous potential during O&M, resulting in overall negligible to minor impacts.

Land disturbance: A wind energy project entails onshore construction, including but not limited to substations and transmission infrastructure. Such construction would result in localized, temporary visual impacts near involved sites due to anticipated vegetation clearing, site grading, trenching, and construction staging. These impacts would last through construction and continue until disturbed areas are restored. Intermittent land disturbance may also be required to maintain such infrastructure. Land disturbance impacts are anticipated to be negligible to minor.

Lighting (offshore): Vessel lighting is anticipated during any periods of nighttime, dusk, or early morning construction or material transport. Depending on a viewer's distance to a lease area, minor to major impacts may occur. Construction impacts of vessel lighting would be localized and short term. Ongoing nighttime lighting would continue through O&M; impacts would be intermittent and long term.

Aviation warning lights would be affixed and activated in port before WTGs are towed to lease areas, and illuminated for the duration of O&M. The WTG aviation warning lights include a minimum of three red flashing lights at the midsection of each tower and one at the top of each nacelle. Such lighting would be visible from beaches and coastlines, resulting in long-term major scenic and visual impacts on unobstructed sensitive onshore and offshore viewing locations. Atmospheric and environmental factors such as clouds and fog may influence visibility and perception of hazard lighting from sensitive viewing locations. Each individual project would be subject to agency consultation (Section 3.4.2, *Cultural Resources*) and pertinent federal and state permitting requirements, which could include mitigation enforceable by other federal and state agencies. FAA has regulatory requirements for the lighting of offshore structures under 14 CFR Part 77. This analysis assumes that one such requirement would be the implementation of ADLS, which would reduce nighttime lighting impacts from Aviation Warning Lights (BOEM 2021b).

Lighting (onshore): Nighttime facility lighting would occur during all project phases. Facility lighting, depending on the quantity, intensity, and location, could be visible from unobstructed sensitive onshore viewing locations. As lessees have not determined precise locations for onshore facilities, onshore lighting impacts cannot be conclusively determined. For this PEIS, impacts are assumed to be localized and short term during construction and decommissioning, and long term during O&M.

Presence of structures: One representative project would install up to 200 WTGs at a height of between 850 feet and 1,100 feet above MLLW and up to 6 OSSs (height not defined). It is assumed that WTGs would be painted white or light gray, no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey. RAL 7035 Light Grey would help reduce potential visibility against the horizon.

The analysis is based on GIS visibility calculations additionally informed by simulations of similar distance, variability of viewer location within the KOP vicinity, variability of sun angles throughout the day, and nighttime variability of cloud cover, ocean reflections, and moonlight. Appendix F provides an assessment of each representative project's WTG distances (by height), noticeable elements, FOV, KOP foreground elements, and influence at each KOP. Open ocean character area, seascape character areas, landscape character areas, and viewer experiences would be affected by each representative project's WTG height, applicable distances, and noticeable WTG elements (Appendix F, Tables F-1 through F-6); KOP open views versus view framing or intervening foregrounds (Appendix F, Table F-25); and form, line, color, and texture contrasts, scale of change, and prominence in the characteristic open ocean, seascape, and landscape (Appendix F, Tables F-26 through F-29). Higher impact significance would stem from unique, extensive, and long-term appearance of strongly contrasting vertical structures in the otherwise horizontal open ocean environment, larger scale of change, and higher prominence, where structures are an unexpected element and viewer experience includes formerly open views of high-sensitivity open ocean, seascape, and landscape, and from high-sensitivity view receptors.

Table 3.4.10-20 and Table 3.4.10-21 consider the totality of each representative project's level of impact by open ocean, seascape, and landscape character area. All lease areas would result in major impacts on open ocean character regardless of WTG height.

Table 3.4.10-20. Representative project impacts with 1,100-foot WTG on ocean, seascape, and landscape character

Open Ocean, Seascape, and Landscape	1,100-foot WTG impact level				
	OCS-P 0561	OCS-P 0562	OCS-P 0563	OCS-P 0564	OCS-P 0565
Open Ocean	Major	Major	Major	Major	Major
Bayside Seascape					
Bayside Seascape Character Type	Moderate	Moderate	Moderate	Moderate	Moderate
Oceanside Seascape[1]					
Oceanside Seascape Character Type	Major	Major	Major	Major	Major
Nearshore Ocean Character Area	Major	Major	Major	Major	Major
Landscape					
Landscape Character Type	Moderate	Moderate	Major	Major	Major

[1] Oceanside Seascape character areas with quantified area but undefined physical characteristics were not analyzed. These areas will be characterized and analyzed for visual impacts by lessees.

Table 3.4.10-21. Representative project impacts with 850-foot WTG on open ocean, seascape, and landscape character

Open Ocean, Seascape, and Landscape	850-foot WTG impact level				
	OCS-P 0561	OCS-P 0562	OCS-P 0563	OCS-P 0564	OCS-P 0565
Open Ocean	Major	Major	Major	Major	Major
Bayside Seascape					
Bayside Seascape Character Type	Moderate	Moderate	Negligible	Negligible	Negligible
Oceanside Seascape[1]					
Oceanside Seascape Character Type	Major	Major	Major	Major	Major
Nearshore Ocean Character Area	Major	Major	Major	Major	Major
Landscape					
Landscape Character Type	Minor	Minor	Moderate	Moderate	Moderate

[1] Oceanside Seascape character areas with quantified area but undefined physical characteristics were not analyzed. These areas will be characterized and analyzed for visual impacts by lessees.

For the 850-foot WTGs summarized in Table 3.4.10-21, all lease areas would result in negligible to moderate impacts on seascape and landscape character. For the 1,100-foot WTGs summarized in Table 3.4.10-20, all lease areas would result in minor to major impacts on seascape and landscape character.

