



Refugio Beach Oil Spill

Final Damage Assessment and Restoration Plan/Environmental Assessment

Prepared by:
California Department of Fish and Wildlife
California State Lands Commission
California Department of Parks and Recreation
University of California
The Department of Interior, U.S. Fish and Wildlife Service
National Oceanic and Atmospheric Administration



Refugio Beach Oil Spill

FINAL

Damage Assessment and Restoration Plan/Environmental Assessment

June 2021

On the Cover:

Oiled Beach by U.S. Coast Guard

Oiled octopus and invertebrates by Natural Resource Damage Assessment Trustees

Dolphins by Natural Resource Damage Assessment Trustees

Pelicans by Natural Resource Damage Assessment Trustees

Harbor seal by Santa Barbara Channelkeeper

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Refugio Beach Oil Spill Natural Resource Damage Assessment Summary:

Shoreline Habitats

\$5.5 million

Injury: Approximately 1,500 acres of shoreline habitat were impacted including sandy beach and rocky intertidal habitats.

Restoration: Remove Ellwood seawall, enhance black abalone populations, and restore degraded sand dune habitats.

Subtidal and Fish Habitats

\$6.1 million

Injury: Approximately 2,200 acres of benthic subtidal habitat were impacted.

Restoration: Restore abalone populations in Marine Protected Areas, restore eelgrass beds in Refugio cove, remove Ellwood seawall, restore sand dwelling kelp offshore of Goleta Beach.

Birds

\$2.2 million

Injury: 558 birds were estimated killed, representing over 28 different species.

Restoration: Remove invasive plants from brown pelican nesting colonies on Anacapa Island, reduce seabird injuries from recreational fishing, and implement conservation actions for western snowy plovers.

Marine Mammals

\$2.3 million

Injury: 156 pinnipeds and 76 cetaceans were estimated injured or killed.

Restoration: Increase the capability to recover and rehabilitate marine mammals in distress in Santa Barbara and Ventura County, and increase the capability to respond to instances of cetacean entanglement in the Santa Barbara Channel.

Human Uses

\$3.9 million

Injury: The Trustees estimate over 140,000 lost recreational user days in Santa Barbara and Ventura Counties; six days of beach closures in Los Angeles County; and lost research, education, and outreach opportunities at the University of California, Santa Barbara Coal Oil Point Natural Reserve. Affected recreational activities included camping, sunbathing, beach combing, exercising, swimming, wildlife viewing, fishing, diving, boating and surfing.

Restoration:

Restoration funds (53%) will be administered by State Parks for use on projects benefiting camping and shore-based recreation from Gaviota State Park to El Capitan State Beach.

Restoration funds (46%) will be administered by State Trustees for use on projects benefiting coastal recreation in Ventura County, Los Angeles County, and Santa Barbara County downcoast of El Capitan State Beach.

Restoration funds (approximately 1%) will be administered by the University of California for use on projects benefiting research, education, or outreach at the Coal Oil Point Reserve.

Restoration Planning, Implementation, and Oversight

\$2 million

Public Input

Full Document: <https://go.usa.gov/xvWEg>

Administrative Record: <https://go.usa.gov/xvWEc>

Submit Questions: RefugioRestoration@fws.gov

Executive Summary

On May 19, 2015 a 24-inch diameter on-shore pipeline (Line 901) that extends approximately 10.7 miles along the Santa Barbara County coastline in California ruptured resulting in the release of approximately 2,934 barrels (123,228 gallons) of heavy crude oil (U.S. DOT 2016, hereafter referred to as “the spill”). Line 901 is a buried, insulated pipeline that transported heated crude oil from Exxon Mobil’s storage tanks in Las Flores Canyon westward to Plains’ Gaviota Pumping Station. The pipeline is owned and operated by Plains All American Pipeline, L.P., and Plains Pipeline, L.P. (jointly, Plains). The Pipeline and Hazardous Materials Safety Administration (PHMSA) determined that the cause of the Line 901 failure was external corrosion under insulation that thinned the pipe wall to a level where it ruptured suddenly and released heavy crude oil. Crude oil from the buried pipeline saturated the soil and flowed into a culvert that crosses under Highway 101 and railroad tracks, and ultimately discharged into the Pacific Ocean at Refugio State Beach.

The crude oil that entered the ocean posed a significant risk to and injured marine plants and wildlife, including seagrasses, kelp, invertebrates, fish, birds, and mammals. In addition to direct natural resource impacts, the closure of beaches and fisheries occurred just days before the Memorial Day weekend, resulting in losses for local businesses and lost opportunities for the public to visit and enjoy the shore and offshore areas. Tar balls attributable to the Line 901 release were carried by southerly ocean currents and eventually reached some beaches in Los Angeles County (California Department of Fish and Wildlife 2016).

The response (cleanup) to this significant spill brought together a number of federal, state, local agencies, and Native American tribes operating under a Unified Command. For the spill response, Incident Commanders consisted of representatives of the United States Coast Guard (USCG), California Department of Fish and Wildlife, Office of Spill Prevention and Response (CDFW-OSPR), Santa Barbara County, and Plains¹. The Refugio Beach oil spill cleanup effort completed Phase I “active cleanup and gross oil removal” on August 31, 2015, and completed Phase II “refined oil cleanup endpoints for shorelines targeting maximum net environmental benefit” on January 22, 2016 (U.S. Coast Guard, 2016). Phase III monitoring activities were largely concluded on May 26, 2016 and the Unified Command disestablished on March 10, 2017 (U.S. Coast Guard 2017).

In parallel with the response and cleanup effort, the natural resources trustee agencies (Trustees) conducted a Natural Resource Damage Assessment (NRDA) to quantify the injuries to natural resources from the spill and assess natural resource damages. In this case, the Trustees for the natural resources injured by the spill include the United States Department of Commerce represented by the National Oceanic and Atmospheric Administration (NOAA); the United States Department of the Interior represented by the United States Fish and Wildlife Service

¹ The National Contingency Plan calls for the Responsible Party to be a member of the Unified Command; ref. 40 CFR 300.135(d)

(USFWS), National Park Service (NPS) and Bureau of Land Management (BLM); the CDFW-OSPR; the California Department of Parks and Recreation (CDPR); the California State Lands Commission (CSLC); and the Regents of the University of California (the Trustees). As a designated Trustee, each of these agencies is authorized to act on behalf of the public under state and/or federal laws to assess and recover natural resource damages and to plan and implement actions to restore, rehabilitate, replace, or acquire the equivalent of the affected natural resources injured as a result of a discharge of oil.

In accordance with the Oil Pollution Act (OPA) NRDA regulations (33 U.S.C. 2706(e)), the Trustees have cooperatively gathered information and prepared this Final Damage Assessment and Restoration Plan (DARP)/Environmental Assessment (EA). This document describes the injuries resulting from the spill and the restoration projects selected to compensate the public for those injuries. This document is also an Environmental Assessment intended to satisfy the Federal Trustees' requirement to evaluate the environmental impacts of the proposed restoration projects under the National Environmental Policy Act (NEPA) and is therefore called a DARP/EA. Prior to releasing this Final DARP/EA, the Trustees released a Draft DARP/EA for public review and comment. After considering the public comments received, the Trustees prepared this Final DARP/EA. A full environmental review would be premature for some of the selected projects in this Final DARP/EA, as well as projects that were deemed "second tier" or of lower priority. The need for additional NEPA review will be determined once detailed engineering design work or operational plans are developed for selected projects. Additional review may also be required if any second tier projects are implemented.

This document describes the restoration projects selected by the Trustees to address the various resources impacted by the spill, as well as a process to identify appropriate human use projects for funding. All of the selected projects are designed to restore, replace, or acquire the equivalent of the lost resources and/or their services through restorative on-the-ground actions. Furthermore, several of the projects address multiple resources. The projects were selected based upon the biological needs of the injured species and the feasibility of restoring the resources.

Under OPA, the responsible party is liable for the cost of implementing restoration projects, as well as the costs incurred by the Trustees to undertake this damage assessment. The Trustees settled their claim for natural resource damages with Plains. A summary of the injury to each resource category, the approximate allocation of damages and selected restoration projects are shown below. Web links to data used in the injury assessment can be found in Appendix B of the DARP/EA.

SHORELINE HABITATS

\$5.5 million

Injury: Trustees estimate that approximately 1,500 acres of shoreline habitat were impacted including sandy beach and rocky intertidal habitats.

Restoration: Remove Ellwood seawall, enhance black abalone populations, and restore degraded sand dune habitats.



SUBTIDAL AND FISH HABITATS

\$6.1 million

Injury: Trustees estimate that approximately 2,200 acres of benthic subtidal and fish habitat were impacted.

Restoration: Restore abalone populations in Marine Protected Areas, restore eelgrass beds in Refugio cove, restore sand-dwelling kelp offshore of Goleta Beach, and remove Ellwood seawall.



BIRDS

\$2.2 million

Injury: Trustees estimate 558 birds were killed, representing approximately 28 different species.

Restoration: Remove invasive plants from brown pelican nesting colonies on Anacapa Island, reduce seabird injuries from recreational fishing, and implement conservation actions for western snowy plovers.

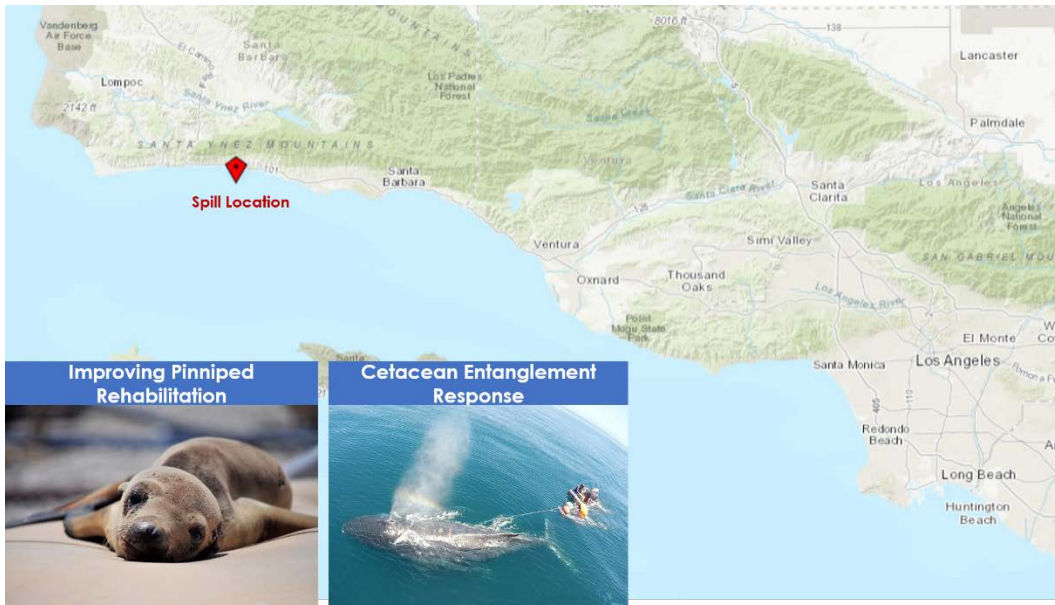


MARINE MAMMALS

\$2.3 million

Injury: Trustees estimate 156 pinnipeds and 76 cetaceans were injured or killed.

Restoration: Increase the capability to recover and rehabilitate marine mammals in distress in Santa Barbara and Ventura Counties, and increase the capability to respond to instances of cetacean entanglement in the Santa Barbara Channel.



HUMAN USE

\$3.9 million

Injury: Trustees estimate over 140,000 recreational user days were lost.

Restoration: Various projects to improve human recreation, to be administrated as follows - 53% to State Parks for projects benefitting camping or shore-based recreation including and upcoast of El Capitan State Beach; 46% for a grants program for projects downcoast of El Capitan State Beach, on non-State Parks lands benefitting coastal recreation as well as boating and off-shore recreation in Santa Barbara, Ventura, and Los Angeles Counties; and approximately 1% to Coal Oil Point Reserve for projects benefitting research, education, and outreach.



RESTORATION PLANNING, IMPLEMENTATION, AND OVERSIGHT

\$2.0 million

The Trustees have prepared this Final DARP/EA to inform the public about the natural resource damage assessment (NRDA) and restoration planning efforts that have been conducted following the spill. This document is also an Environmental Assessment (EA) intended to satisfy the Federal Trustees' requirement to evaluate the environmental impacts of the selected restoration projects, and the alternatives considered, under NEPA. As environmental review would be premature for some of the projects in the document, additional review may be required in some instances. This will be determined once recreational use projects are identified and/or when more detailed engineering design work or operational plans for the selected projects are available. To coordinate and oversee implementation of this DARP/EA, the Trustees have formed a Trustee Council comprised of representatives from each of the Trustee agencies. To submit questions or contact the Trustee Council, please use the following contact information:

Electronic Mail:

RefugioRestoration@fws.gov

U.S. Mail:

Refugio Beach Oil Spill Natural Resource Trustees
C/O Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, California 93003

Attn:

Michael Anderson, California Department of Fish and Wildlife
Jennifer Boyce, National Oceanic and Atmospheric Administration
Colleen Grant, U.S. Fish and Wildlife Service

Abbreviations

BLM	Bureau of Land Management	RP	Responsible Party
CDFW	California Department of Fish and Wildlife	SCAT	Shoreline Cleanup and Assessment Team
CESA	California Endangered Species Act	USFWS	United States Fish and Wildlife Service
CEQA	California Environmental Quality Act	UV	Ultraviolet light
CFR	Code of Federal Regulations		
CSLC	California State Lands Commission		
CSSC	California Species of Special Concern		
CWA	Clean Water Act		
CZMA	Coastal Zone Management Act		
DARP	Damage Assessment and Restoration Plan		
DOC	United States Department of Commerce		
DOI	United States Department of the Interior		
EA	Environmental Assessment		
EFH	Essential Fish Habitat		
EIR	Environmental Impact Report		
EIS	Environmental Impact Statement		
ESA	Endangered Species Act		
FLAT	Federal Lead Administrative Trustee		
FONSI	Finding of No Significant Impact		
FWCA	Fish and Wildlife Coordination Act		
GNOME	General NOAA Operation Modeling Environment		
HEA	Habitat Equivalency Analysis		
IBA	Important Bird Area		
IEc	Industrial Economics, Inc.		
LAT	Lead Administrative Trustee		
MBTA	Migratory Bird Treaty Act		
MMPA	Marine Mammal Protection Act		
NCP	National Contingency Plan		
NEPA	National Environmental Policy Act		
NMFS	National Marine Fisheries Service		
NMSA	National Marine Sanctuaries Act		
NOAA	National Oceanic and Atmospheric Administration		
NOI	Notice of Intent		
NPDES	National Pollution Discharge Elimination System		
NPFC	National Pollution Funds Center		
NPS	National Park Service		
NRDA	Natural Resource Damage Assessment		
NWR	National Wildlife Refuge		
ONMS	Office of National Marine Sanctuaries		
OPA	Oil Pollution Act of 1990		
OSPR	Office of Spill Prevention and Response		
PAHs	Polycyclic aromatic hydrocarbons		
REA	Resource Equivalency Analysis		
RFP	Request for Proposals		

Common and Scientific Names

Mammals and Other Vertebrates

Blue whale (*Balaenoptera musculus*)
California red-legged frog (*Rana draytonii*)
California sea lion (*Zalophus californianus*)
Common bottlenose dolphin (*Tursiops truncatus*)
Fin whale (*Balaenoptera physalus*)
Gray whale (*Eschrichtius robustus*)
Green turtle (*Chelonia mydas*)
Guadalupe fur seal (*Arctocephalus townsendi*)
Hawksbill turtle (*Eretmochelys imbricate*)
Humpback whale (*Megaptera novaeangliae*)
Leatherback turtle (*Dermochelys coriacea*)
Loggerhead turtle (*Dermochelys coriacea*)
Long-beaked common dolphin (*Delphinus capensis*)
Northern elephant seal (*Mirounga angustirostris*)
Northern fur seal (*Callorhinus ursinus*)
Pacific harbor seal (*Phoca vitulina*)
Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)
Short-beaked common dolphin (*Delphinus delphis*)
Southern sea otter (*Enhydra lutris nereis*)
Steller sea lion (*Eumetopias jubatus*)