The following tables summarize impacts as follows:

1. Table 3.4.10-22 describes the magnitude of change criteria for determining viewer impact levels at onshore and offshore KOPs. Negligible impacts are based on very little to no effect on viewer experiences because the project is not visible.
2. Table 3.4.10-23 considers the totality of the 1,100-foot-tall WTGs level of impact (the sensitivity level and magnitude of change; BOEM 2021a) on KOPs.
3. Table 3.4.10-24 considers the totality of the 850-foot-tall WTGs level of impact on KOPs. All KOPs are rated high sensitivity.
4. Appendix F, Table F-30 lists the applicable impact level for each KOP and lease area based on specific measures of distance, occupied FOV, noticeable facility elements, visual contrasts, scale of change, and prominence for each WEA.

Table 3.4.10-22. Criteria for measuring magnitude of change impacts

Impact Measure	Major	Moderate	Minor
Distance	Lease area facilities located from 0.0 mile (0.0 kilometer) to 12 miles (19.3 kilometers) of the KOP's viewers.	Lease area facilities located between 12 miles (19.3 kilometers) and the visible distance of the aviation lights, 33.6 miles (54.1 kilometers) and 30.7 miles (49.4 kilometers) for 1,100-foot and 850-foot WTGs, respectively, of the KOP's viewers.	For 1,100-foot WTGs, lease area facilities located between 33.6 miles (54.1 kilometers) and 43.6 miles (70.2 kilometers) of the KOP's viewers. For 850-foot WTGs, lease area facilities located between 30.7 miles (49.4 kilometers) and 38.7 miles (62.3 kilometers) of the KOP's viewers.
Field of View	Extensive FOV occupied by the facilities, horizon is dominated to mostly filled (>60%) by WTGs.	Moderate FOV occupied by the facilities, roughly 30–50% of HFOV.	Minor FOV occupied by the facilities, viewing is an oblique angle so that <30% HFOV is filled.
Visual Contrast	Strong-rated visual contrasts between facilities' forms, lines, colors, and textures and the existing viewing condition's forms, lines, colors, textures, spatial composition, and motion.	Moderate-rated visual contrasts between facilities' forms, lines, colors, and textures and the existing viewing condition's forms, lines, colors, textures, spatial composition, and motion.	Weak-rated visual contrasts between facilities' forms, lines, colors, and textures and the existing viewing condition's forms, lines, colors, textures, spatial composition, and motion.

Impact Measure	Major	Moderate	Minor
Noticeability	Greater extents of noticeable facility elements in the view.	Moderate extents of noticeable facility elements in the view.	Minor extents of noticeable facility elements in the view.
View Duration	Strong-rated view duration will be experienced for long duration and/or a full view.	Moderate-rated view duration will be experienced for moderate duration and/or a partial view.	Weak-rated view duration will be experienced for short duration and/or glimpses.
Scale of Change	Large-rated scale of change by facilities.	Medium-rated scale of change by facilities.	Small-rated scale of change by facilities.
Geographic Extent	Large extent reflects a central angle of view, large apparent size, and/or a wide area over which the project is visible.	Moderate extent reflects a less central view angle, moderate size, and/or a moderate area over which the project is visible.	Small extent reflects a peripheral view angle, small apparent size, and/or a limited area over which the project is visible.
Prominence[1]	6- or 5-rated prominence in the view.	4- or 3-rated prominence in the view.	2- or 1-rated prominence in the view.
Duration/ Reversibility	Permanent Not reversible	Long term Partially reversible	Short term Fully reversible

[1] WTGs and OSS prominence: 0 = Not visible. 1 = Visible only after extended study; otherwise not visible. 2 = Visible when viewing in general direction of the wind farm; otherwise, likely to be missed by casual observer. 3 = Visible after brief glance in general direction of the wind farm; unlikely to be missed by casual observer. 4 = Plainly visible; could not be missed by casual observer but does not strongly attract visual attention or dominate view. 5 = Strongly attracts viewers' attention to the wind farm; moderate to strong contrasts in form, line, color, or texture, luminance, or motion. 6 = Dominates view; strong contrasts in form, line, color, texture, luminance, or motion fill most of the horizontal FOV or vertical FOV (Sullivan et al. 2013).

Table 3.4.10-23. Impact levels on the viewer experience (sensitivity level and magnitude of change) for 1,100-foot WTGs

Offshore Key Observation Points	1,100-foot WTG impact level				
	OCS-P 0561	OCS-P 0562	OCS-P 0563	OCS-P 0564	OCS-P 0565
KOP-H1 Patrick's Point—daytime (156' elev) KOP-H1 Patrick's Point—nighttime (156' elev)	Major Major	Moderate Major	--	--	--
KOP-M1 Julia Pfeiffer Burns—daytime (458' elev) KOP-M1 Julia Pfeiffer Burns—nighttime (458' elev)	--	--	Major Major	Major Major	Moderate Major
KOP-M2 Limekiln State Park—daytime (779' elev) KOP-M2 Limekiln State Park—nighttime (779' elev)	--	--	Major Major	Major Major	Major Major
KOP-M3 Piedras Blancas Lighthouse—daytime KOP-M3 Piedras Blancas Lighthouse—nighttime	--	--	Moderate Major	Moderate Major	Major Major
KOP-M4 Valencia Peak Montaña de Oro SP—daytime (1,344' elev) KOP-M4 Valencia Peak Montaña de Oro SP—nighttime (1,344' elev)	--	--	Minor Moderate	Minor Moderate	Moderate Major
KOP-A Representative Recreational Fishing, Pleasure, and Tour Boat Area	Major	Major	Major	Major	Major
KOP-B Representative Commercial and Cruise Ship Shipping Lanes	Major	Major	Major	Major	Major

Table 3.4.10-24. Impact levels on the viewer experience (sensitivity level and magnitude of change) for 850-foot WTGs