Birds

American pipit (*Anthus rubescens*)
Ashy storm-petrel (*Oceanodroma homochroa*)
Belding's savannah sparrow (*Passerculus sandwichensis beldingi*)
Black-bellied plover (*Pluvialis squatarola*)
Black-crowned night heron (*Nycticorax nycticorax*)
Black phoebe (*Sayornis nigricans*)
Brandt's cormorant (*Phalacrocorax penicillatus*)
Brown pelican (*Pelecanus occidentalis*)
California gull (*Larus californicus*)
California least tern (*Sterna antillarum browni*)
Common loon (*Gavia immer*)
Ducks (Anatidae)
Forster's tern (*Sterna forsteri*)
Glaucous-winged gull (*Larus glaucescens*)
Horned grebe (*Podiceps auritus*)
Horned lark (*Eremophila alpestris*)
Light-footed Ridgeway's rail (*Rallus obsoletus levipes*)
Long-billed curlew (*Numenius americanus*)
Long-billed dowitcher (*Limnodromus scolopaceus*)
Marbled godwit (*Limosa fedoa*)
Mew gull (*Larus brachyrhynchus*)
Red-throated loon (*Gavia stellata*)
Ring-billed gull (*Larus delawarensis*)

Royal tern (*Thalasseus maximus*)
Sanderling (*Calidris alba*)
Say's phoebe (*Sayornis saya*)
Scripp's murrelet (*Synthliboramphus scrippsi*)
Short-billed dowitcher (*Limnodromus griseus*)
Surf scoter (*Melanitta perspicillata*)
Western grebe (*Aechmophorus occidentalis*)
Western gull (*Larus occidentalis*)
Western snowy plover (*Charadrius nivosus nivosus*)
Whimbrel (*Numenius phaeopus*)
White-winged scoter (*Melanitta fusca*)
Willet (*Tringa semipalmata*)
Yellow-rumped warbler (*Setophaga coronate*)

Fish

Anchovy (Engraulidae)
Barred surfperch (*Amphistichus argenteus*)
Blenny (*Blennioidei*)
Broomtail grouper (*Mycteroperca xenarcha*)
Cabezón (*Scorpaenichthys marmoratus*)
California corbina (*Menticirrhus undulatus*)
California grunion (*Leuresthes tenuis*)
California sheephead (*Semicossyphus pulcher*)
Chinook "King" salmon (*Oncorhynchus tshawytscha*)
Coho "Silver" salmon (*Oncorhynchus kisutch*)
Croaker (Sciaenidae)
Garibaldi (*Hypsypops rubicundus*)
Giant "Black" sea bass (*Stereolepis gigas*)
Giant kelpfish (*Heterostichus rostratus*)
Gopher rockfish (*Sebastes carnatus*)
Grass rockfish (*Sebastes rastrelliger*)
Guitarfish (Rhinobatidae)
Halfmoon fish (*Medialuna californiensis*)
Kelp bass (*Paralabrax clathratus*)
Kelp rockfish (*Sebastes atrovirens*)
Leopard shark (*Triakis semifasciata*)
Northern anchovy (*Engraulis mordax*)
Opaleye (*Girella nigricans*)
Pacific halibut (*Hippoglossus stenolepis*)
Painted greenling (*Oxylebius pictus*)
Plainfin midshipman (*Porichthys notatus*)
Ray (Batoidea)
Sandab (*Citharichthys* spp.)
Scorpion fish (Scorpaenidae)
Señorita (*Oxyjulis californica*)
Silverside (Atherinidae)
Skate (Rajidae)
Smooth-hound shark (*Mustelus* spp.)

Sole (Soleidae)
Starry flounder (*Platichthys stellatus*)
Steelhead trout (*Oncorhynchus mykiss*)
Surfperch (Embiotocidae)
Tidepool sculpin (*Oligocottus maculosus*)
Tidewater goby (*Eucyclogobius newberryi*)
Topsmelt (*Atherinops affinis*)
Walleye surfperch (*Hyperprosopon argentuem*)
White seabass (*Atractoscion nobilis*)
White shark (*Carcharodon carcharias*)

Invertebrates

Acorn barnacle (*Balanus* spp.)
Bat star (*Patiria miniata*)
Beach hopper (*Megalorchestia* spp.)
Bean clam (*Donax gouldii*)
Black abalone (*Haliotis cracherodii*)
Bloodworm (*Thoracophelia mucronata*)
Bryozoan (Bryozoa)
California mussel (*Mytilus californianus*)
California spiny lobster (*Panulirus interruptus*)
Chiton (Polyplacophora)
Clam (Bivalvia)
Cup coral (*Balanophyllia elegans*)
Decorator crab (Majoidea)
Feather duster worm (Sabellidae)
Gastropod (Gastropoda)
Globose dune beetle (*Coelus globosus*)
Gooseneck barnacle (*Pollicipes polymerus*)
Hermit crab (Paguroidea)
Inshore “Market” squid (*Loligo opalescens*)
Isopod (*Alloniscus perconvexus* and *Tylos punctatus*)
Kelp fly (Diptera)
Keyhole limpet (Fissurellidae)
Limpet (Gastropoda)
Lined shore crab (*Pachygrapsus crassipes*)
Mole crab (*Emerita* spp.)
Nemertean worm (Nemertea)
Nudibranch (Nudibranchia)
Ochre sea star (*Pisaster ochraceus*)
Octopus (Cephalopoda)
Olive snail (*Olivella biplicata*)
Opheliid polychaete worm (Ophelia)
Pacific purple sea urchin (*Strongylocentrotus purpuratus*)
Periwinkle snail (*Littorina littorea*)
Pismo clam (*Tivela stultorum*)
Polychaete worm (Polychaeta)
Red abalone (*Haliotis rufescens*)
Red sea urchin (*Mesocentrotus franciscanus*)
Rock crab (*Cancer productus*)

Rove beetle (Staphylinidae)
Salp (Salpidae)
Sand castle “Honeycomb” worm (*Phragmatopoma californica*)
Sand crab (*Emerita analoga*)
Sand dollar (Echinodermata)
Sea anemone (Actiniaria)
Sea cucumber (Holothuroidea)
Sea hare (Anaspidea)
Sheep crab (*Loxorhynchus grandis*)
Shrimp (Dendrobranchiata and Caridea)
Sponge (Porifera)
Talitrid amphipod (*Megalorchestia* spp.)
Top snail (Trochidae)
Tunicate (Tunicata)
Turban snail (*Tegula funebris*)
Whelk (Gastropoda)
White abalone (*Haliotis sorenseni*)
Plants and algae
Bladder chain kelp (*Stephanocystis osmundacea*)
Bladder kelp (*Sargassum muticum*)
Cape ivy (*Delairea odorata*)
Coast live oak (*Quercus agrifolia*)
Coralline algae (Corallina/Bossiella/Calliarthron spp.)
Cordgrass (*Spartina alterniflora* and *Spartina densiflora*)
Eelgrass (*Zostera pacifica*)
Feather boa kelp (*Egregia menziesii*)
Gaviota tarplant (*Deinandra increscens* ssp. *villosa*)
Giant kelp (*Macrocystis pyrifera*)
Grapestone seaweed (*Mastocarpus papillatus*)
Nailbrush seaweed (*Endocladia muricata*)
Palm tree (Arecaceae)
Red algae (*Prionitis* spp. and *Porphyra* spp.)
Rockweed (*Fucus distichus* and *Silvetia compressa*)
Sea lettuce (*Ulva lactuca*)
Surfgrass (*Phyllospadix* spp.)
Turkish-towel seaweed (*Chondracanthus* spp.)
Western sycamore (*Platanus racemose*)

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1.0 Introduction and Purpose

The purpose of this Final Damage Assessment and Restoration Plan (DARP)/Environmental Assessment (EA) is to provide information to the public about the results of the Natural Resource Damage Assessment (NRDA) that was conducted to assess injuries to natural resources that were caused by the Refugio Beach Oil Spill. This document further describes the selected restoration projects to restore habitats and natural resources affected by the spill and compensate for interim losses of natural resources and their services from the date of the incident until recovery. A list of second tier restoration projects are also identified, should any selected restoration projects become infeasible or funded by other entities. The document incorporates feedback provided through the public comment process. A full summary of public comments received on the Draft DARP/EA and the Trustees' responses to those comments can be found in Appendix O. The document also serves as an Environmental Assessment under the National Environmental Policy Act (NEPA) evaluating the potential effects to the environment from implementing the selected restoration projects.

1.1 Overview of the Incident

On May 19, 2015, a 24-inch diameter buried pipeline known as Line 901, owned and operated by Plains All American Pipeline, L.P., and Plains Pipeline, L.P. (jointly, Plains), ruptured in Santa Barbara County, California, in the vicinity of Refugio State Beach. Line 901 transported heated crude oil extracted from deep subsea formations at several offshore platforms. As a result of the rupture, an estimated 2,934 barrels (123,228 gallons) of heavy crude oil were released from the pipeline (U.S. DOT 2016). A significant portion of the oil reached the Pacific Ocean at Refugio State Beach after flowing through culverts and across several upland areas (Figure 1). The incident is referred to throughout this document as the Refugio Beach Oil Spill or the "spill."

Plains initially estimated that approximately 2,400 barrels (100,800 gallons), of crude oil were spilled and that 500 barrels (21,000 gallons) reached the ocean (U.S. DOT 2016). The total volume released from the pipeline was later revised to 2,934 barrels (123,228 gallons) (U.S. DOT 2016). Subsequently, consultants for Plains increased the estimate of oil reaching the ocean to 598 barrels (25,116 gallons). An analysis on behalf of the Trustees concluded that as much as 1,262 barrels (53,000 gallons) of oil reached the ocean (Baker 2018).

Within hours of the spill, based on recommendations from the California Office of Environmental Health Hazard Assessment (OEHHA), the California Department of Fish and Wildlife (CDFW) initiated a fishery closure in the vicinity of the spill. The following day, Governor Edmund G. Brown, Jr., declared a state of emergency for Santa Barbara County. Several beaches in Santa Barbara County were closed to the public, including Refugio and El Capitan State Beaches (described further in Section 5.5). On May 21, 2015, the fishery closure was expanded along the shore and offshore out to 6 miles, encompassing a total area of 138 square miles, based on aerial observations and National Oceanic and Atmospheric

Administration (NOAA) oil spill trajectory models of where the oil was likely to move (OEHHA 2015). The fishery closure ended on June 29, 2015 (OEHHA 2015).



Figure 1. Flow path of the Line 901 pipeline rupture into culverts under Highway 101 and railroad tracks and ultimately into the Pacific Ocean at Refugio State Beach. Credit: John Wiley (<http://flickr.com/jw4pix>)

The crude oil smothered and soaked into terrestrial areas along the pathway from the pipeline rupture to the site where the oil entered the ocean, a short distance west of Refugio Cove (Figure 1). The shorelines from the release point, within Refugio State Beach to El Capitan State Beach, received the heaviest coastal oiling. Shorelines downcoast as far as Long Beach were intermittently oiled with tarballs and subject to beach closures, with the level of oiling generally decreasing farther away from the release point. Subtidal habitats in the vicinity of the release point also experienced oil exposure.

In the days after the spill, ocean surface currents and strong afternoon winds carried oil mostly downcoast, although some oil was deposited on beaches upcoast of the release site.

Marine organisms, including plants, invertebrates, fish, birds, and mammals, were exposed to oil. In addition to direct natural resource impacts, the closure of beaches and fisheries occurred just days before the Memorial Day weekend resulting in lost opportunities for the public to visit and enjoy the shore and offshore areas after the spill. Floating oil attributed to Line 901 was identified 17 km southwest of the release site, and more than 8 miles offshore (Valentine 2017). Tarballs attributed to the Line 901 release were identified as far south as Los Angeles County, more than 100 miles from the release site, where there were additional beach closures.

1.1.1 Cleanup Operations

The spill brought together many federal, state, and local agencies for cleanup operating under a Unified Command. For the spill response, the Incident Commanders consisted of representatives

of the USCG, CDFW-OSPR, Santa Barbara County, and Plains². Throughout the response, the incident received high interest from news media, legislators, non-governmental organizations, members of the public, and other stakeholders.

The Unified Command conducted a phased approach to oil spill cleanup, in accordance with the National Oceanic and Atmospheric Administration's Shoreline Assessment Manual that provides for defined cleanup processes and goals for each cleanup phase. The cleanup effort completed Phase I "active cleanup and gross oil removal" on August 31, 2015, and completed Phase II "refined oil cleanup endpoints for shorelines targeting maximum net environmental benefit" on January 22, 2016 (U.S. Coast Guard 2016). Phase III monitoring activities were largely concluded on May 26, 2016, and the Unified Command was disestablished on March 10, 2017 (U.S. Coast Guard 2017).

The majority of the response effort was focused on minimizing environmental and cultural site damage and maximizing the recovery of discharged oil. Oil spill response operations were divided into three areas including an Inland Branch, Shoreline Branch, and On-water Branch.

The Inland Branch included the discharge site and pathway of oil to the Pacific Ocean. Inland branch response operations included oil recovery and removal, pipeline excavation, contaminated soil removal, contaminated vegetation removal, community and responder air monitoring, and oil sampling from the source of discharge.

The Shoreline Branch addressed oil in the path of discharge from the top of a cliff down to the beach and along 96 miles of affected shoreline. Response teams applied manual and mechanical recovery methods, primarily removal and disposal of oiled sand, wrack, and marine organisms. Removal of oil from rock was accomplished with scrapers or wire brushes. In some areas, dry ice was also used in conjunction with compressed air to freeze oil on rocks, allowing it to flake off more easily. In other areas, oiled cobble was placed in the surf zone to be scrubbed clean by wave action and tumbling amongst other cobble. Other operations included community and responder air monitoring, oil sampling, and wildlife recovery, rehabilitation, and release.

The On-water Branch addressed recoverable oil in offshore waters affected by the spill. On-water response operations included the use of oil containment and protection boom, skimmers, and oil recovery vessels. Local private vessels were also enlisted to assist with removal of oil from the marine environment.

² The National Contingency Plan calls for the Responsible Party, in this case Plains, to be a member of the Unified Command; ref. 40 CFR 300.135(d).

Staff responsible for conducting reconnaissance, recovery, and rehabilitation for wildlife exposed to Line 901 oil throughout the response area were organized and deployed through a Wildlife Branch that operated throughout the spill-affected area.

1.1.2 Transport and Fate of the spilled Oil

Line 901 oil coated shores predominantly downcoast for several miles from the release site within hours of the spill, primarily due to along-shore transport of the oil by currents, surge and surf action. While there are known active natural off-shore oil seeps in the spill vicinity, virtually all oil observed in the area from the release point to El Capitan in the days immediately after the spill, was from the Refugio Beach Oil Spill. Oil was also transported offshore by currents, surge action and wind drift and was observed during Unified Command overflights between May 20 and June 3 (Figure 3). Over time, oil from the spill spread farther offshore and downcoast, and in the days and weeks after the spill, light to moderate shoreline oiling, largely in the form of tarballs, occurred much farther away from the spill site. By May 28 unusually heavy tar ball stranding was reported in Ventura County near Oxnard. Soon after, unusually heavy depositions of tar balls were reported at several beaches near Redondo and Manhattan Beaches in Los Angeles County. The presence of stranded oil along some Los Angeles County beaches was heavy enough that several beach closures were declared by County officials, and a separate Unified Command was established in Los Angeles to respond to the oiling.

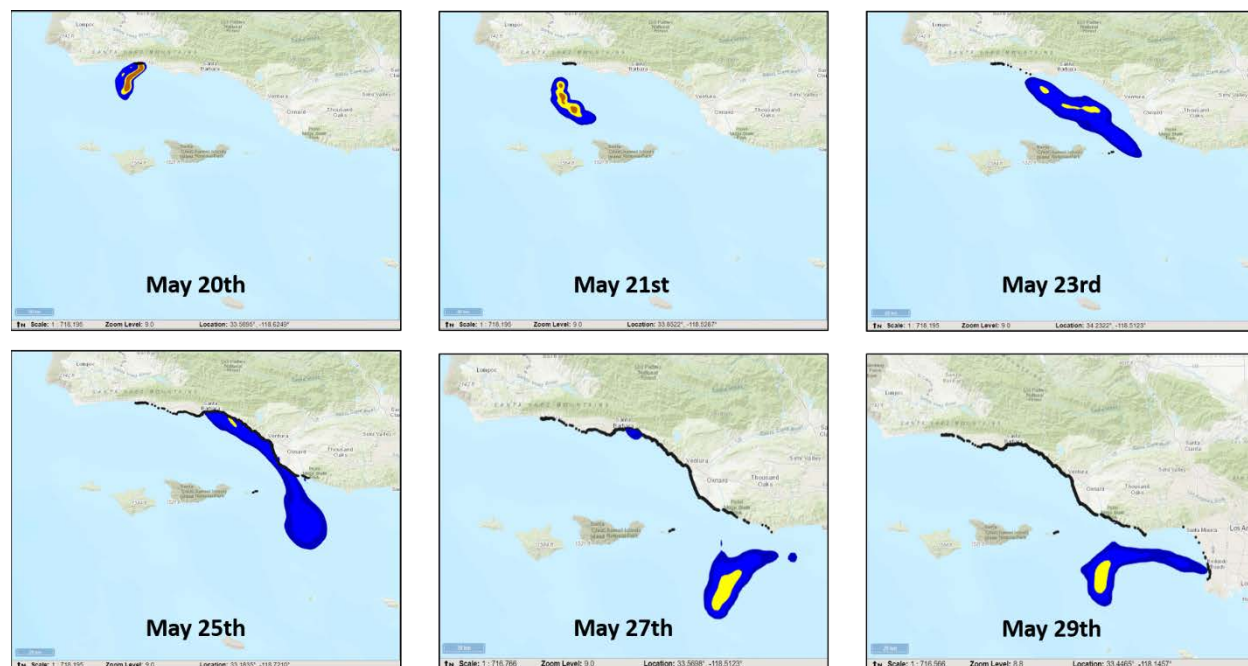


Figure 2. Results of hindcast modeling that shows the simulated oil transport trajectory based on the spill origin, winds, and currents that occurred between May 19, 2015 and May 29, 2015. The colors represent particle density, with red/orange being the highest density, yellow moderate density, and blue low density. See Appendix B for data associated with this figure.

To further understand and illustrate the transport and fate of spilled Line 901 oil, NOAA performed hindcast modeling using the General NOAA Operation Modeling Environment (GNOME). GNOME is an oil spill trajectory model in which the surface oil is divided into a

large number of small particles of equal mass that move under the influence of surface ocean currents, wind drift, and horizontal mixing from the time of the spill. GNOME also includes algorithms that simulate surface oil weathering, e.g., evaporation and dispersion. GNOME modeling snapshots (Figure 2) show Line 901 oil moving into the Santa Barbara Channel May 20, 2015 and May 21, 2015, transiting the waters of the Channel Islands National Marine Sanctuary, but no particles reached the Channel Island shores. Rather, the particles move east, making landfall on the Ventura coast about May 25, 2015 with subsequent deposition by May 29, 2015 in Los Angeles County. More information on the GNOME modeling can be found in Appendix A.

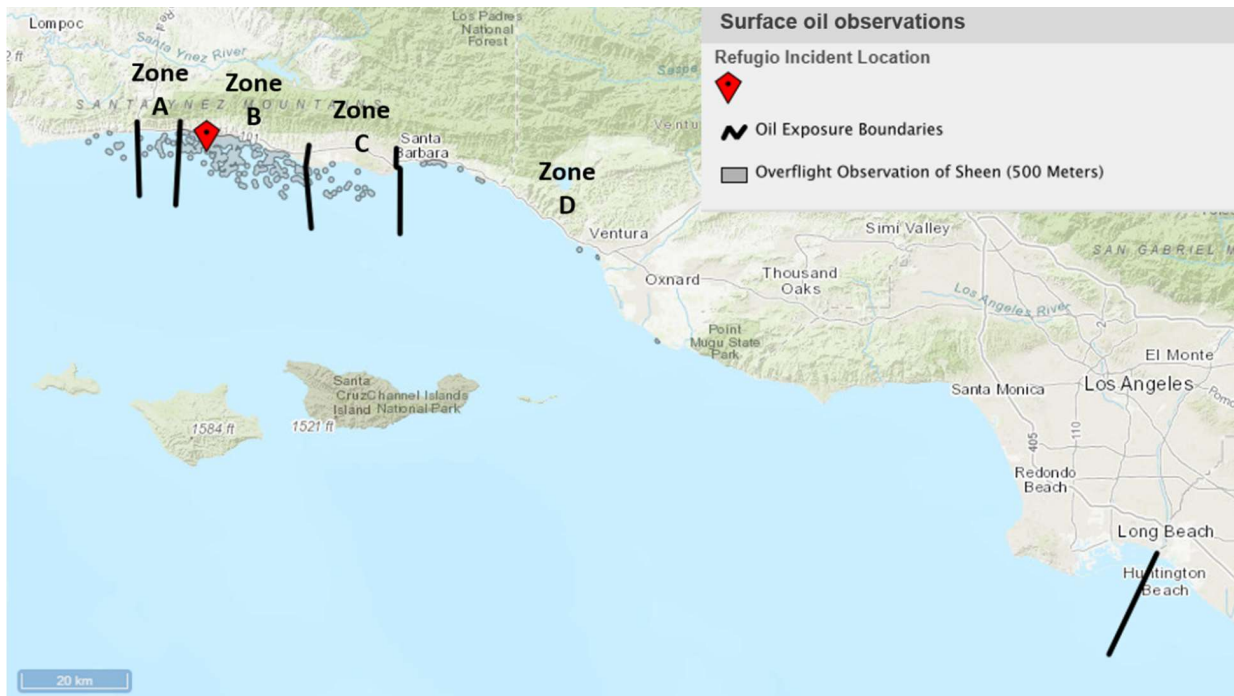


Figure 3. Map showing total U.S. Coast Guard overflight observations of surface oil over a 14 day period between May 21, 2015 and June 3, 2015. Note that the representations of sheen in this graphic are cumulative, i.e., oil was not in all of these locations at any given time. See Appendix B for data associated with this figure.

Line 901 oil was also transported downward through the water column due to mixing in the nearshore environment and the surf zone. Submerged oil was observed at several locations between May 22, 2015 and June 2, 2015 by UCSB and other entities. Of the oil observed, seven samples were collected and analyzed forensically, five of the samples matched Line 901 oil (Valentine 2019). The Unified Command undertook a submerged oil survey on May 29, 2015 through May 30, 2015 and reported no recoverable submerged oil. Oil may have been mixed with sediment through the surf action and was subsequently redistributed along the bottom and surface through sinking, tidal action, and surf transport. Based on general oceanographic conditions in the area vertical mixing of oil droplets and dissolved oils is estimated to occur to a depth of approximately 14 meters (Appendix A).

1.1.3 Forensic Identification of Line 901 Oil in the Environment

There are active, well-studied natural oil seeps in the region where the Refugio Beach Oil Spill occurred (Lorenson et al. 2009; Lorenson et al. 2011). These seafloor seeps release oil and gas that float to the ocean surface and periodically strand on regional shorelines, generally in the form of tar balls. Thus, not all of the oil evident in the region in the aftermath of the initial spill came from the Line 901 pipeline.

Spilled Line 901 oil can be distinguished from natural seep oil by using specialized chemical fingerprinting techniques³. In the days after the spill, hundreds of oil samples were collected from Santa Barbara, Ventura, Los Angeles, and Orange Counties. Selected samples were analyzed and forensically interpreted by experts working on behalf of the Natural Resource Trustees (Trustees), as well as by several other laboratories and experts engaged by the Unified Command and independently by Plains (Valentine 2015; Jeffrey 2016; Stout 2016; Stout et al. 2018). Oil samples collected from the ocean surface and from beaches were determined in some cases to be from Line 901, in other cases to be from known natural seeps, and in some cases to have characteristics of both, implying they were mixtures of natural seep and spilled oil.

After careful investigation, the Trustees concluded that oil from the Refugio Beach Oil Spill was deposited intermittently on shores from Gaviota State Park in Santa Barbara County to Los Angeles County (Figure 4). For purposes of the NRDA, the furthest southern extent of the spill was determined to be Long Beach based on beach closures.

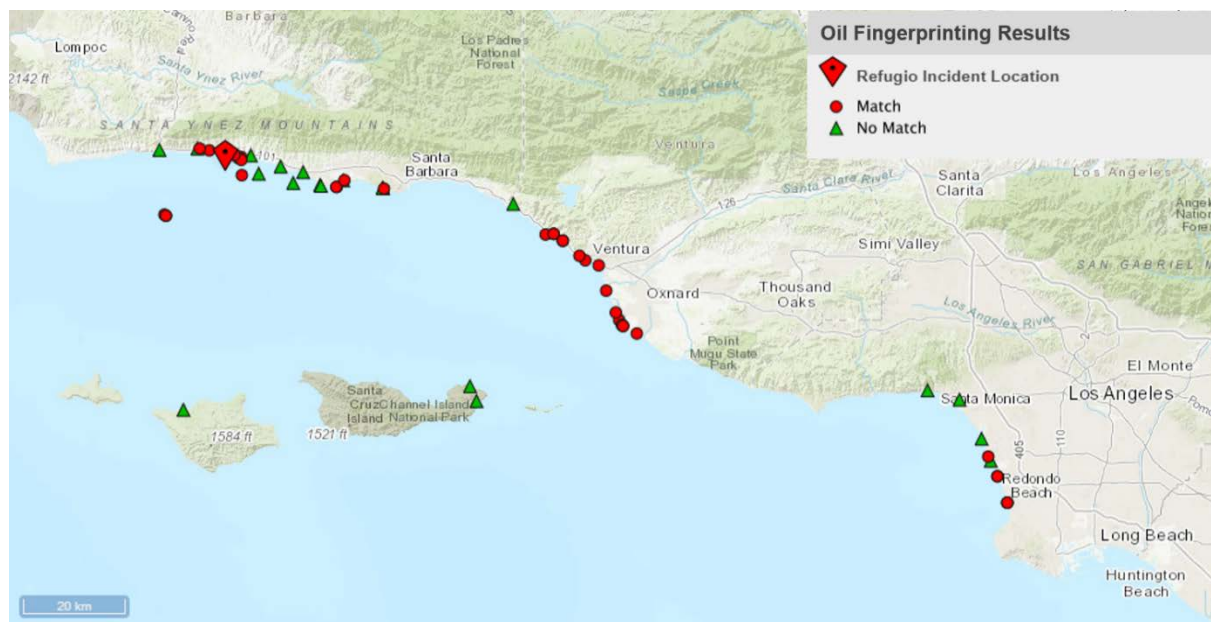


Figure 4. Geographic extent of Line 901 oil. This Figure shows oil samples collected and analyzed on behalf of the Trustees through June 2, 2015 when the Trustees’ trajectory modeling suggests that oil would have moved through the impacted area. This does not include samples collected by the response and analyzed for the criminal investigation. In *People of the State of California v Plains All American Pipeline, L.P.*, Sup. Court of State of California, County of Santa Barbara, Case No. 1495091, People’s Trial Exhibit 078.0001 oil was documented as far south as Seal Beach in Orange County. See Appendix B for data associated with this figure.

³ Plains does not agree.

1.2 NRDA Overview

There are typically four types of claims that are made against responsible parties in an oil spill such as this one:

1. reimbursement for cleanup costs;
2. natural resource damages (including the costs of assessment);
3. fines and penalties under various laws; and
4. third-party claims (e.g. from non-government parties, such as commercial fisheries and affected businesses).

This document is only concerned with the second item, natural resource damages. This Damage Assessment and Restoration Plan and Environmental Assessment (DARP/EA) has been prepared by state and federal natural resource Trustee agencies responsible for restoring natural resources⁴ and resource services⁵ injured by the release of oil from the May 19, 2015, Refugio Beach Oil Spill. This document provides details regarding:

- Environment affected by the spill (Section 2);
- Coordination and compliance among the government agencies and responsible party (Section 3);
- Injury quantification and restoration planning methods (Section 4);
- Nature and scope of injuries and the quantification of those injuries (Section 5);
- Selected restoration projects to address the injuries (Section 5); and
- NEPA alternatives analysis (Section 6).

Consistent with the Oil Pollution Act (OPA) and the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321, et seq., the purpose of restoration planning is to identify and evaluate restoration alternatives and to provide the public with an opportunity for review and comment on the proposed restoration alternatives. Restoration planning provides the link between injury and restoration. The purpose of restoration, as stated in this DARP/EA, is to make the environment and the public whole for injuries resulting from the spill by implementing restoration actions that return injured natural resources and services to baseline conditions and compensate for interim losses.

United States Department of Commerce represented by the National Oceanic and Atmospheric Administration (NOAA); the United States Department of the Interior represented by the U.S. Fish and Wildlife Service (USFWS), National Park Service (NPS), and Bureau of Land

⁴ Natural resources are defined under the Oil Pollution Act as "land, fish, wildlife, biota, air, water, groundwater, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States, any State or local government or Indian tribe, or any foreign government." 33 U.S.C. §2701(20).

⁵ Services (or natural resources services) means the functions performed by a natural resource for the benefit of another natural resource and/or the public.

Management (BLM); the CDFW-OSPR; the California Department of Parks and Recreation (CDPR); the California State Lands Commission (CSLC); and the Regents of the University of California are the Trustees who are addressing the natural resources injured by the spill. As a designated Trustee, each agency is authorized to act on behalf of the public under state and/or federal law to assess and recover natural resource damages and to plan and implement actions to restore, rehabilitate, replace, or acquire the equivalent of the affected natural resources injured by a discharge of oil. For purposes of coordination and compliance with OPA and NEPA, NOAA is designated as the lead federal Trustee.

The Trustees have prepared this DARP/EA to inform the public about the NRDA and restoration planning efforts that have been conducted following the spill. This document is also an EA intended to satisfy the Federal Trustees' requirement to evaluate the environmental impacts of the selected restoration projects under NEPA. As full environmental review would be premature for some of the selected projects in the document pending development of sufficient project-level detail. This will be determined once detailed engineering design work or operational plans are developed for those projects.

1.3 Summary of Natural Resource Injuries

The injuries from the oil spill can be divided into the following categories: shoreline habitats, subtidal and fish habitats, birds, marine mammals, and human uses. The injuries to each category are summarized here (Figure 5) and presented in greater detail in Section 5.

- **Shoreline Habitats:** The Trustees estimate approximately 1,500 acres of shoreline habitat were impacted including sandy beach and rocky intertidal habitats.
- **Subtidal and Fish Habitats:** The Trustees estimate approximately 2,200 acres of benthic subtidal habitat were impacted.
- **Birds:** The Trustees estimate 558 birds were killed, representing over 28 different species. The primary species impacted were brown pelicans, representing 57% of the total estimated mortality. Western snowy plovers were also impacted through effects to reproduction the year after the spill, following oil exposure.
- **Marine Mammals:** The Trustees estimate that 156 pinnipeds (94% California sea lions, 5% northern elephant seals and 1% Pacific harbor seals) and 76 cetaceans (95% long-beaked common dolphins and 5% common bottlenose dolphins) were injured or killed by the spill.
- **Human Uses:** The Trustees estimate over 140,000 lost recreational user days in Santa Barbara and Ventura Counties; six days of beach closures in Los Angeles County; and lost research, education, and outreach opportunities at the University of California, Santa Barbara Coal Oil Point Natural Reserve. Affected recreational activities included camping, sunbathing, beach combing, exercising, swimming, wildlife viewing, fishing, diving, boating and surfing.