Offshore Key Observation Points	850-foot WTG impact level				
	OCS-P 0561	OCS-P 0562	OCS-P 0563	OCS-P 0564	OCS-P 0565
KOP-H1 Patrick's Point—daytime (156' elev) KOP-H1 Patrick's Point—nighttime (156' elev)	Major Major	Moderate Major	--	--	--
KOP-M1 Julia Pfeiffer Burns—daytime (458' elev) KOP-M1 Julia Pfeiffer Burns—nighttime (458' elev)	--	--	Major Major	Major Major	Moderate Major
KOP-M2 Limekiln State Park—daytime (779' elev) KOP-M2 Limekiln State Park—nighttime (779' elev)	--	--	Major Major	Major Major	Major Major
KOP-M3 Piedras Blancas Lighthouse (daytime) KOP-M3 Piedras Blancas Lighthouse (nighttime)	--	--	Minor Major	Moderate Major	Major Major
KOP-M4 Valencia Peak Montaña de Oro SP—daytime (1,344-foot elevation) KOP-M4 Valencia Peak Montaña de Oro SP—nighttime (1,344-foot elevation)	--	--	Minor Moderate	Minor Moderate	Moderate Major
KOP-A Representative Recreational Fishing, Pleasure, and Tour Boat Area	Major	Major	Major	Major	Major
KOP-B Representative Commercial and Cruise Ship Shipping Lanes	Major	Major	Major	Major	Major

Vessel traffic: Average annual vessel traffic volumes from 2017 through 2022 was 638 vessels for Morro Bay WEA and 190 vessels for the Humboldt WEA (Section 3.4.7, *Navigation and Vessel Traffic*). All phases of offshore wind development O&M would increase vessel traffic, particularly along routes between ports and lease areas, resulting in moderate to major impacts. One representative project would generate up to 51 vessels at any given time during construction (27 percent increase), and up to 8 vessel trips per day during operations, based on experience from East Coast offshore wind projects (BOEM 2024). Stationary and moving construction vessels would change the daytime and nighttime seascape and open ocean character from open ocean to active waterway. Impacts from increased vessel traffic would be minor to moderate.

3.3.1.4.2 Impacts of Five Representative Projects

Five representative projects would continue to result in impacts related to accidental releases, land disturbance, lighting, presence of structures, and vessel traffic, with impact magnitude increasing with additional onshore and offshore development.

Accidental releases: Five projects would not change impact levels for accidental releases. Although there would be additional vessel activity, impacts would remain negligible to minor.

Land disturbance: Five projects would increase the number of substations and transmission lines in each WEA unless onshore infrastructure can be collocated. Construction would result in localized, temporary visual impacts near involved sites due to anticipated vegetation clearing, site grading, trenching, and construction staging. These impacts would last through construction and continue until disturbed areas are restored. Intermittent land disturbance may also be required to maintain such infrastructure. Visual impacts due to land disturbance would be minor to moderate.

Lighting (onshore): Five projects would increase impact levels for onshore lighting in proportion to increased development for each WEA. As lessees have not determined precise locations for onshore facilities, onshore lighting impacts cannot be conclusively determined. If onshore facilities are collocated, overall impacts from five projects would be less. For this PEIS, impacts are assumed to be localized and short term during construction and decommissioning, and long term during O&M.

Lighting (offshore): Five representative projects would increase lighting impact levels. The collective effect of aviation lighting of five projects (up to 400 WTGs in Humboldt and 600 in Morro Bay, plus OSSs) would result in long-term major impacts as each would add new permanent sources of nighttime lighting where none existed.

Presence of Structures: Five representative projects would also increase presence of structures impacts. Table 3.4.10-25 summarizes the magnitude of visibility for the five lease areas based on the nearest beach or shoreline view from Humboldt, Monterey, and San Luis Obispo Counties for the 1,100-foot and 850-foot WTGs, respectively. Compared to one project, the horizontal FOV would be substantially wider because, depending on viewer location, a viewer would have the potential to see portions of more than one lease area. In Humboldt County, a viewer would have the potential to see portions of two lease areas; in Monterey and San Luis Obispo Counties, a viewer would have the potential to see portions of three lease areas.[3] This would be most pronounced along Highway 1 in Monterey County, where the visible portions of the two or three representative projects with 1,100-foot WTGs would occupy 62.9° of the typical human's 124° horizontal FOV, meaning that 51 percent of the viewer's horizontal FOV would be occupied by wind turbine arrays from the representative projects.

Table 3.4.10-25. Magnitude of view summary for the five Humboldt and Morro Bay lease areas to nearest onshore viewpoint for 1,100-foot and 850-foot WTGs

Nearest Viewpoint by Region	Distance to nearest viewpoint in miles (kilometers)	Turbine Visibility		Vertical FOV (% of 55)		
		Width[1] of wind turbine array in miles (kilometers)	Horizontal FOV (% of 124)	WTG Height Above horizon[2] in feet (meters)	1,100-foot WTGs	850-foot WTGs
Humboldt Samoa Dunes Recreation Area	20.2 (32.5)	28.5 (45.9)	54.7° (44 %)	965.3 (294.2) and 715.3 (218.0)	0.52° (.9 %)	0.38° (0.7 %)
Morro Bay Piedras Blancas Light Station (ground level)	19.15 (30.8)	37.9 (61.0)	63.2° (51 %)	972.6 (296.5) and 722.6 (220.3)	0.55° (1%)	0.41° (0.7 %)

[1] Maximum extent of the visible wind turbine array.
[2] Height of rotor blade tip, based on intervening EC, clear-day, and clear-night conditions.

Table 3.4.10-26 (1,100-foot WTG option) and Table 3.4.10-27 (850-foot WTG option) consider the totality of the level of impact upon open ocean character area, seascape character area, and landscape character area from five representative projects.

Table 3.4.10-26. 1,100-foot WTG impact on open ocean character, seascape character, and landscape character from five representative projects

Open Ocean, Seascape, and Landscape	1,100-foot wind turbine impact level for five representative projects	
Humboldt WEA	Humboldt WEA (2 projects)	Morro Bay WEA (3 projects)
Ocean		
Open Ocean	Major	Major
Seascape		
Bayside Seascape Character Type	Moderate	Moderate
Oceanside Seascape Character Type	Major	Major
Nearshore Ocean	Major	Major
Landscape		
Landscape Character Type	Moderate	Major

[3] Due to the distance between the two WEAs, viewers would not be able to see all five lease areas at one time.

Table 3.4.10-27. 850-foot WTG impact on open ocean character, seascape character, and landscape character from five representative projects

Open Ocean, Seascape, and Landscape	850-foot wind turbine impact level for five representative projects	
Humboldt WEA	Humboldt WEA (2 projects)	Morro Bay WEA (3 projects)
Ocean		
Open Ocean	Major	Major
Seascape		
Bayside Seascape Character Type	Moderate	--
Oceanside Seascape Character Type	Major	Major
Nearshore Ocean	Major	Major
Landscape		
Landscape Character Type	Minor	Moderate

Table 3.4.10-28 considers the totality of the 1,100-foot and 850-foot WTGs level of impact on offshore KOPs from five representative projects (the sensitivity and magnitude of change criteria are the same as described for one representative project in Table 3.4.10-22). Appendix F, Tables F-26 through F-29 list the applicable impact level for each KOP based on specific measures of distance, occupied FOV, noticeable facility elements, visual contrasts, scale of change, and prominence, for the 1,100-foot and 850-foot WTG project options and Humboldt and Morro Bay WEAs, respectively.

Table 3.4.10-28. Impact levels on the viewer experience for WTGs from five representative projects in two WEAs

Offshore Key Observation Points	1,100-foot WTG impact level		850-foot WTG impact level	
	Humboldt WEA	Morro Bay WEA	Humboldt WEA	Morro Bay WEA
KOP-H1 Patrick's Point—daytime (156-foot elevation)	Major	--	Major	--
KOP-H1 Patrick's Point—nighttime (156-foot elevation)	Major		Major	
KOP-M1 Julia Pfeiffer Burns—daytime (458-foot elevation)	--	Major	--	Major
KOP-M1 Julia Pfeiffer Burns—nighttime (458-foot elevation)		Major		Major
KOP-M2 Limekiln State Park—daytime (779-foot elevation)	--	Major	--	Major
KOP-M2 Limekiln State Park—nighttime (779-foot elevation)		Major		Major
KOP-M3 Piedras Blancas Lighthouse—daytime	--	Major	--	Major
KOP-M3 Piedras Blancas Lighthouse—nighttime		Major		Major
KOP-M4 Valencia Peak Montaña de Oro SP—daytime (1,344-foot elevation)	--	Moderate	--	Moderate
KOP-M4 Valencia Peak Montaña de Oro SP—nighttime (1,344-foot elevation)		Major		Major

Offshore Key Observation Points	1,100-foot WTG impact level		850-foot WTG impact level	
	Humboldt WEA	Morro Bay WEA	Humboldt WEA	Morro Bay WEA
KOP-A Representative Recreational Fishing, Pleasure, and Tour Boat Area	Major	Major	Major	Major
KOP-B Representative Commercial and Cruise Ship Shipping Lanes	Major	Major	Major	Major

[1] Representative KOP.

Vessel traffic: The development of five lease areas would increase construction vessel traffic in and near the Humboldt and Morro Bay WEAs during all phases of development, focused along routes between ports and lease areas. BOEM estimates the projects would collectively generate an average of up to 102 vessels per day (VPD) for construction and 16 VPD for O&M in the Humboldt WEA and 153 VPD during construction and up to 24 VPD for O&M in the Morro Bay WEA. Impacts would be greatest if all five projects overlapped, resulting in the potential for all vessels to be operating in the lease areas or over export cable routes at any given time. Vessel traffic increase during O&M for both WEAs would be minor. Stationary and moving construction vessels would change the daytime and nighttime seascape and open ocean character from open ocean to active waterway. Increases in these vessel movements would be noticeable to onshore and offshore viewers and would have a minor to moderate, long-term effect.

3.3.1.4.3 Cumulative Impacts of Alternative B

Overall, potential cumulative impacts on visual resources under Alternative B would occur in the same manner as those described for cumulative impacts under Alternative A. However, the additive impacts of five representative projects would increase the degree and nature of impacts on open ocean, seascape, and landscape character areas and viewers.

Accidental releases: Cumulative accidental release impacts under Alternative B would be similar to or slightly greater than those under Alternative A. Offshore wind development would increase the number of vessels and facilities containing fuel, fluids, hazardous materials, trash, or debris in the region and, therefore, increase the likelihood of an accidental release and associated cleanup activities that could affect coastal visual resources. However, the majority of potential visual impacts would in most cases be negligible except for rare cases of large-scale accidental release that would represent major impacts.

Land disturbance: Cumulative land disturbance impacts under Alternative B would be similar or increased compared to those under Alternative A. Similar impacts could occur if onshore facilities are developed in already urbanized or previously disturbed areas. More substantial impacts could occur if designs could not collocate or underground infrastructure to reduce impacts on sensitive visual seascape and landscape character areas and sensitive viewers.

Lighting: Cumulative lighting impacts under Alternative B would be increased compared to those under Alternative A. All phases of offshore wind development would increase the number of lighting sources in the region and, therefore, increase the number of aboveground resources subject to potential visual impacts.

Presence of structures: Cumulative presence of structure impacts would be increased relative to Alternative A. All phases of offshore wind development would increase the number of structures in the region and therefore increase the number of historic aboveground resources subject to potential visual impacts.

Vessel traffic: The cumulative vessel traffic impacts would be increased relative to Alternative A. All phases of development of five lease areas would increase construction vessel traffic in and near the Humboldt and Morro Bay WEAs along routes between ports and lease areas. Impacts would be greatest if all five representative projects overlapped, resulting in the potential for all vessels to be operating in the lease areas or over export cable routes at any given time and in combination with other vessel dependent development in the region. Increases in vessel movements would be noticeable to onshore and offshore viewers and would have a minor to moderate, long-term effect.