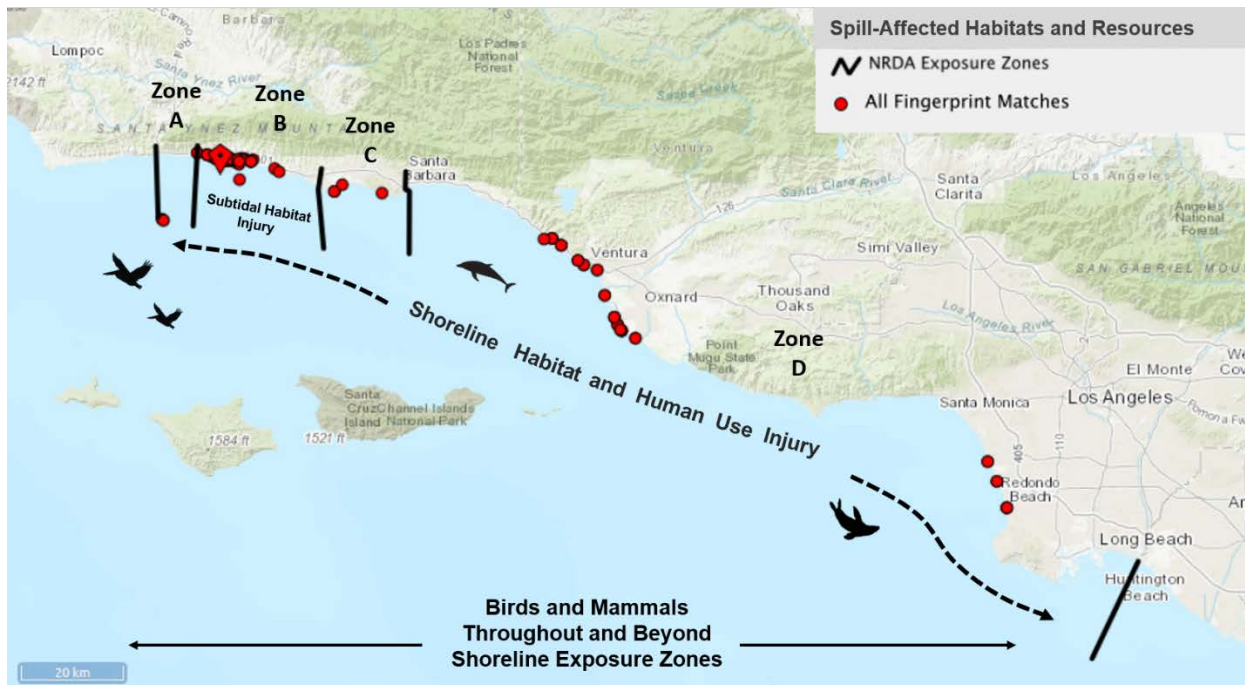


Figure 5. Refugio Beach Oil Spill fingerprint matches (red circles) along with the habitats and resources that were injured by the spill. See Appendix B for data associated with this figure.

1.4 Summary of Selected Restoration Projects

The Trustees' mandate under OPA (see 33 U.S.C. 2706(b)) is to make the environment and the public whole for injuries to natural resources and natural resource services resulting from the discharge of oil. This requirement must be achieved through the restoration, rehabilitation, replacement, or acquisition of equivalent natural resources and/or services. Thus, for a project to be considered there must be a connection, or nexus, between the natural resource injuries and the proposed restoration actions.

Compensatory restoration is any action taken to compensate for interim losses of natural resources and services pending recovery to baseline conditions. The scale, or amount, of the required compensatory restoration will depend on the extent and severity of the initial resource injury and how quickly each resource and associated service returns to baseline. Primary restoration actions that speed resource recovery will reduce the amount of required compensatory restoration.

The Trustees considered restoration concepts and alternatives with the potential to provide compensatory restoration. These were evaluated based on selection criteria developed by the Trustees, consistent with the legal guidelines provided in the OPA regulations (15 C.F.R. 990.54(a)). Section 4.2 presents OPA-based selection criteria developed by the Trustees for the spill. Based on the Trustees' evaluation, and after considering public comments on the Draft DARP/EA, a suite of preferred restoration projects were selected and are summarized below.

Additional details on all projects that met the threshold screening criteria are presented in Section 5.

The Trustees have grouped the injuries into categories, sometimes combining impacts to similar species. In this way, one restoration project, benefiting a suite of species or one primary species, may address all injuries for that category. In accordance with OPA, all of the selected projects have been “scaled” in size, such that the benefits of the restoration offset the injuries caused by the spill. Summaries of the selected restoration projects are provided below. More details on the projects are provided in Section 5.

Under OPA, the responsible party is liable for the cost of the compensatory restoration projects, as well as the costs incurred by the Trustees to undertake this damage assessment. The Trustees have settled this claim for natural resource damages with the responsible party for \$22.3 million. The following amounts are allocated to fund the projects described in this document:

- | | |
|---|---------------|
| Shoreline Habitats | \$5.5 million |
| <ul style="list-style-type: none">• Remove the Ellwood seawall that is currently constraining natural functioning condition of sandy beach and subtidal habitats;• Restore black abalone populations to enhance the overall health of rocky intertidal habitats; and• Restore degraded sand dune habitats by removing invasive/non-native vegetation, and/or precluding disturbance to sensitive areas to allow native dune vegetation to regrow. | |
| Subtidal and Fish Habitats | \$6.1 million |
| <ul style="list-style-type: none">• Restore abalone populations in Marine Protected Areas along the Gaviota coast to enhance the overall health of subtidal habitats;• Restore eelgrass beds on the Gaviota Coast to enhance overall health of subtidal habitat; and• Extend a pilot project for restoring sand-dwelling kelp offshore of Goleta Beach to determine the feasibility of this novel method for restoring kelp forests. | |
| Birds | \$2.2 million |
| <ul style="list-style-type: none">• Remove invasive plants from brown pelican nesting colonies on Anacapa Island to prevent these important breeding sites from becoming unsuitable for nesting;• Reduce seabird injuries from recreational fishing; and• Implement conservation actions for western snowy plovers at Coal Oil Point Reserve to protect and enhance breeding success. | |

Marine Mammals

\$2.3 million

- Increase the capability to recover and rehabilitate marine mammals in distress in Santa Barbara and Ventura Counties to increase survivorship of pinnipeds; and
- Expand the capacity to respond to instances of cetacean entanglement in the Santa Barbara Channel to increase survivorship of entangled cetaceans.

Human Use

\$3.9 million

- Restoration funds (53%) to be administered by State Parks for use on projects benefiting camping and shore-based recreation from Gaviota State Park to El Capitan State Beach;
- Restoration funds (46%) to be administered by State Trustees for use on projects outside of State Park property benefiting coastal recreation in Ventura County, Los Angeles County, and Santa Barbara County downcoast of El Capitan State Beach; and
- Restoration funds (approximately 1%) to be administered by the University of California for use on projects benefiting research, education, or outreach at the Coal Oil Point Reserve.

The remaining funds will be used by the Trustees for restoration planning and oversight. Any unused funds will be allocated toward one or more projects described in this document, or identified through further project scoping.

2.0 Affected Environment

This section presents a brief description of the physical, biological, and cultural environment affected by the oil spill.

The physical environment considered in the NRDA encompasses approximately 155 miles of shoreline from Gaviota to Long Beach, as well as the Santa Barbara Channel, and supports a rich diversity of coastal and marine species⁶. Many areas within the affected environment are protected by state or federal designations to preserve the biological integrity of the habitat, while other areas are available to the public for recreation. The affected environment also is home to a wide variety of culturally and historically important resources.

This section also provides information on the affected environment for the preferred restoration projects which are located within the general spill-affected area. For restoration projects that occur outside of the spill-affected area, information on the affected environment is provided along with the project descriptions in Section 5.

2.1 Physical Environment

This subsection describes the physical setting of the coastal areas affected by the Refugio Beach Oil Spill, including areas where restoration projects are proposed. The geographical extent of the physical environment described herein extends from Gaviota to Long Beach.

2.1.1 Climate

The atmospheric climate in the region is generally, consistently mild and considered Mediterranean-like. Winters are rainy and summers are dry, and predominant coastal breezes suppress wide air temperature changes. Air temperatures generally range between the mid-60s and mid-70s (16-21°C). The years 2015 and 2016 were characterized by El Niño conditions, officially beginning in March 2015. El Niño conditions in southern California typically mean increased precipitation in the winter and higher sea surface temperatures (NOAA 2016; SCCOOS 2019).

2.1.2 Land Use and Geology

The spill originated at Refugio State Beach, in an area known as the “Gaviota Coast” which is one of southern California’s largest remaining continuous stretches of undeveloped rural coastline. As described in the Gaviota Coast Plan, the Gaviota Coast includes the shoreline between Vandenberg Air Force Base to the west and Coal Oil Point to the east (Figure 6). It is world renowned as a biodiversity hotspot and one of the most ecologically diverse regions on the planet. The Gaviota Coast Plan, developed by Santa Barbara County, describes natural resources in the area. The Plan is intended to preserve the rural character of Gaviota by protecting and

⁶ Not all areas within this physical environment were impacted by the spill.

enhancing its varied and unique natural and cultural resources, agricultural productivity, and by enhancing public recreation and access consistent with the capacity of its resources. Downcoast from Gaviota, beginning with the cities of Goleta and Santa Barbara and extending into Ventura County, the majority of the land use is residential, light commercial, and agricultural, with areas of undeveloped open space. The spill-affected area extends into Los Angeles County, from Santa Monica to Long Beach, which is heavily populated, developed, and industrialized.

The coastal terrestrial landscapes are equally significant, diverse, and rare, representing a high degree of endemism. They include such diverse vegetation alliances as active coastal fore dunes, coastal terrace prairie, and northern coastal salt marsh. The shoreline and offshore physical environment are typically sandy beaches and submerged sandy seabed, but also include boulder cobble fields and rock bench platforms in the intertidal and subtidal rocky reefs in the nearshore area. The Gaviota Coast also includes tidally influenced lagoons, harbors, and jetties. Because of the range of habitats, the marine biodiversity in the region is high.

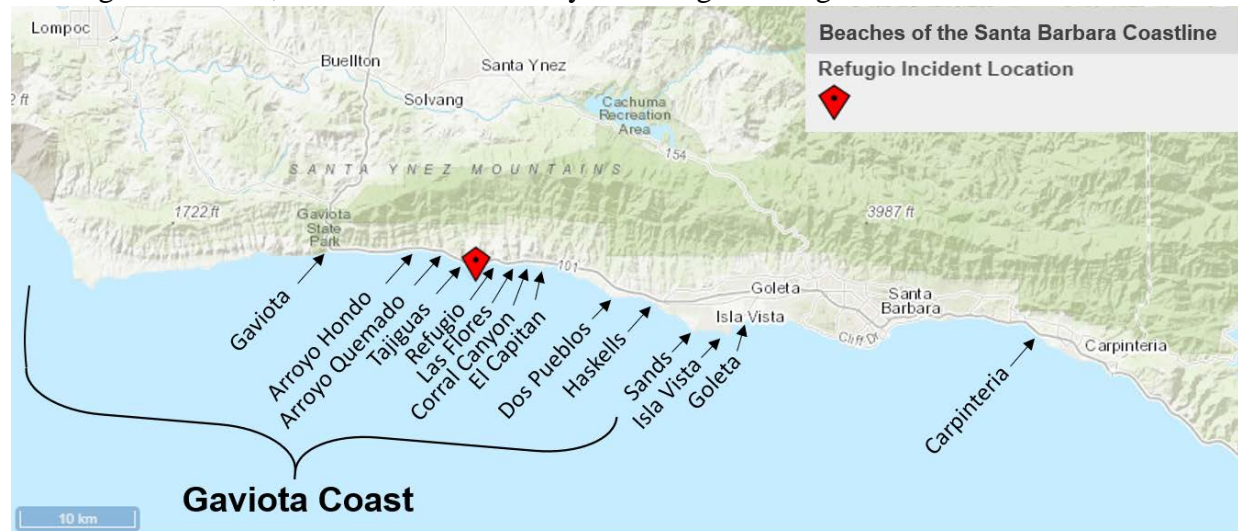


Figure 6. The location of the spill origin and various Trustee post-spill study sites along the Santa Barbara Coastline.

2.1.3 Ocean Waters

The waters offshore of the mainland comprise the Santa Barbara Channel with surface seawater temperatures typically ranging from about 54°F (12°C) in spring to about 66°F (19°C) in fall. The Channel is oriented east-west, extending from Point Conception to Ventura and bounded on the north side by the mainland coast and on the south side by the northern Channel Islands (San Miguel, Santa Rosa, Santa Cruz, Santa Barbara, and Anacapa). The Santa Barbara Channel is where the California Current of cold water flowing south meets and mixes with the warmer water of the Davidson Current flowing north. The convergence and mixing in the marine region tends to occur as a counterclockwise gyre or eddy in the Channel (Nishimoto and Washburn 2002). As a result, the Santa Barbara Channel is a transition zone where the composition of many groups of marine species (fishes, invertebrates, and algae) shifts from species typically associated with the cooler waters north of Point Conception to species typically associated with the warmer waters south of Point Conception. The Channel area can thus be recognized as a dividing line between two bioregions that represent geographically distinct

ecological systems, the Oregonian Province from Point Conception northward and the San Diegan Province from Point Conception southward (Stephens, et.al. 2016). The fact that the affected area overlaps with the transition region in the Santa Barbara Channel underscores the importance of this section of the California coastline being unique for its diversity and sensitivity to environmental changes.

Unusual ocean weather and climate patterns were observed throughout 2014 and 2015 across the North Pacific basin. An area of the North Pacific from Alaska into California was as much as 5°C (9° F) warmer than average. This atmospheric anomaly nicknamed “the blob,” due to its amoeba-like form, impacted oceanic productivity and food availability for marine life in some areas. In addition, El Niño conditions, which strengthened in early March 2015, are also associated with warmer sea surface temperatures.

2.1.4 Petroleum Seeps

Natural oil seeps are common in the area (Hornafius et al. 1999; Lorenson et al. 2009). For example, the seep field just offshore from Coal Oil Point in Goleta extends over approximately one square mile. These seeps slowly release weathered oil from fractures in the ocean floor. Because of the slow nature of seep oil traveling through the ocean floor substrate before making its way into the water column, some of the volatile, more toxic, components of seep oil dissipate before the oil reaches the ocean surface. At the surface, the oil continues to weather, forming tarballs generally less than one centimeter (0.4 inches) in diameter that may be moved by winds and currents to strand on the shoreline (Del Sontro 2007). The weathered nature and pattern of slow release of seep oil poses a lower exposure risk to marine life and has a lower acute toxicity than fresh oil that contains more toxic fractions. In contrast, during an oil spill, the amount of more toxic fresh oil released from a point source in a short time can overwhelm an ecosystem (National Research Council 2003).

In 1969, an oil spill occurred five miles off the coast of Summerland from a blow-out at Union Oil Platform A. Over 3,000,000 gallons (11 million liters) of crude oil was released that mainly affected the area from Gaviota to Carpinteria. Some oil from the spill was detected as far north as Pismo Beach, located approximately 75 miles (121 km) north from the spill point (straight line distance), and as far south as Mexico located approximately 200 miles (322 km) south from the spill point (straight line distance). At that time, this was the largest oil spill in U.S. history, and is credited as having catalyzed the U.S. environmental movement.

2.2 Marine and Coastal Managed and Protected Areas

Several Marine Protected Areas (MPAs) occur near or within the general area affected by the spill from Point Conception to Ventura. MPAs are protected areas of ocean where human activity, such as fishing, is restricted for conservation purposes. MPAs come in a variety of forms that include National Marine Sanctuaries and State Marine Protected Areas. MPAs are a versatile management tool for helping to maintain biological diversity and productivity, rebuild fishery stocks, support sustainable fisheries, and conserve and protect historical and cultural artifacts. In addition, the Channel Islands National Park and portions of the California Coastal National Monument provide protected habitat for resources in the area. Finally, public beaches, including high use beaches were affected by the spill (Figure 7).

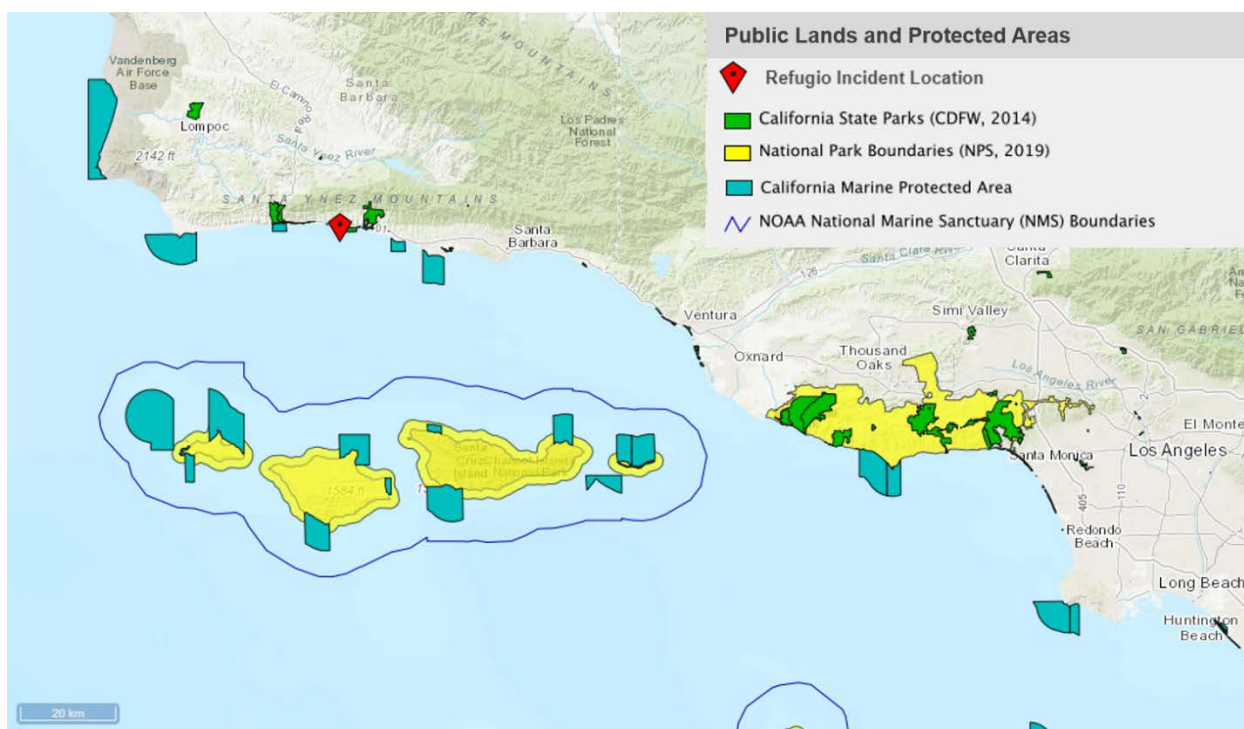


Figure 7. Public lands and protected areas in the vicinity of the Refugio Beach Oil Spill origin. Additional public lands managed by Counties and Cities occur in the area but are not shown on this map. See Appendix B for data associated with this figure.

2.2.1 County and City Beaches

Several County and City beaches were affected by the spill within Santa Barbara, Ventura, and Los Angeles Counties. For example, Goleta Beach Park is a day use facility managed by the Santa Barbara County Parks. It is located on a section of sand beach east of the University of California, Santa Barbara (UCSB). Amenities include a fishing pier, picnic tables, BBQs, trails, grass park, play areas, restaurant, and launch/hoist for small boats at the end of the pier. Isla Vista Beach at Isla Vista is used extensively by UCSB students and the community. Haskell's Beach (previously known as Tecolote Canyon Beach) is a high public use beach and surfing area in the City of Goleta. City and County beaches within Ventura and Los Angeles Counties are

frequently used as recreation access points for surfing, fishing, diving, boating, and general beach use.

2.2.2 University of California Santa Barbara Natural Reserve System

The Coal Oil Point Reserve is part of the University of California Natural Reserve System. The reserve protects coastal dune, estuarine, tidal lagoon, sandy beach, and rocky reef habitats to support research, education, outreach, and stewardship.

2.2.3 State Beaches

Within the spill-affected area, Gaviota State Park, Refugio, El Capitan, Carpinteria, Emma Wood and McGrath State Beaches are areas of high public use with amenities for overnight camping and shore access. The State Beaches along the Gaviota coast provide the public with unique camping and recreational opportunities that are highly sought after and are booked well in advance. Additionally, San Buenaventura and Mandalay State Beaches provide coastal day use access. The pier at Gaviota State Beach was closed in 2014 due to storm damage, so public use was precluded prior to the spill.

2.2.4 State Marine Protected Areas

In 1999, the State legislature enacted the Marine Life Protection Act. This directed the CDFW to restructure the state's MPA system to increase the ability to protect marine life, habitats, and ecosystems. In 2012, MPAs were designated along the Santa Barbara County coast south of Point Conception.

Seven state marine conservation areas occur in the spill-affected area with varying levels of resource protection ranging from no-take to limited take involving fishes, invertebrates, kelp, and restoration, maintenance, and operation of artificial structures; these are Kashtayit, Naples, Campus Point, Goleta Slough, Point Dume, and Point Vincente State Marine Conservation Areas (Figure 7). The Goleta Slough Ecological Reserve overlaps with a portion of the Goleta Slough State Marine Conservation Area where no human activities are allowed, except access on an established trail/bike path. Public access is limited because the airport is next to the Reserve. To the west of the spill-affected area is the Point Conception State Marine Reserve of no-take.

2.2.5 National Marine Sanctuary System

NOAA's Office of National Marine Sanctuaries serves as the trustee for a network of underwater parks encompassing more than 600,000 square miles of marine and Great Lakes waters. The network includes a system of 13 national marine sanctuaries and two marine national monuments. The program's function through the creation of National Marine Sanctuaries is to protect marine environments with special ecological, historical, cultural, archeological, scientific, educational, recreational, and aesthetic qualities.

There was no oil observed or collected matching Line 901 oil within the waters of the Channel Island National Marine Sanctuary (CINMS). However according to the GNOME trajectory, it is

possible that scattered tarballs did travel through CINMS waters at some point in time. The CINMS, designated in 1980, warrants inclusion in this report for its importance with regards to environmental protection and public interest proximate to the spill. The CINMS (Figure 7) encompasses the waters surrounding five Channel Islands (San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara) below the mean high tide level and out 6.9 miles (6 nautical miles, 11 km). Associated with the Channel Islands are 20 other MPAs. Within five Federal, and 11 State Marine Reserves, it is unlawful to injure, damage, take, or possess any living geological, or cultural marine resource. In another five State Marine Conservation Areas, limited take is allowed, and within two State Special Closure Areas boating activities are restricted in waters adjacent to sea bird rookeries and/or marine mammal haulout sites.

2.2.6 National Park System

The Channel Islands National Park consists of San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara Islands (Figure 7) and the waters extending out one nautical mile around each island. Congress established the Channel Islands as a National Park in 1980 in order to protect their natural, scenic, wildlife, marine, ecological, archeological, cultural, and scientific values. The Islands are home to over 2,000 plant and animal species, of which 145 are found nowhere else in the world, and much of the terrestrial environment is managed as proposed or potential Wilderness Area. Important to this incident, West Anacapa and Santa Barbara Islands provide the only breeding colonies for the California Brown Pelican in the western United States. Tourism is allowed, and hiking, camping, and kayaking occur at varying levels on and around each island.

2.2.7 California Coastal National Monument

The California Coastal National Monument, managed by the Bureau of Land Management, consists of the rocky areas above the mean high tide level, including over 20,000 offshore rocks, islands, reefs, and pinnacles within 13.8 miles (12 nautical miles, 22 km) of the mainland shore. Sixty-two of these rocky features occur along the shore from the Gaviota Pier east to Campus Point at U.C. Santa Barbara. The monument provides untrammelled nesting habitat for breeding seabirds and protected haulout habitat for seals and sea lions.

2.3 Biological Resources

The affected area has one of the most diverse and abundant assemblages of marine organisms in the world. A rich array of habitats including the open ocean, rugged rocky shores, sandy beaches, lush kelp forests, and wetlands, support large numbers of seals and sea lions, whales, fish, otters, and seabirds. For many migratory species such as whales, seals, salmonids, and brown pelicans, the affected area is also an important link to other habitats. This section includes a broad description of all biological resources in areas that were affected by the spill, as well as resources that weren't affected by the spill but may be included in restoration projects. A description of resources that were injured is presented in Section 5.

2.3.1 Marine Mammals

The mainland coast of southern California that includes Santa Barbara County and the Channel Islands provides important breeding, pupping and resting areas for most of the pinniped species in the region. These include two species of sea lions (California sea lion and Stellar sea lion), four species of seals (northern elephant seal, Pacific harbor seal, northern fur seal, and the endangered Guadalupe fur seal). The threatened southern sea otter also occurs along the mainland coast of Santa Barbara County, primarily west of Gaviota.

California sea lions are the most abundant pinniped. Nearly all breeding and pupping occurs in the California Channel Islands area. Sea lions also haul out on offshore rocks and beaches on the mainland and Channel Islands.

Northern elephant seals breed in the winter months, molt in spring, and forage in offshore waters throughout the eastern North Pacific during summer and fall. Peak haul out abundances occur during spring when juveniles and females come ashore to molt.

Pacific harbor seals are year-round residents in the area. They haul out on several mainland beaches within the spill-affected area and on the Channel Islands. Mainland haulouts include near El Capitan State Beach, Naples, Haskell's, and a major rookery at Carpinteria, peaking in February-June when breeding, pupping and molting is occurring. Harbor seals typically forage relatively close to where they haul out.

More than 20 species of whales, dolphins, and porpoises occur regularly in the waters off Santa Barbara and Ventura Counties and the Channel Islands, but the following are the most common: gray, blue and humpback whales, long- and short-beaked common dolphins, common bottlenose dolphins, and Pacific white-sided dolphins. The whales are migratory and are most often sighted during spring and summer. Dolphins are considered year-round residents. The region is also the migratory pathway of gray whales (adult females and calves), which migrate within 1 km of shore as they travel north to their summer foraging grounds. Other large baleen whales also forage in the area. The coastal ecotype of common bottlenose dolphin, a distinct population, live within 1 km of shore, and both species of common dolphin can be regularly sighted from shore.

2.3.2 Seabirds

The spill-affected area is also within the Pacific Flyway, which is a major north-south flyway for migratory birds in America, extending from Alaska to Patagonia, South America. The spill-affected area includes several areas identified by the Audubon Society as Important Bird Areas (IBAs): Point Conception, Santa Barbara Basin, Point Mugu, Santa Cruz Basin, Northern Channel Islands, and Palos Verdes. The Goleta Coast IBA is also within the spill-affected area, and includes Coal Oil Point and Goleta Slough and the beaches between.

Seabirds characteristic of open water areas within the spill-affected area include surf and white-winged scoters; horned and western grebes; red-throated and common loons; brown pelicans;

Brandt's, double-crested, and pelagic cormorants; and many species of gulls and terns. Pelagic seabirds that were present in the area during the summer when the spill occurred include black-footed albatrosses, shearwaters, storm-petrels, phalaropes, jaegers, and several alcids including Scripp's murrelets.

Seabirds characteristic of rocky shores within the spill-affected area include black oystercatchers, Brandt's and pelagic cormorants, and pigeon guillemots. Rocky platforms exposed during low tide tend to be occupied by black and ruddy turnstones, great and snowy egrets, brown pelicans, black-crowned night-herons, shorebirds, and gulls. Western snowy plovers, California least terns, and horned larks all nest on sandy beaches and dune areas within the spill area; the same areas are also utilized by shorebirds that include black-bellied plovers, whimbrels, long-billed curlews, marbled godwits, sanderlings and willets, gulls (mew, ring-billed, western, California, glaucous-winged), and Forster's and royal terns. Beach wrack in the upper zones of sandy beaches are used by short-billed and long-billed dowitchers, black and Say's phoebes, American pipits, and yellow-rumped warblers.

2.3.3 Subtidal and Fish Habitats

Fish composition and abundance are both strongly associated with habitat type and structure, and each type of habitat generally supports its own characteristic assemblage of fishes. The Santa Barbara County nearshore coastal fish habitats described and defined here are the habitats inshore of the -66 ft (-20 m) depth contour relative to the mean lower low water (MLLW) tide level. This nearshore zone includes kelp forests, rocky reefs, sandy bottom, seagrass beds, and the pelagic water column.

Submerged rocky reefs support forests of giant kelp. Anchored by holdfasts to the rocky seafloor, the buoyant stipes and fronds rise through the water column and spread out on the sea surface. Kelp forests thus provide benthic (seafloor), mid-water, and surface habitats that are utilized by many fish species, many of which are residential in kelp forests (Schiel and Foster 2015). Fishes, such as kelp rockfish, surfperch, sheephead, opaleye, halfmoon, señorita, white seabass, and kelp bass tend to occur in the mid-water and swim about freely in the kelp forest. Kelp forests also provide habitat for certain sharks, such as leopard and smoothhound sharks.

In addition to kelp, submerged rocky reefs also support macroalgae and surfgrass species, often occurring as understory to giant kelp. Fish, such as gopher rockfish, grass rockfish, giant kelpfish, scorpion fish, cabezon, and painted greenlings are bottom-dwellers (demersal fishes) and are often associated with the foliose algal understory. Adult spiny lobsters inhabit cracks and crevices of the rocky reef, while juvenile spiny lobsters use surfgrass habitat in the shallow subtidal for refuge and feeding.

Along sand flats and in sand channels bisecting rocky reefs, rays, skates, and flat fishes (halibut, sandabs, flounders, soles) are more common. Seagrasses (eelgrass and surfgrass) occur as meadows of long grass-green leaves (blades) that provide refuge and foraging areas for many of

the same species of fish that occur in kelp forests and on sand flats. Eelgrass beds also provide spawning habitat for fish.

The pelagic water column habitat contains numerous species of plankton, or life forms that cannot swim against the current but rather move primarily by drifting. Many of these plankton are important food sources for fishes and other marine creatures, providing a foundation for the complex food webs that make up the marine environment in the marine region. The larvae and eggs of many fish and invertebrate species are also considered plankton, though their adult stages are sessile or free-swimming organisms. These marine larvae develop and grow while subject to the movement of ocean currents that can transport them many miles from their natal (spawning) habitat. Eventually, these planktonic larvae mature into their non-planktonic life stage and settle out in their adult habitats, which can include kelp forests, rocky reefs, seagrass beds, sand flats, and deep offshore water. The nearshore pelagic water column habitat is also the main habitat for many species of schooling fishes, such as anchovies, sardines, and topsmelt, and also includes mobile invertebrates (e.g., market squid). In turn, these forms are the basis food source for larger forms (e.g., predatory fishes, sharks, seabirds, and marine mammals).

The rocky intertidal zone, the shore between the high and low tidal levels, is also habitat for fishes. The fishes in this zone are characterized by a smaller group of species specially adapted for life in tidepools and in the spaces beneath and between cobbles and boulders. The most representative intertidal fish species are tidepool sculpins, juvenile opaleye, and blennies.

Sandy beaches are extensive along the Santa Barbara, Ventura, and Los Angeles County coasts, and many beaches in south Santa Barbara County are important spawning habitat for California grunion. A variety of other fish species, such as barred surfperch, walleye surfperch, and corbina, forage on the burrowing intertidal invertebrates in surf and swash zones.

Several fishes that occur in the area have special protections. The Southern California Coast Distinct Population Segment (DPS) of steelhead trout is a federally endangered species. Steelhead are rainbow trout that spend the majority of their life in the ocean and return to freshwater streams to spawn (anadromous species). However, unlike the closely related salmon that are also anadromous, adult steelhead return to spawn in freshwater several times, not just once. In addition to steelhead trout, coho (silver) salmon and Chinook (king) salmon can also occur in the marine region. The coho salmon is both a state and federally listed endangered species, and the Chinook (king) salmon is a federally threatened species in California coastal waters.

Giant (black) sea bass is a marine species prohibited from commercial and recreational fishery take, and the International Union for Conservation of Nature classifies giant (black) sea bass as a critically endangered species. However, one giant (black) sea bass may be taken incidentally per trip in gill or trammel nets in the commercial fisheries, which is not uncommon. Take of great white sharks is also prohibited, with exceptions for possible incidental and accidental take in

commercial fisheries. Broomtail grouper is another fully protected marine fish species with a large range (San Francisco-Peru, South America) that can occur along the Santa Barbara, Ventura, and Los Angeles County coasts. One of the more visible fishes is the garibaldi, a very recognizable, bright orange damselfish. California State Legislature designated the garibaldi as the state marine fish and prohibited from take in California coastal waters.