3.3.1.4.4 Conclusions

Impacts of Alternative B. Impacts on high- and moderate-sensitivity seascape character units, open ocean character units, and landscape character units from one or five representative projects would be **negligible** to **major**, due to view distances; minor to moderate FOVs; strong, moderate, and weak visual contrasts; clear-day conditions; and nighttime lighting.

The open ocean character unit, seascape character units, landscape character units, and viewer experience would be affected by wind project features, applicable distances, horizontal and vertical FOV extents, view framing or intervening foregrounds, and form, line, color, and texture contrasts, scale of change, and prominence. Refer to Appendix F for documentation of these assessments. Project decommissioning impacts would be similar to construction impacts.

Due to distance, extensive FOVs, strong contrasts, large scale of change, and level of prominence, as well as heretofore undeveloped ocean views, the representative projects would have **major** impacts (BOEM 2021a) on the open ocean character unit and viewer boating and cruise ship experiences. The daytime presence of offshore WTGs and OSSs, as well as their nighttime lighting, would change perception of ocean scenes from natural and undeveloped to a developed wind energy environment characterized by WTGs and OSSs. In clear weather, the WTGs and OSSs would be an unavoidable presence in views from the coastline, with likely **minor** to **major** impacts on seascape character, landscape character, viewer experience, and **major** impacts on open ocean character.

Onshore, temporary, **moderate** to **major** impacts would occur during construction and decommissioning of the landfalls and onshore export cables. Impacts during O&M activities would involve temporary vehicular and personnel presence and would be **negligible**.

Cumulative Impacts of Alternative B. BOEM anticipates cumulative impacts on visual resources from representative projects in combination with other ongoing and planned activities would likely be **minor**

to **major** due to the extent of onshore and offshore development and extent of sensitive visual resources in each region. In the context of other reasonably foreseeable environmental trends, the incremental impacts on visual resources contributed by Alternative B would be noticeable.

3.3.1.5 Impacts of Alternative C (Proposed Action) – Adoption of mitigation Measures – Scenic and Visual Resources

Alternative C, the Proposed Action, is the adoption of mitigation measures such that the potential impacts described in Alternative B may be avoided or reduced. The analysis for this alternative is presented as the change in impacts from those discussed under Alternative B. Appendix E, *Mitigation*, identifies the mitigation measures that make up the Proposed Action and Table 3.4.10-29 provides a summary of the mitigation measures that are proposed to avoid or reduce impacts on scenic and visual resources.

Table 3.4.10-29. Summary of mitigation measures for scenic and visual resources

Measure ID	Measure Summary
MM-32	Lessees should coordinate transmission infrastructure among projects. Where practicable, transmission infrastructure should use shared intra- and interregional connections, have requirements for meshed infrastructure, apply parallel routing with existing and proposed linear infrastructure (including export cables and other existing infrastructure such as power and telecommunication cables, pipelines), and limit the combined footprint to minimize impacts and maximize potential capacity. Collocated infrastructure would reduce visual impacts on onshore receptors by reducing the number of new transmission line corridors.
MM-39	This measure requires lessees, in coordination with BOEM, to prepare and implement a Scenic and Visual Resource Monitoring Plan that monitors and compares the visual effects of the wind farm during construction and operations/maintenance (daytime and nighttime) to the findings in the COP Visual Impact Assessment and verifies the accuracy of the visual simulations (photo and video). The monitoring plan must include monitoring and documenting the meteorological influences on actual wind turbine visibility over a duration of time from selected onshore key observation points, as determined by BOEM and the lessee.

3.3.1.5.1 Impacts of One Representative Project in Each WEA

Mitigation measures could potentially reduce impacts from onshore land disturbance identified as part of Alternative B (lighting, presence of structures, and land disturbance). Accidental releases, onshore and offshore lighting, presence of structures, and vessel traffic impacts would remain the same as described for Alternative B.

Presence of structures: MM-32 would encourage collocation of infrastructure where practicable. This measure would likely reduce the visual impact of onshore facilities. However, since the context, location, and visibility of onshore infrastructure is unknown and not analyzed these measures would not alter the impact determination. MM-39 would require monitoring of visual effects to improve accountability and to verify that impacts are consistent with impacts to be disclosed in COP VIAs. While adoption of this measure would improve accountability, it would not alter the impact determination.

3.3.1.5.2 Impacts of Five Representative Projects

For five representative projects, mitigation measures would be the same as described for one representative project but would reduce impacts on onshore scenic and visual resources resulting from more lease areas and associated infrastructure across a larger geographic area and, therefore, would affect more landscape character areas and viewers. MM-39 would provide valuable monitoring data for all five representative projects across the Affected Environment, which would provide information about the real scale of impacts during O&M but would not reduce impact levels.

3.3.1.5.3 Cumulative Impacts of Alternative C

Overall, the cumulative impacts would be the same or similar to the cumulative impacts described under Alternative B. The extent to which measures listed in Table 3.4.10-5 would or are able to reduce cumulative impacts on visual resources—both at this and the COP stage—is the same as described for one representative project in Section 3.3.1.5.1, *Impacts of One Representative Project in Each WEA*.

3.3.1.5.4 Conclusions

Impacts of Alternative C. The construction, O&M, and decommissioning of one and five representative projects under Alternative C on seascape character, open ocean character, landscape character, and viewer experience would be similar to the impacts of Alternative B. Alternative C would likely have **minor** to **major** impacts on open ocean, seascape, and landscape character areas and viewer experiences. Due to view distances, FOVs, visual contrasts, clear-day conditions, and nighttime lighting, impacts of Alternative C on high- and moderate-sensitivity character units would be **minor** to **major**. The development of a lease area closer to shore or with a larger overall footprint would likely have greater impacts on visual resources than development of a smaller lease area further from shore. Likewise, the taller the WTG chosen for each lease area, the more visible that project would be to sensitive visual resources and at greater distances from the lease area. Five representative projects would likely have **minor** to **major** impacts overall on visual resources.