2.3.4 Shoreline Habitats

The richness and diversity of intertidal invertebrates in any given area is closely related to the composition, rugosity, and stability of the substrate, tidal level, depth, and exposure to waves. Much of the rocky intertidal habitat in the affected environment consists of low-lying shale or sandstone occurring as ridges parallel to shore with lower elevation portions heavily exposed to periodic sand burial and sand scour. Some intertidal areas near creek mouths can be characterized as being largely boulder fields. Mussel beds are limited to the areas of larger and harder rock substrate in areas above sand burial depths. Common intertidal invertebrates can also include sand castle (honeycomb) worms, acorn and gooseneck barnacles, sea anemones, purple sea urchins, bryozoans, tunicates, and sponges. Common mobile invertebrate species in the intertidal zone include ochre sea stars, bat stars, hermit crabs, turban snails, limpets, whelks, nudibranchs, chitons, lined shore crabs, polychaete and nemertean worms, and more. The high intertidal splash zone is inhabited by periwinkle snails and limpets. Many more invertebrates occur in the mid- and low-intertidal zone, and also in the subtidal zone. These include octopus, top snails, abalone, red sea urchins, clams, California spiny lobsters, shrimp, rock crabs, decorator crabs, cup corals, feather duster worms, and more.

Sandy beaches are the most common intertidal habitat in the spill-affected area, and support a diversity of invertebrates tolerant of the constantly shifting sands from wave action and strong directional longshore transport of sand. Bivalve mollusks, polychaete worms (including bloodworms), beach endemic insects, and crustaceans that include sand or mole crabs, and beach hoppers (i.e., talitrid amphipods) are the predominant invertebrates on sandy beaches. The accumulation of drift algae (wrack) that is stranded on sandy beaches provides food and habitat for many species of beach hoppers, terrestrial isopods, and insects. Insects include the kelp fly, flightless beetles such as the globose dune beetle (candidate for federal listing), and predatory rove beetles. The sand bottom of the surf zone and immediately beyond support sand dollars, clams, and gastropods such as the purple olive snail.

2.3.5 Algae and Seagrasses

Macroalgae such as kelp and marine grasses (discussed above in the Subtidal and Fish Habitats section) such as surfgrass and eelgrass are examples of foundational species for the nearshore environment along the Gaviota Coast. A foundational species is one where the organism itself creates ecological communities by providing habitat structure and primary productivity.

Intertidal algae tend to occur as bands parallel to shore and their distribution depends on exposure to waves, tidal height, and rock structure. The upper vertical range of an algal species

in the rocky intertidal is largely determined by its ability to withstand desiccation. Accordingly, the high intertidal zone that is only occasionally wetted by wave splash is sparsely populated with algae. The barren appearance of the splash zone disappears lower in the intertidal zone, below the +3 ft (1 m) Mean Low-Low Water (MLLW) tide level and lower, with algal cover being more prevalent and persistent. Algal forms can be blade/sheet-like, branch-like, turf, filamentous, and crustose. Some of the more conspicuous intertidal species include the turf-like nailbrush seaweed and the blade-like grapestone seaweed, which are perennial species. A species group characteristic of most mid-intertidal zones in California but conspicuously absent or in low abundances along the Santa Barbara, Ventura, and Los Angeles County coast are brown rockweed species of the order Fucales. In the low-intertidal, Turkish-towel seaweed can be abundant with articulated coralline algae. The lowest zones will include brown feather boa kelp, bladder kelp, and branched red alga.

Unlike algal species, seagrasses are true plants. They have vascular tissue to transport internal metabolites and nutrients, and they reproduce via flowers and seeds instead of spores, as is the case with algae. The plants are attached to the substrate by rhizomes, and the remaining structure consists of long narrow emerald green leaves (blades) up to 1.5 m long. Seagrasses are important primary producers, and they provide important habitat functions, including shelter and nursery grounds for invertebrates and fishes. Seagrasses also stabilize sand from shifting about. Surfgrass occurs on boulders and rocky reefs from the low-intertidal to as deep as approximately -23 ft (-7 m) MLLW with abundance declining with depth (Williams 1995). Along the south coast, eelgrass grows in soft sediments between depths of approximately -20 ft (-6 m) and -40 ft (-12 m) (J. Altstatt, personal communication, April 9, 2018). Seagrass habitat is classified as Essential Fish Habitat by NOAA, National Marine Fisheries Service (NMFS).

Subtidal algal composition is largely dependent on the stability of the substrate and available light based on water clarity and depth. Giant kelp are the predominant kelp along the coast, occurring as dense forests growing on rocky reefs from the low-intertidal to depths of approximately -18 m MLLW. Bladder chain kelp and feather boa kelp are common in shallower water along the inshore fringes of giant kelp forests. The algal understory is generally characterized by mostly red algal species of various sizes, morphology, distribution, and abundance.

The wrack created from the seasonal loss of these plants (e.g., beach-stranded drift algae and surf grass) through storms also fuels the productivity of local sand beach and nearshore sand bottom habitats. Loss of or damage to these plants, particularly in the spring and summer, have cascading consequences for multiple associated fish and invertebrate species in the affected area.

2.3.6 Threatened and Endangered Species

Federal and state levels of special-status designations include:

- Federally Endangered;
- Federally Threatened;

- State Endangered;
- State Threatened;
- State Fully Protected Species; and
- California Species of Special Concern (pursuant to the 2008 list).

The federal Endangered Species Act (ESA) of 1973 (16 USC Section 1531 et seq.) and the California Endangered Species Act (CESA) of 1970 (Ca. Fish and Game Code Section 2050 et seq.) require the protection and conservation of listed endangered and threatened fishes, plants, and wildlife. The habitat of endangered, threatened, and rare species also takes on special importance because of these laws, and the protection and conservation of these species requires diligent management. At least three state- and/or federally-listed species were exposed to Line 901 oil from the spill: the threatened western snowy plover, the endangered black abalone, and the endangered humpback whales.

Several other state- and federally-listed or protected species occur in areas exposed to the spill. However, these species are not thought to have been affected by the spill either because they were not present in the area at the time of the spill due to migration timing, low overall population density or scarcity, or because oil never reached their habitat. These species include the California red-legged frog, Gaviota tarplant, light-footed Ridgway rail, Belding's savannah sparrow, California least tern, southern sea otter, Steller sea lion, Guadalupe fur seal, blue whale and fin whale, green turtle, hawksbill turtle, leatherback turtle, and loggerhead turtle. For pelagic seabirds such as the Scripps's murrelet it is possible that these birds could have encountered oil from the spill, but there was no evidence of mortality.

Two federally endangered fish species, the tidewater goby and Southern California Coast Steelhead DPS, are known to occur in coastal watersheds along the Gaviota Coast (USFWS 2005; NMFS 2012). Following the spill, a visual assessment of the entrances to streams and estuaries was completed by USFWS and NOAA. It was determined that there were large natural berms or artificial booms in place at the entrances to the streams and estuaries in the spill-affected area, making exposure to oil unlikely. Thus, the Trustees did not pursue further studies in these watersheds.

2.4 Archeological and Cultural Resources

The affected environment along the Gaviota coast is home to a wide variety of culturally and historically important resources. A number of Federal and State laws, regulations, and policies govern the protection of cultural and historic resources during an emergency response and subsequent NRDA restoration, including the National Historic Preservation Act of 1966, The Native American Graves Protection and Repatriation Act of 1990, and California Executive Order B-10-11.

To protect cultural and archeological resources during the spill response, the Unified Command established a Cultural/Historic Group comprised of State, Federal and tribal representatives with knowledge and expertise of the cultural and historical resources in the area. The Unified Command invited California tribes listed by the Native American Heritage Commission, regardless of federal recognition status, to be a part of the response (CDFW 2016). The Cultural/Historic Group's participating tribes included:

- Santa Ynez Band of the Chumash Indians (federally-recognized);
- Coastal Band of the Chumash Nation, including the Owl Clan;
- Barbareno Band of Chumash Indians; and
- Barbareno Ventureno Band of Mission Indians.

A report of cultural resource monitoring that occurred during the spill, along with a summary of impacts to cultural resources, was compiled by Nocerino et al. (2016) of Applied Earth Works. Because it contains archeological site information, it is confidential. The sections below are excerpted largely from Nocerino et al. (2016) and contain the non-confidential details summarizing the general nature of archeological and cultural resources in the spill-affected area, as well as impacts to those resources from the spill and response activities.

The Chumash Indians and their Native American ancestors have occupied the Santa Barbara Channel region for at least 13,000 years and thousands of their descendants live in the area today. Prior to European contact, the coastal Chumash had some of the highest population densities recorded for hunter-gatherers in North America. The Chumash people lived in villages along the California coast from Malibu to Morro Bay, and extended to the northern Channel Islands (McGinnis et al. 2004). Along the Santa Barbara Channel, the antiquity and density of Chumash occupation has led to a very large number of archeological sites ranging from historic Chumash coastal towns to ancient villages, cemeteries, campsites, and temporary locations. The density of Native American sites is particularly high within the central response area along the western Santa Barbara Channel, where the narrow coastal plain concentrated settlement within a thin band of land. The area also contains numerous historical sites dating to the Spanish, Mexican, and American periods, including shipwrecks, homesteads, ranching and fishing facilities, roads, railroads, oil facilities, and more. In some cases, historical facilities such as piers and seawalls extended into the intertidal zone and into nearshore waters. As was the case with Native American sites, coastal erosion has also resulted in the exposure or redeposition of historic artifacts or properties in the intertidal zone or on beaches of the Santa Barbara Coast.

The archeological sites along the Gaviota coast demonstrate an intimate use of coastal resources for subsistence of native people and their cultural traditions through time. Sites dating back to at least 13,000 years contain stemmed points and flaked stone crescents associated with remains of shellfish, fish, marine mammals, seabirds, and waterfowl, including a number of species closely associated with kelp forest habitats. The Channel Islands region is considered the place of origin for the Chumash people and is central to their cosmology (Office of National Marine Sanctuaries 2019). A Chumash creation story tells of the crossing of Chumash people from the Channel Islands to the mainland across a wištoyo (rainbow), during which some become dizzy and fall

from the bridge and are transformed into ‘alolk’oy (dolphins) by Hutash (Earth Goddess) (Tumamait-Stenslie 2014). This story exemplifies the foundational importance of the Santa Barbara Channel and its natural resources to the Chumash people, and illustrates the cultural importance of key species, such as dolphins. Dolphins and abalone are regarded as Chumash brothers and sisters of the ocean (Office of National Marine Sanctuaries 2019).

Applied Earthworks initiated a records search on May 20, 2015, in order to identify the types of cultural resources that may be encountered in the response area. The records search encompassed the area within 0.5 mile of the shoreline between Point Conception and Rincon Point. A review of the records identified 99 archeological sites were within the “response envelope” between Gaviota and Rincon Point, from the low tideline to 0.25 mile inland. Only one other cultural resource (a row of historic palm trees at Refugio State Beach) is within the response envelope. Of the 99 archeological sites within the response envelope, 26 sites plus the row of palm trees were assessed for potential impacts resulting from response activities. The remaining 73 sites were not in or near response activities and were not assessed. Three previously unrecorded archeological sites, six previously unrecorded historic seawalls, and a historical culvert were identified within the response envelope during the cleanup monitoring and survey.

During beach and shoreline cleaning operations, the Cultural/Historical Group, led by a Cultural/Historical Technical Specialist from CDFW, coordinated tribal representatives and non-tribal archeologists to be present to identify bones, artifacts, and potential artifacts encountered. Additional details of this coordination are available in the Refugio Oil Spill Response Evaluation Report (CDFW 2016). In several areas, access to beaches necessitated foot travel by cleanup crews across archeological sites because no safe alternatives could be identified. Trail delineations, carpet anchored with sandbags, and all-terrain vehicle restrictions were implemented for these locations. In addition, archaeologists and tribal representatives were present to ensure crews remained on the paths and protective measures remained in place.

During cleaning operations, isolated redeposited artifacts were noted in the intertidal zone at Refugio State Beach and El Capitan State Beach, within the jurisdiction of California State Parks, beginning on the first day of the incident response. The majority of the items were ground stone fragments (e.g., bowl or mortar fragments). These artifacts were evaluated by the Cultural/Historical Group. Because their original context could not be identified, these items were considered ineligible for listing on the National Register of Historic Places and California Register of Historical Resources. Some tribal representatives expressed concerns regarding sensitive cultural values associated with these intertidal artifacts and their desire to avoid oiling or other disturbance of these items during response activities.

The incident’s Historic Properties Treatment Plan called for leaving isolated intertidal artifacts in place unless there was an imminent risk of oiling or disturbance by incoming tides, in which case such artifacts were to be temporarily collected until such risk abated. During the spill, the Cultural/Historical Group collected 37 artifacts from the intertidal zone, as well as numerous other items that were inspected and determined not to be artifacts. Of the items collected, two

were redeposited at sea during the response, following consultation among the Cultural/Historical Group. The remaining artifacts were archived at the La Purisima Mission State Historic Park following discussion and consent among California State Parks and the involved tribes.

Nocerino et al. (2016) conclude that there were no significant impacts to potentially significant archeological deposits due to the oil release or resulting response operations, and that efforts made by the Unified Command, and the Cultural/Historical Group successfully avoided significant impacts to cultural resources.

2.4.1 Coordination with Native American Tribes

During the course of the NRDA, the Trustees coordinated with several tribes identified during the oil spill response with cultural and traditional affiliation to the area affected by the spill, including:

- Santa Ynez Band of the Chumash Indians (federally-recognized);
- Coastal Band of the Chumash Nation, including the Owl Clan;
- Barbareño Band of Chumash Indians; and
- Barbareño/Ventureño Band of Mission Indians.

Most of these tribes participated in the oil spill response by providing monitors to protect historic sites during cleanup operations. Under OPA, federally-recognized tribes may designate tribal officials to act as trustee for their tribal natural resources and may make a claim for injuries to those resources, such as in cases where reservation lands or a treaty right has been injured by the spill. In this case, reservation lands of the Santa Ynez Band of Chumash Indians were not impacted, and no treaty rights were identified to have been injured by the spill. However, the natural resources that are the subject of the NRDA are culturally important to all of the affected tribes and, as such, the Trustees made efforts to communicate with the tribes throughout the NRDA process and to seek their input on restoration priorities.

While the other bands do not have trustee status under OPA, the trustees from the State of California communicated with as many tribes as possible throughout the process consistent with state law and policies. During the public comment period following the release of the Draft DARP/EA, the Trustees were informed that additional tribes, bands and clans may have an interest in some of the Tier 1 and 2 projects impact natural cultural resources important to the Chumash community and/or restore sensitive ecosystems critical to Chumash lifeways.

Following the public comment period, the Trustees contacted the Native American Heritage Commission to obtain an updated list of tribes with cultural and traditional affiliation to the area of impact. In addition, through the public comment process the Trustees were provided the names of the additional tribes, bands and clans that may have an interest in some of the Tier 1 and 2 projects. Through these combined efforts, the following additional tribes were identified:

- Barbareño Chumash Tribal Council;

- Chumash Indian Council of Bakersfield of California;
- Northern Chumash Tribal Council;
- Salinan-Chumash Nation;
- San Luis Obispo County Chumash Council;
- Tejon Indian Tribe; and
- Yak Tityu Tityu Yak Tilhini Northern Chumash.

The Trustees conducted additional coordination with tribes following the public comment process and before finalizing the DARP/EA. We anticipate continued coordination with tribes throughout the implementation of restoration to ensure that restoration is conducted in a way that is protective of sacred sites and is respectful of cultural keystone species that have significance beyond their role in the ecosystem. This coordination will allow tribes to share traditional and local knowledge of managing the resources that were damaged as a result of the spill (Sea Grant Network 2018).

2.5 Recreational Services

The impacted beaches are some of the most popular in the state. Refugio and El Capitan State Beaches are among the few places on the California coast where one can camp immediately adjacent to the beach in the shade of coast live oaks, western sycamores, and in the case of Refugio, palm trees. These campgrounds are often full in the summer and require reservations made long in advance. In addition to these camping areas, there are numerous coastal access points where the public can enjoy beach access along undeveloped areas with a variety of recreation activities. The affected environment also supports boating and offshore recreation opportunities such as diving and fishing. There are significant recreational impacts from the spill that are described further in Section 5.5.

3.0 Coordination and Compliance

3.1 Federal and State Trustee Agencies

United States Department of Commerce represented by NOAA; the United States Department of the Interior represented by USFWS, NPS and BLM; the CDFW-OSPR; the CDPR; the CSLC; and the Regents of the University of California are the Trustees who are addressing the natural resources injured by the spill. NOAA and DOI are designated Trustees for natural resources pursuant to the Oil Pollution Act (33 U.S.C. §§ 2701–2762) and subpart G of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 C.F.R § 300.600) and Executive Order 12580 (3 CFR, 1987 Comp., p. 193, 52 Fed. Reg. 2923 (January 23, 1987), as amended by Exec. Order No. 12777 (56 Fed. Reg. 54757 (October 22, 1991))). CDFW and CDPR have been designated as state trustees for natural resources pursuant to Section 1006(b)(3) of the OPA. In addition, CDFW has state natural resource trustee authority pursuant to Fish and Game Code §§ 711.7 and 1802 and the Lempert-Keene-Seastrand Oil Spill Prevention and Response Act (Government Code § 8670.1 et seq.). CDPR and UC Regents also have jurisdiction over natural resources within the state park system and the natural reserve system, respectively, which are held in trust for the people of the State of California. Finally, CSLC is participating as a Trustee pursuant to its jurisdiction under Public Resources Code §§ 6009 and 6301 over all state sovereign lands, including ungranted tidelands and submerged lands. As a designated Trustee, each agency is authorized to act on behalf of the public under state and/or federal law to assess and recover natural resource damages and to plan and implement actions to restore, rehabilitate, replace, or acquire the equivalent of the affected natural resources injured as a result of a discharge of oil.

3.2 Coordination

3.2.1 Coordination Among the Trustees

Federal regulations implementing OPA with respect to natural resource damages (“OPA NRDA regulations”) provide that where an oil spill affects the interests of multiple Trustees, they should act jointly to ensure that full restoration is achieved without double recovery of damages (15 CFR § 990.14(a)). The Trustees in this matter have worked together closely in a shared effort to fully assess the nature and extent of injuries to natural resources and plan appropriate actions to restore the injured resources.

At the beginning of the NRDA, the Trustees jointly designated CDFW as the Lead Administrative Trustee (LAT) to act as coordinator pursuant to 15 CFR § 990.14(a)(1). The Trustees also designated NOAA as the Federal Lead Administrative Trustee (FLAT) to coordinate those activities, such as NEPA compliance, that must be undertaken by a Federal agency. In addition to coordinating amongst themselves, the Trustees also coordinated NRDA activities with other affected entities, including Santa Barbara County, the City of Goleta and others.

3.2.2 Coordination with Federally Recognized and Non-Federally Recognized Tribes

The Trustees coordinated with several American Indian tribes in the course of this NRDA. These included:

- Santa Ynez Band of the Chumash Indians (federally-recognized);
- Coastal Band of the Chumash Nation, including the Owl Clan;
- Barbareno Band of Chumash Indians; and
- Barbareno Ventureno Band of Mission Indians.

These tribes participated in the oil spill response by providing monitors to protect historic sites during cleanup operations. Under OPA, federally-recognized tribes may serve as natural resource trustees and make a claim for NRD. In this case, the Santa Ynez Band of Chumash Indians elected not to join the claim, but remain interested in the restoration process generally. For this reason, the Trustees continue to engage with Santa Ynez Band of Chumash regularly, simultaneously fulfilling the federal Trustees' tribal consultation obligations. While the non-federally recognized tribes are not eligible to be a natural resource trustee under OPA, the state Trustees have communicated with these tribes throughout the process, regardless of recognition status.

3.2.3 Coordination with the Responsible Party

The OPA NRDA regulations encourage natural resource trustees and responsible parties to cooperate in the assessment and restoration process, providing broad discretion to the parties to determine the nature and extent of participation (15 C.F.R. § 990.14(c)). However, the Trustees retain sole authority to make determinations regarding injury and restoration (15 C.F.R. § 990.14(c)(4)).

In accordance with the regulations, the Trustees extended an invitation to the responsible party, Plains, within days of the Incident, and Plains accepted (15 C.F.R. § 990.14(c)). Thereafter, the Parties established an active cooperative assessment process, by which Trustee representatives would coordinate studies and other technical activities in the injury determination and quantification stages of the assessment with representatives of Plains. The Trustees formed technical working groups that included biologists, economists, toxicologists, and other specialists, and developed work plans that were used to guide injury assessment activities. Plains commented on work plans and participated in some studies.

This DARP/EA, while prepared solely by the Trustees, reflects consideration of the input provided by Plains' representatives. Plains does not agree with certain conclusions presented in this document.

3.2.4 Coordination with the Public

Throughout the NRDA process, the Trustees have made information available to the public. The Trustees held a public meeting in Santa Barbara shortly after the oil spill on January 20, 2016,

and they published a series of newsletters to keep the public up to date on the progress of the NRDA.

The Trustees published a Notice of Intent (NOI) to Conduct Restoration Planning on March 8, 2019, pursuant to the OPA NRDA regulations (15 C.F.R § 990.44), and concurrently opened an administrative record (15 CFR § 990.45). The Record includes documents relied upon or considered by the Trustees during the assessment and restoration planning process.

A 45-day public review period was held for the Draft DARP/EA that began on April 22, 2020 and closed on June 8, 2020. During the public review period, the Trustees received extensive comments on the DARP/EA, which can be found with the Trustees' responses in Appendix O.

The Trustees held virtual public meetings on May 13, 2020 at 1:00 and 6:00 pm PDT. At these meetings, the Trustees presented an overview of the Draft DARP/EA, answered questions, and accept public comments.

The Administrative Record is available at: <https://www.diver.orr.noaa.gov/web/guest/diver-admin-record/6104>. The administrative record is also available upon request at:

Ventura Fish and Wildlife Office
U.S. Fish and Wildlife Service
2493 Portola Road, Suite B
Ventura, California 93004
(805) 644-1766.

3.3 Compliance with Environmental Laws, Regulations, and Policies

3.3.1 The Oil Pollution Act

The Oil Pollution Act (33 U.S.C. § 2701–2762) establishes a liability regime for oil spills into navigable waters or adjacent shorelines that injure or are likely to injure natural resources and the services that those resources provide to the ecosystem or humans. Pursuant to OPA, federal and state agencies and Indian tribes may act as Trustees on behalf of the public to assess the injuries, scale restoration to compensate for those injuries, and implement restoration. The DARP/EA has been prepared jointly by DOI, NOAA, CDFW, CSPR, CSLC, and UC Regents. As described above, each of these agencies is a designated Trustee for natural resources injured by the spill.

OPA defines “natural resources” to include land, fish, wildlife, water sources, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States, any State or local government or Indian tribe, or any foreign government (33 U.S.C. § 2701(20)). OPA authorizes the Trustees to assess damages for injured natural resources under their trusteeship, and develop and implement a plan for the restoration, rehabilitation,

replacement, or acquisition of the equivalent of those injured natural resources (33 U.S.C. § 2706(c)).

The regulations for natural resource damage assessments under OPA are found at 15 C.F.R Part 990. These regulations provide the Trustees with guidelines on processes and methodologies for carrying out an NRDA, including guidelines for conducting assessments cooperatively with the responsible parties. While the decision whether or not to follow the NRDA regulations is left to the discretion of the Trustees, OPA provides that if the Trustees conduct the NRDA in accordance with the regulations, their determination or assessment of damages to natural resources will have the force and effect of a rebuttable presumption in an administrative or judicial proceeding under OPA (33 U.S.C. § 2706(e)(2); 15 C.F.R. § 990.13). In this case, the Trustees elected to conduct the NRDA in accordance with the OPA NRDA regulations.

3.3.2 National Marine Sanctuaries Act, 16 USC. § 1431, et seq.

The National Marine Sanctuaries Act (NMSA) authorizes the Secretary of Commerce (Secretary) to designate and manage areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or esthetic qualities as national marine sanctuaries. Day-to-day management of national marine sanctuaries has been delegated by the Secretary to the Office of National Marine Sanctuaries (ONMS). The primary objective of the NMSA is to protect marine resources, such as coral reefs, sunken historical vessels or unique habitats.

The NMSA prohibits the destruction, loss of, or injury to any sanctuary resource. The Secretary is required to conduct such enforcement activities as are necessary and reasonable to carry out the Act. The Secretary may issue special use permits which authorize specific activities in a sanctuary to establish conditions of access to and use of any sanctuary resource or to promote public use and understanding of a sanctuary resource. The NMSA also establishes, similar to OPA, liability for response costs and natural resource damages for injury to sanctuary natural resources.

In this case, the ONMS participated because of potential injury to the Channel Islands Marine Sanctuary (CINMS). CINMS staff participated as part of the Trustee group early on to identify potential injury to Sanctuary resources concurrently with similar work being conducted under OPA. However, no injuries were assessed within Sanctuary boundaries, although oiled marine mammals and birds use marine sanctuaries as part of their habitats.

The CINMS also participated in restoration planning, identifying appropriate restoration projects occurring within the CINMS. This coordination will continue for restoration projects that have the potential to affect resources within a sanctuary.

3.3.3 The National Environmental Policy Act

The National Environmental Policy Act (NEPA) is the basic national charter for the protection of the environment, and it sets forth a specific process of impact analysis and public review for federal agency actions that may significantly affect the environment (42 U.S.C. §§ 4321–4335; 40 C.F.R. § 1500.1). Its purposes are to “encourage productive and enjoyable harmony between man and the environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; and to enrich the understanding of the ecological systems and natural resources important to the Nation” 42 U.S.C. §4321. NEPA provides a mandate and a framework for federal agencies to consider all reasonably foreseeable environmental effects of their proposed actions and to potentially involve and inform the public in their process. NEPA also established the Council on Environmental Quality (CEQ) in the Executive Office of the President to formulate and recommend national policies which ensure that the programs of the federal government promote improvement of the quality of the environment. CEQ also promulgated regulations to provide Federal agencies with procedures to comply with NEPA (40 C.F.R. § 1500.1(a)).

Where potential environmental impacts are unknown or considered not likely to be significant, federal agencies will prepare an environmental assessment (EA). The EA may undergo a public review and comment period, and the process concludes with either a finding by the action agency of no significant impact (FONSI) or a determination that an Environmental Impact Statement (EIS) should be prepared. An EIS is prepared for actions considered to have significant effects on the environment, and after public review and comment, findings are documented in a record of decision (ROD).

In accordance with the regulations implementing the OPA NRDA process, the Trustees have integrated OPA restoration planning with the NEPA process (15 C.F.R. § 990.23). Accordingly, the DARP/EA serves as both an OPA restoration plan and a NEPA EA document. The Trustees anticipate that this DARP/EA will meet NEPA requirements for most of the restoration projects described herein. However, subsequent NEPA compliance may be required prior to implementation of some of the restoration actions pending development of sufficient project-level detail. The need for additional NEPA review will be determined once detailed engineering design work or operational plans are developed for selected projects. Additional review may also be required if any second tier projects are implemented.

3.3.4 Other Federal and State Laws, Regulations, and Policies

As described above, OPA, NMSA, and NEPA, and federal regulations implementing these laws are the major federal laws and regulations guiding the development of this DARP/EA for restoration of injured resources and services resulting from the spill. However, there are other federal and state laws, regulations or policies that may be pertinent to this DARP/EA or to implementation of the specific restoration actions described herein. Potentially relevant laws, regulations, and policies are set forth below.

Clean Water Act

The federal Water Pollution Control Act (commonly referred to as the Clean Water Act or CWA) is the principal federal statute governing water quality (33 U.S.C. §§ 1257–1387). The CWA's objective is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. The CWA regulates both the direct (point source) and indirect (non-point source) discharge of pollutants into the Nation's waters.

Section 402 of the CWA established the National Pollution Discharge Elimination System (NPDES) program. The CWA allows EPA to authorize state governments to implement the NPDES program. Section 301 of the CWA prohibits the discharge into navigable waters of any pollutant by any person from a point source unless it is in compliance with a National Pollution Discharge Elimination System (NPDES) permit. Section 319 of the CWA directs states to identify best management practices and measures to reduce non-point source pollution.

Section 311 of the CWA regulates, among other things, the discharge of oil and other hazardous substances into navigable waters, adjoining shorelines, and waters of the contiguous zone. The CWA allows the federal government to remove the discharges and assess the removal costs against the responsible party. The CWA defines removal costs to include costs for the restoration or replacement of natural resources damaged or destroyed as a result of a discharge of oil or a hazardous substance.

Section 404 of the CWA authorizes the U.S. Army Corps of Engineers (the Corps) to issue permits, after notice and opportunity for public hearings, for the discharge of dredged or fill material into the waters of the United States. Section 401 of the CWA provides that any applicant for a federal permit or license to conduct any activity which may result in any discharge into navigable waters must obtain certification of compliance with state water quality standards.

The Trustees anticipate that some restoration projects may trigger CWA permitting requirements. For those projects, such as the Ellwood seawall removal, the implementing entity will be required, as a condition of receiving restoration funds, to obtain the appropriate permits prior to project implementation.

Rivers and Harbors Appropriation Act of 1899

The Rivers and Harbors Appropriation Act of 1899 regulates the development and use of the nation's navigable waterways (33 USC. §§ 401–427). Section 10 of the Act prohibits unauthorized obstruction or alteration of navigable waters and vests the U.S. Army Corps of Engineers with authority to regulate discharges of fill and other materials into such waters.

The Trustees do not believe that any of the restoration projects set forth in this DARP/EA have the potential to negatively affect navigable waters because none of the projects will result in the obstruction or alteration of navigable waters.

Coastal Zone Management Act

The goal of the Coastal Zone Management Act (CZMA) is to encourage and assist states to preserve, protect, develop and, where possible, restore and enhance valuable natural coastal resources (16 U.S.C. §§ 1451–1466). Participation by states is voluntary. California developed the California Coastal Management Program pursuant to the requirements of the federal CZMA, and NOAA approved the program in 1977. The State has also enacted the federally approved California Coastal Act.

Section 1456 of the CZMA requires that any federal action inside or outside of the coastal zone that affects any land or water use or natural resources of the coastal zone shall be consistent to the maximum extent practicable with the enforceable policies of approved state management programs. It states that no federal license or permit may be granted without giving the State the opportunity to concur that the project is consistent with the state's coastal policies. The regulations implementing the CZMA outline the consistency procedures.

The California Coastal Commission (CCC) is designated under California's federally approved Coastal Management Program as the state agency responsible for reviewing all consistency documents concerning most coastal lands in California. Under the California Coastal Management Program, the CCC is empowered to use the authority of the federal CZMA to ensure that federal projects and activities within the coastal zone are consistent with the policies of the California Coastal Management Program and state law.

The Trustees believe that the projects set forth in this DARP/EA can be implemented in a manner that will either have no adverse effect on coastal resources or uses or will be consistent to the maximum extent practicable with the CZMA, the California Coastal Act (California Public Resources Code Sections 30000, et seq.), and the California Coastal Management Program. Prior to implementation, the Trustees and/or the project implementers, as appropriate, will seek concurrence from the CCC for these projects.

Endangered Species Act

The purpose of the Endangered Species Act (ESA) is to conserve endangered and threatened species and the ecosystems upon which they depend (16 U.S.C. §§ 1531–1544). The ESA, among other things, directs all federal agencies to utilize their authorities to further these purposes. Pursuant to Section 7 of the ESA, federal agencies shall, in consultation with the Secretaries of the Interior and/or Commerce, ensure that any action that they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modification of designated critical habitat.