Cumulative Impacts of Alternative C. Cumulative impacts would likely be **minor** to **major** due to the extent of onshore and offshore development and the susceptibility, sensitivity, and magnitude of change to open ocean, seascape, and landscape character areas, and to viewers.

Chapter 4

Other Required Impact Analyses

4.1 Unavoidable Adverse Impacts of the Proposed Action

CEQ's NEPA-implementing regulations (40 CFR 1502.16(a)(1)) require that a PEIS evaluate the potential unavoidable adverse effects associated with a Proposed Action. This PEIS does not approve any activities; however, unavoidable impacts would occur if and when COPs are approved and a COP-specific NEPA analysis is completed (Table 4.1-1). Most potential unavoidable adverse impacts associated with the Proposed Action would occur during the construction phases and would be temporary. Chapter 3, *Affected Environment and Environmental Consequences,* provides additional information on the potential impacts listed below.

All impacts from planned activities are still expected to occur as described in the No Action Alternative analysis in this PEIS, regardless of whether any offshore wind construction and/or operation proceeds.

Table 4.1-1. Potential unavoidable adverse impacts of the Proposed Action

Resource Area	Potential Unavoidable Adverse Impacts of the Proposed Action
Physical Resources	
Air Quality and Greenhouse Gas Emissions	• Air quality impacts from emissions from engines associated with vessel traffic, construction activities, and equipment operation
Water Quality	• Increase in turbidity and suspended sediments due to seafloor disturbance, and inadvertent spills during construction, O&M, and decommissioning
Biological Resources	
Bats	• Displacement and avoidance behavior due to habitat loss or alteration, equipment noise, and vessel traffic • Individual mortality due to collisions with operating WTGs
Benthic Resources	• Suspension and resettling of sediments due to seafloor disturbance • Conversion of soft-bottom habitat to new hard-bottom habitat • Habitat quality impacts, including reduction in certain habitat types as a result of seafloor alterations • Disturbance, displacement, and avoidance behavior due to habitat loss or alteration, equipment activity and noise, and vessel traffic • Individual mortality due to construction activities
Birds	• Displacement and avoidance behavior due to habitat loss or alteration, equipment noise, and vessel traffic • Individual mortality due to collisions with operating WTGs
Coastal Habitat, Fauna, and Wetlands	• Habitat alteration and removal of vegetation, including trees • Temporary avoidance behavior by fauna during construction activity and noise-producing activities • Individual fauna mortality due to collisions with vehicles or equipment during clearing and grading activities, particularly species with limited mobility • Wetland and surface water alterations, including increased sedimentation and removal of vegetation

Resource Area	Potential Unavoidable Adverse Impacts of the Proposed Action
Fishes, Invertebrates, and Essential Fish Habitat	• Suspension and resettling of sediments due to seafloor disturbance • Displacement, disturbance, and avoidance behavior due to construction-related impacts, including noise, vessel traffic, increased turbidity, sediment deposition, and EMFs • Individual mortality due to construction activities • Entrainment/impingement due to HVDC converter OSSs • Habitat quality impacts, including reduction in certain habitat types as a result of seafloor disturbance • Conversion of soft-bottom habitat to new hard-bottom habitat • Changes in fish communities due to FADs
Marine Mammals	• Slight risk of injury (TTS or PTS) to individuals due to underwater noise from UXO detonation • Disturbance (behavioral effects) and acoustic masking due to underwater noise from vessel traffic, aircraft, WTG operation, and dredging during construction, O&M, and decommissioning • Presence of structures resulting in hydrodynamic effects that influence primary and secondary productivity and availability of prey and forage resources • Increased risk of individual injury and mortality due to vessel strikes • Increased risk of individual injury and mortality due to entanglement associated with fisheries survey gear • Increased risk of individual injury and mortality due to secondary entanglement associated with derelict fishing gear and debris on mooring lines and anchors
Sea Turtles	• Disturbance, displacement, and avoidance behavior due to bottom habitat disturbance • Increased risk for individual injury and mortality due to vessel strikes and UXO detonation (if needed) • Increased risk of individual injury and mortality due to entanglement associated with fisheries survey gear • Increased risk of individual injury and mortality due to secondary entanglement associated with derelict fishing gear and debris on mooring lines and anchors
Socioeconomic Conditions and Cultural Resources	
Commercial Fisheries and For-Hire Recreational Fishing	• Disruption of access or temporary restriction in harvesting activities due to construction • Permanent exclusion of harvesting activities in WEAs during operations of offshore wind facilities • Changes in vessel transit and fishing-operation patterns • Changes in risk of gear entanglement or availability of target species • Changes in the distribution of target species attracted to floating wind turbine structures
Cultural Resources	• Visual impacts on viewsheds of historic properties • Physical impacts on marine and terrestrial archaeological resources • Physical impacts on ancient submerged landforms

Resource Area	Potential Unavoidable Adverse Impacts of the Proposed Action
Demographics, Employment, and Economics	• Disruption of onshore and marine recreational businesses during onshore and offshore construction and cable installation • Potential changes to ocean economy sectors due to the long-term presence of offshore wind facilities, including commercial fishing, recreational fishing, sailing, sightseeing, and supporting businesses
Environmental Justice	• Compounded health issues of local environmental justice communities near ports as a result of air quality impacts from engine emissions associated with vessel traffic, construction activities, and equipment operation • Loss of employment or income due to disruption to commercial fishing, for-hire recreational fishing, or marine recreation businesses • Hindrances to subsistence fishing due to offshore construction and operation of offshore wind facilities
Tribal Values and Concerns	• To be determined pending further consultation with Tribes and identification of resources of value and concern, but anticipated to include physical and viewshed impacts
Land Use and Coastal Infrastructure	• Land use disturbance due to construction, as well as effects due to noise and travel delays • Potential for accidental releases during construction
Navigation and Vessel Traffic	• Congestion in port channels • Increased navigational complexity, vessel congestion, and allision and collision risk in the Humboldt and Morro Bay lease areas, along potential export cable corridors, and along vessel routes to/from ports • Potential for disruption to marine radar on smaller vessels operating within or in the vicinity of the Humboldt and Morro Bay lease areas, increasing navigational complexity • Hindrances to USCG SAR missions in the Humboldt and Morro Bay lease areas
Other Uses	• Disruption to offshore scientific research and surveys and species monitoring and assessment • Increased navigational complexity for military or national security vessels operating in the Humboldt and Morro Bay lease areas • Changes to aviation and air traffic navigational patterns
Recreation and Tourism	• Disruption of coastal recreation activities during onshore construction, such as beach access • Viewshed effects from WTGs altering enjoyment of marine and coastal recreation and tourism activities • Disruption to access or temporary restriction of in-water recreational activities from offshore construction • Temporary disruption to the marine environment and marine species important to fishing and sightseeing due to turbidity and noise • Hindrances to some types of recreational fishing and boating in the area occupied by WTGs during operation

Resource Area	Potential Unavoidable Adverse Impacts of the Proposed Action
Scenic and Visual Resources	• Alterations to the ocean, seascape, landscape character units' character, and effects on viewer experience by wind turbine arrays, vessel traffic, onshore landing sites, onshore export cable routes, onshore substations, converter stations or both, and electrical connections with the power grid

4.2 Irreversible and Irretrievable Commitment of Resources

CEQ's NEPA-implementing regulations (40 CFR 1502.16(a)(4)) require that a PEIS review potential irreversible or irretrievable commitments of resources that may result from implementation of a proposed action. CEQ considers a commitment of a resource irreversible when the primary or secondary impacts from its use limit the future options for its use. Irreversible commitment of resources typically applies to impacts on nonrenewable resources such as marine minerals or cultural resources. The irreversible commitment of resources occurs from the use or destruction of a specific resource. An irretrievable commitment refers to the use, loss, or consumption of a resource, particularly a renewable resource, for a period of time.

If chosen by BOEM, the Proposed Action would allow for the adoption of mitigation measures to reduce potential impacts of future offshore wind development in the Humboldt and Morro Bay lease areas. BOEM and/or the lessees would consider additional mitigation measures during analysis of site-specific COPs, as summarized below.

- As required under 30 CFR 585, the lessees are required to submit a COP, which typically includes measures as part of the Proposed Action that lessees commit to for reducing impacts.
- BOEM, in consultation with cooperating agencies, participating agencies, and cooperating Tribal governments, will propose mitigation measures in the development of the project-specific NEPA document. These will be published in the draft NEPA document for public review and comment.
- The completion of project-specific consultations under the MMPA, Section 7 of the ESA, the MSA, and Section 106 of the NHPA may result in additional measures or changes to the measures.

Table 4.2-1 lists the potential irreversible and irretrievable impacts by resource area. Chapter 3, *Affected Environment and Environmental Consequences*, provides additional information on the impacts summarized below.

Table 4.2-1. Irreversible and irretrievable commitment of resources by resource area for the Proposed Action

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Physical Resources			
Air Quality and Greenhouse Gas Emissions	No	No	BOEM expects air pollutant emissions to comply with permits regulating compliance with air quality standards. Emissions would be temporary during construction activities. During O&M, emissions would be limited to the lifetime of each California offshore wind project. To the extent that the California offshore projects displace fossil-fuel energy generation, overall improvement of regional air quality would be expected.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Water Quality	No	No	BOEM does not expect activities to cause loss of, or substantial impacts on, existing inland waterbodies, wetlands, or groundwater. Turbidity and other water quality impacts in marine and coastal environments would be short term.
Biological Resources			
Bats	No	No	Irreversible impacts on bats could occur if injury or mortality resulted in population-level effects on bat species; however, implementation of mitigation measures developed in consultation with USFWS would reduce or eliminate the potential for such impacts. Tree clearing for onshore components would result in habitat loss for bat species. Decommissioning of the California offshore wind projects would reverse some of the impacts of bat displacement and allow foraging habitat to recover.
Benthic Resources	No	No	Although local mortality of benthic fauna and habitat alteration is likely to occur, BOEM does not anticipate population-level impacts on benthic organisms; habitat could recover after decommissioning activities.
Birds	No	No	Irreversible impacts on birds could occur if injury or mortality resulted in population-level effects on bird species; however, implementation of mitigation measures developed in consultation with USFWS would reduce or eliminate the potential for such impacts. Decommissioning of the California offshore wind projects would reverse the impacts of bird displacement from foraging habitat.
Coastal Habitat, Fauna, and Wetlands	No	No	Although limited removal of natural habitat associated with clearing and grading for construction of onshore facilities is likely to occur, BOEM does not anticipate population-level impacts on flora or fauna; coastal habitat could recover after construction in some areas and after decommissioning activities in other areas. BOEM expects most California offshore wind projects would avoid activities that would cause loss of, or substantial impacts on, wetlands to the extent feasible.
Fishes, Invertebrates, and Essential Fish Habitat	Yes	No	Although local mortality of fish and invertebrates and habitat alteration and temporary loss of submerged aquatic vegetation could occur, BOEM does not anticipate population-level impacts on fish, invertebrates, and EFH. It is expected that most of the aquatic habitat for fish and invertebrates would recover following decommissioning activities. However, irreversible impacts on habitat areas of particular concern could be permanent.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Marine Mammals	No	Yes	With implementation of mitigation measures (e.g., vessel speed restrictions), the potential for an ESA-listed species to experience behavioral effects with severe consequences or be injured or killed would be reduced or eliminated. No irreversible high-severity behavioral effects from California offshore wind project activities are anticipated. Irretrievable impacts could occur if individuals or populations grow more slowly as a result of injury or mortality due to vessel strikes, entanglement in fisheries survey gear, secondary entanglement with derelict gear or debris caught on anchor and mooring lines, or displacement from the California offshore wind lease areas.
Sea Turtles	No	Yes	Implementation of mitigation measures would reduce or eliminate the potential for impacts on ESA-listed species, and BOEM does not expect irreversible impacts on sea turtles. Irretrievable impacts could occur if individuals or populations grow more slowly as a result of injury or mortality due to vessel strikes, entanglement in fisheries survey gear, secondary entanglement with derelict gear or debris caught on anchor and mooring lines, or displacement from the California offshore wind lease areas.
Socioeconomic Conditions and Cultural Resources			
Commercial Fisheries and For-Hire Recreational Fishing	No	Yes	Based on the anticipated duration of construction and O&M activities, BOEM does not anticipate irreversible impacts on commercial fisheries and for-hire recreational fishing. The California offshore wind projects could alter habitat during construction and O&M activities, limit access to fishing areas during construction, or reduce vessel maneuverability at sea and in port areas during O&M. However, decommissioning would reverse those impacts. Irretrievable impacts (lost revenue) could occur due to the loss of use of fishing areas at an individual level.
Cultural Resources	Yes	Yes	Although unlikely, unanticipated removal or disturbance of cultural resources onshore and offshore could result in irreversible and irretrievable impacts. Permanent setting changes could result in irreversible and irretrievable impacts on resources for which the view is integral to its significance.
Demographics, Employment, and Economics	No	Yes	Construction activities could temporarily increase contractor needs, housing needs, supply requirements, and demand for local businesses, leading to an irretrievable loss of workers for other projects. These factors could lead to increased housing and supply costs.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Environmental Justice	No	Yes	Impacts on environmental justice communities could occur due to loss of income or employment for low-income workers in marine industries. This could be reversed by decommissioning the California offshore wind projects or by other employment, but income lost during O&M would be irretrievable.
Tribal Values and Concerns	Yes	Yes	Ground and seabed disturbances during onshore and offshore construction resulting in disturbance to resources of Tribal value or concern or permanent setting changes could result in irreversible and irretrievable impacts.
Land Use and Coastal Infrastructure	Yes	Yes	Land use for construction and operation could result in irreversible impacts due to the temporary or long-term loss of use of the land. Onshore facilities may or may not be decommissioned. Depending largely on future consultations with state and municipal agencies, onshore facilities (e.g., onshore substations and converter stations and buried duct banks) would either be retired in place or reused for other purposes.
Navigation and Vessel Traffic	No	Yes	Based on the anticipated duration of construction and O&M activities, BOEM does not anticipate impacts on vessel traffic to result in irreversible impacts. Irretrievable impacts could occur due to changes in traditional vessel transit routes, which could be less efficient during the life of the California offshore wind projects.
Other Uses	No	Yes	Disruption of offshore scientific research and surveys would occur during construction, O&M, and decommissioning activities. Irretrievable impacts would occur for radar systems as a result of interference caused by the presence of WTGs, which would last until decommissioning. Irreversible and irretrievable impacts are not expected for marine mineral extraction, military use, aviation, and cables and pipelines.
Recreation and Tourism	No	No	Based on the anticipated duration of construction and O&M activities, BOEM does not anticipate irreversible impacts on recreation and tourism. The California offshore wind projects could alter recreational fishing habitat during construction and O&M activities, limit access to offshore areas for recreational fishing and boating during construction and alter viewsheds of coastal recreational resources. However, decommissioning would reverse those impacts. Irretrievable impacts (lost revenue) could occur due to the loss of use of recreational fishing areas at an individual level.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Scenic and Visual Resources	No	Yes	Until post-decommissioning, the following would occur: (1) long-term impacts on seascape units, open ocean units, and landscape units’ character alterations; and (2) effects on viewer experience by the wind farms, vessel traffic, onshore landing sites, onshore export cable routes, onshore substations or converter stations (or both), and electrical connections to the power grid.

4.3 Relationship Between the Short-Term Use of the Human Environment and the Maintenance and Enhancement of Long-Term Productivity

CEQ's NEPA-implementing regulations (40 CFR 1502.16(a)(3)) require that a PEIS address the relationship between short-term use of the environment and potential impacts of such use on the maintenance and enhancement of long-term productivity. Such impacts could occur due to a reduction in the flexibility to pursue other options in the future, or assignment of a specific area (land or marine) or resource to a certain use that would not allow other uses, particularly beneficial uses, to occur at a later date. An important consideration when analyzing such effects is whether short-term environmental effects of an action will result in detrimental effects on long-term productivity of the affected areas or resources.

BOEM anticipates the majority of potential adverse effects associated with wind energy projects in the Humboldt and Morro Bay WEAs would occur during construction; most such effects would be short term and would range in severity/intensity. These effects would cease after decommissioning.

In assessing the relationships between short-term use of the environment and the maintenance and enhancement of long-term productivity, it is important to consider the following long-term benefits of prospective wind energy projects in the Humboldt and Morro Bay WEAs.

- Development of domestic energy sources and creation of renewable energy jobs.
- Delivery of power to the California energy grid, contributing to the state's renewable energy requirements.
- Generation of new offshore wind energy resources to advance the Administration's goal of 30 GW of offshore wind energy capacity by 2030 and consistency with Executive Order 14008, Tackling the Climate Crisis at Home and Abroad.

Long-term benefits include the adoption of programmatic mitigation measures that BOEM may require as conditions of approval for activities proposed by lessees in COPs submitted for the Humboldt and Morro Bay lease areas. Such measures could, in turn, reduce impacts from construction, O&M, and decommissioning of associated wind energy projects.

Based on the anticipated potential impacts evaluated in this document that could occur during construction, O&M, and decommissioning of prospective wind energy projects in the Humboldt and Morro Bay WEAs, and with the exception of some potential impacts associated with onshore components, BOEM anticipates that such projects would not result in impacts that would significantly narrow the range of future uses of the environment. Removal or disturbance of habitat associated with onshore activities could create long-term irreversible impacts. For purposes of this analysis, BOEM assumes that the irreversible impacts presented in Table 4.2-1 would be long term. Following O&M and decommissioning phases of prospective wind energy projects, BOEM expects the majority of marine and onshore environments to return to normal long-term productivity levels.