Under the ESA, the National Marine Fisheries Service (NMFS) and the USFWS publish lists of endangered and threatened species. Before initiating an action, the federal action agency (i.e., the federal agency authorizing, funding, or carrying out a discretionary activity or program), or its

non-federal permit applicant, must ask the USFWS and/or NMFS to provide a list of threatened, endangered, proposed, and candidate species and designated critical habitat that may be present in the project area. If no species or critical habitats are known to occur in the action area⁷, the federal action agency has no further ESA obligations under Section 7. If the federal action agency determines that a project may affect a listed species or designated critical habitat, consultation is required.

If the federal action agency concludes that the project will not adversely affect listed species or critical habitat, the agency submits a “not likely to adversely affect” determination to the USFWS and/or NMFS. If the USFWS and/or NMFS concur with the federal action agency’s determination of “not likely to adversely affect,” then the consultation (informal to this point) is completed and the decision is put in writing.

If the federal action agency determines that the project is likely to adversely affect either a listed species or its critical habitat, then more formal consultation procedures are required. There is a designated period in which to consult (90 days), and beyond that, another set period for the USFWS and/or NMFS to prepare a biological opinion (45 days). The determination of whether or not the proposed action would be likely to jeopardize the species or adversely modify its critical habitat is contained in the biological opinion. If a jeopardy or adverse modification determination is made, the biological opinion must identify any reasonable and prudent alternatives that could allow the project to move forward.

Several federally-listed species occur in the project areas for this DARP/EA. For each selected project described in this Final DARP/EA, the Trustees and/or the project implementer, as appropriate, will evaluate the potential effects of the project on listed species and critical habitat. Based on this analysis, the Trustees and/or project implementer will perform the appropriate level of consultation with the USFWS and/or NMFS pursuant to Section 7 of the ESA.

Magnuson-Stevens Fishery Conservation and Management Act

The federal Magnuson-Stevens Fishery Conservation and Management Act, as amended and reauthorized by the Sustainable Fisheries Act of 1996, establishes a program to promote the protection of essential fish habitat (EFH) in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat (16 U.S.C. §§ 1801–1869). After EFH has been described and identified in fishery management plans by the regional fishery management councils, federal agencies are obligated to consult with the Secretary of Commerce with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any EFH.

⁷ An “action area” consists of all areas that may be affected directly or indirectly by the proposed action and not merely the immediate area involved in the action.

EFH occurs within the project areas for this DARP/EA. For each selected project in this Final DARP/EA, the Trustees and/or the project implementer, as appropriate, will evaluate the potential effects of the project on EFH. Based on this analysis, the Trustees and/or project implementer will perform the appropriate level of consultation with NMFS.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA) provides the basic authority for the USFWS involvement in the evaluation of impacts to fish and wildlife from proposed water resource development projects (16 U.S.C. §§ 661–667d). The FWCA requires that federal agencies consult with the USFWS (and/or NMFS as may be appropriate) and state wildlife agencies for activities that affect, control or modify waters of any stream or other bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. This consultation is generally incorporated into the process of complying with Section 404 of the Clean Water Act, NEPA or other federal permit, license or review requirements.

The Trustees or the project implementer, as appropriate, will consult with the necessary agencies on any of the selected restoration projects that involve activities that affect, control, or modify streams or other bodies of water.

Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) prohibits, with certain exceptions, the take of marine mammals in US waters and by US citizens on the high seas, and the importation of marine mammals and marine mammal products into the United States. (16 U.S.C. §§ 1361–1423h). Under the MMPA, the Secretary of Commerce, through NMFS, is responsible for the conservation and management of pinnipeds (other than walruses) and cetaceans, and the Secretary of the Interior, through USFWS, is responsible for walruses, sea and marine otters, polar bears, manatees, and dugongs. Title II of the MMPA established an independent Marine Mammal Commission which provides independent oversight of the marine mammal conservation policies and programs being carried out by federal regulatory agencies. The Commission is charged with developing, reviewing, and making recommendations on domestic and international actions and policies of all federal agencies with respect to marine mammal protection and conservation. The MMPA provides for several exceptions to the moratorium on taking and importing marine mammals and marine mammal products. NMFS and USFWS may issue permits for take or importation for purposes of scientific research, public display, photography for educational or commercial purposes, enhancing the survival or recovery of a species or stock, importation of certain polar bear parts taken in sports hunting in Canada, and incidental taking in the course of commercial fishing operations.

The restoration actions set forth by the Trustees in this DARP/EA are permitted actions under the MMPA. The Trustees will consult with NMFS and/or USFWS to ensure the selected restoration projects do not violate the MMPA.

Migratory Bird Treaty Act of 1918

The Migratory Bird Treaty Act (MBTA) implements four international treaties involving protection of migratory birds, including all marine birds, and is one of the earliest statutes to provide for avian protection by the federal government (16 U.S.C. §§ 703–712). The MBTA generally prohibits actions to “pursue, hunt, take, capture, kill, attempt to take, kill, possess, offer for sale, sell, offer to purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird...or any part, nest, or egg of such bird.” Exceptions to these prohibitions are only allowed under regulations or permits issued by the USFWS. Hunting of migratory game birds is regulated annually through a process in which the USFWS sets “framework regulations” and “special regulations” designed to maintain sustainable hunting levels. All other actions prohibited by the MBTA are only allowed under specific permits issued by the USFWS Regional Bird Permit Offices.

Implementation of restoration projects selected in this Final DARP/EA will be conducted in full compliance with the MBTA.

Executive Order 11988 – Construction in Flood Plains

The 1977 Executive Order 11988 seeks to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct or indirect support of development in flood plains wherever there is a practicable alternative. Each federal agency is responsible for evaluating the potential effects of any action it may take in a flood plain. Before taking an action, the federal agency should determine whether the proposed action would occur in a flood plain. For any major federal action significantly affecting the quality of the human environment, the evaluation would be included in the agency’s environmental impact statement prepared pursuant to NEPA. The agency should consider alternatives to avoid adverse effects and incompatible development in flood plains. If the only practicable alternative requires siting in a flood plain, the agency should: (1) design or modify the action to minimize potential harm, and (2) prepare and circulate a notice containing an explanation of why the action is proposed to be located in the flood plain.

None of the restoration projects set forth in this DARP/EA involve construction in a floodplain.

Executive Order 13112 – Invasive Species

The 1999 Executive Order 13112 requires that all federal agencies whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law, (1) identify such actions, and (2) take actions specified in the Order to address the problem consistent with their authorities and budgetary resources; and (3) not authorize, fund, or carry out actions that they believe are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, “pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh

the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.”

The Trustees do not believe that any of the restoration projects set forth in this DARP/EA have the potential to cause or promote the introduction or spread of invasive species. However, some of the restoration projects considered in this DARP/EA are aimed at the removal or control of non-native species.

Executive Order 12898 – Environmental Justice

The 1994 Executive Order 12898 requires each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. In the memorandum to heads of departments and agencies that accompanied executive Order 12898, the President specifically recognized the importance of procedures under NEPA for identifying and addressing environmental justice concerns. The memorandum states that “each federal agency shall analyze the environmental effects, including human health, economic and social effects, of federal actions, including effects on minority communities and low-income communities, when such analysis is required by [NEPA].” The memorandum particularly emphasizes the importance of NEPA’s public participation process, directing that “each federal agency shall provide opportunities for community input in the NEPA process.” Agencies are further directed to “identify potential effects and mitigation measures in consultation with affected communities, and improve the accessibility of meetings, crucial documents, and notices.” The CEQ has oversight of the federal government’s compliance with Executive Order 12898 and NEPA.

The Trustees have involved the affected communities by providing notice to the public, seeking public comments, holding public meetings and providing public access to the Administrative Record. In addition, all selected actions described in this Final DARP/EA are expected to have positive environmental impacts and not to impose any adverse impacts on any community.

Information Quality Act, Public Law 106-554, Section 515

Information disseminated by federal agencies to the public after October 1, 2002, is subject to information quality guidelines developed by each agency pursuant to Section 515 of Public Law 106-554 that are intended to ensure and maximize the quality of the objectivity, utility and integrity of such information. This DARP/EA is an information product covered by information quality guidelines established by NOAA and DOI for this purpose. The quality of the information contained herein is consistent with the applicable parts of these guidelines.

3.3.5 State Laws, Regulations, and Policies

California Lempert-Keene-Seastrand Oil Spill Prevention and Response Act, Government Code § 9574.1, et seq.

The Lempert-Keene-Seastrand Oil Spill Prevention and Response Act became effective on September 24, 1990. This legislation and subsequent amendments are the key state compensatory

mechanism for oil spills and establishes a comprehensive liability scheme for damages resulting from oil spills into waters of the state, excluding groundwater. The legislation also established an Administrator for oil spill response, appointed by the Governor, and the Office of Spill Prevention and Response (OSPR) within the CDFW. The Administrator is required to ensure that, as part of the response to any significant spill, damages to natural resource are assessed. Recoverable damages include damages for the injury to, destruction of, or loss of natural resources, including the reasonable costs of assessing the injury, destruction, or loss, the cost of rehabilitating wildlife, habitat, and other resources, and the loss of use and enjoyment of natural resources, public beaches, and other public resources.

The Administrator, a chief deputy director of CDFW, must coordinate all actions required by state or local agencies to assess injury to, and provide full mitigation for injury to, or to restore, rehabilitate, or replace, natural resources, including wildlife, fisheries, wildlife or fisheries habitat, and beaches and other coastal areas, that are damaged by an oil spill. Such actions include actions required by state trustees under Section 1006 of OPA (requiring state trustees to assess natural resource damages under their trusteeship and to develop and implement a plan for restoration of natural resources).

In this case, the state Trustees participated as part of the Trustee group to identify and quantify injuries to natural resources, including wildlife, fisheries, wildlife or fisheries habitat, and beaches and other coastal areas, and the loss of their use, under the Lempert-Keene-Seastrand Oil Spill Prevention and Response Act concurrently with similar work being conducted under OPA.

The Lempert-Keene-Seastrand Oil Spill Prevention and Response Act does not contain public participation requirements like OPA; however, since the natural resources belonging to, managed by, controlled by, or appertaining to the State of California or political subdivision thereof that were injured by the spill are also compensable under OPA, they are dealt with concurrently in this document.

California Environmental Quality Act, Pub. Res. Code 21000-21178.1

The California Environmental Quality Act (CEQA) was adopted in 1970. Its basic purposes are to inform California governmental agencies and the public about the potentially significant effects of proposed activities, to identify ways that environmental damage can be avoided or significantly reduced, to prevent significant avoidable damage to the environment through adoption of feasible alternatives or mitigation measures, and to disclose the reasons for agency approval of a project resulting in significant environmental effects.

The CEQA process begins with a preliminary review as to whether CEQA applies to the project in question. Generally, a project is subject to CEQA if it involves a discretionary action that is carried out, funded or authorized by an agency (i.e., the lead agency), and has the potential to impact the environment, including tribal cultural resources. Once the lead agency determines that the project is subject to CEQA, the lead agency must then determine whether the action is

exempt from CEQA compliance under either a statutory or categorical exemption. Examples of categorical exemptions include actions taken by regulatory agencies for protection of natural resources and actions by regulatory agencies for protection of the environment (Title 14 CCR, Chapter 3, §§ 15307-15308).

If the lead agency determines that the project is not exempt, then an Initial Study is generally prepared to determine whether the project may have a significant effect on the environment. Based on the results of the Initial Study, the lead agency determines whether to prepare a Negative Declaration (i.e., the project will not result in significant adverse effects to the environment) or an Environmental Impact Report (EIR). The test for determining whether an EIR or negative declaration must be prepared is whether a fair argument can be made based on substantial evidence that the project may have a significant adverse effect on the environment. Lead agencies must also provide notice to tribes that are traditionally and culturally affiliated with the geographic area of a proposed project and who have requested notice of projects proposed within that area. If the tribe requests consultation, the lead agency must consult with the tribe and consider any alternatives or mitigation measures recommended by the tribe.

CEQA encourages the use of a federal EIS or FONSI prepared pursuant to NEPA when such documents are available, or the preparation of joint state/federal documents, in lieu of preparing a separate EIR or negative declaration under CEQA. Accordingly, this DARP/EA and subsequent FONSI, if issued, may be relied upon by the lead agency towards compliance with CEQA as required for discretionary projects that are authorized, funded or carried out by California state or local agencies. Toward this end, the state Trustees will coordinate with the federal Trustees to ensure the Final DARP/EA and FONSI (if issued) are consistent with the provisions of CEQA Guidelines including state public review requirements. (Title 14 CCR, Chapter 3, § 15220 *et seq.*).

The Trustees anticipate that this DARP/EA and subsequent FONSI, if issued, will comply with the CEQA guidelines for most of the restoration projects described herein. However, subsequent CEQA compliance may be required prior to implementation of some of the restoration actions that are conceptual at this stage, pending development of sufficient project-level detail. This will be determined once detailed engineering design work or operational plans are developed for the selected projects, and once human use projects have been defined.

California Coastal Act, California Public Resources Code § 30000, et seq.

The California Coastal Act was enacted by the California State Legislature in 1976 to provide long-term protection of California's 1,100-mile coastline for the benefit of current and future generations. The Coastal Act created a partnership between the state (acting through the California Coastal Commission [Commission]) and coastal cities and counties to manage the conservation and development of land and water in the coastal zone through a comprehensive planning and regulatory program. New development in the coastal zone may require a permit from the Commission or the appropriate local governmental agency. Development activities are

broadly defined to include construction projects, divisions of land, and activities that change the intensity of use of land or public access to coastal waters. The Commission also reviews and approves Local Coastal Programs, which are the basic planning tools used by local governments to guide development in the coastal zone. The coastal zone established by the Coastal Act does not include San Francisco Bay which is regulated by the BCDC pursuant to the McAteer-Petris Act (California Government Code Sections 66690, et seq.).

While the Trustees do not anticipate that any of the restoration projects will adversely affect coastal resources, some of the projects may meet the definition of development under the California Coastal Act, such as the Ellwood seawall removal project. The implementing entity for each selected project will be required to apply for any necessary permits and approvals, including any required coastal development permit. In addition, the federal Trustees or the implementing entity, as appropriate, will conduct consultation with the CCC, as discussed above under the CZMA.

California Endangered Species Act, Fish and Game Code 2050 et seq.

Pursuant to CESA (California Fish and Game Code Sections 2050 et seq.), it is the policy of the State of California that state agencies should not approve projects that would jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat essential to the continued existence of those species if there are reasonable and prudent alternatives available. However, if reasonable alternatives are infeasible, individual projects may be approved if appropriate mitigation and enhancement measures are provided.

Pursuant to the CESA, the Fish and Game Commission has established a list of threatened and endangered species based on criteria recommended by the California Department of Fish and Game. Section 2080 of the California Fish and Game Code prohibits “take” of any species that the Commission determines to be an endangered species or a threatened species. Take is defined in Section 86 of the Fish and Game Code as “hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill.” The CESA allows for take incidental to otherwise lawful development projects. The CESA emphasizes early consultation to avoid potential impacts to rare, endangered, or threatened species and to develop appropriate mitigation planning to offset project-caused losses of populations of listed species and their essential habitats.

Several state-listed species occur in the spill-affected area. While the Trustees do not believe the restoration projects set forth in this DARP/EA will result in the take of any state-listed species, the Trustees will evaluate the potential effects of the projects on these species and consult with the CDFW as may be appropriate pursuant to the requirements of the CESA.

Public Resources Code, Division 6, § 6001, et seq.

The Public Resources Code, Division 6, gives the California State Lands Commission trustee ownership over State sovereign tide and submerged lands. Permits or leases may be required from the State Lands Commission if a restoration project is located on such lands.

3.3.6 Other Potentially Applicable Statutes and Regulations

Additional legal requirements may be applicable to NRDA restoration planning activities. The statutes listed below, or their implementing regulations, may require permits from federal or state permitting authorities:

- National Park Service Organic Act of 1916, 54 U.S.C. 100101-104907;
- Archaeological Resources Protection Act, 16 USC 460, et seq.;
- National Historic Preservation Act of 1966 as amended (16 USC 470-470t, 110);
- Clean Air Act, 42 USC 7401, et seq.; and
- Porter-Cologne Water Quality Control Act, Water Code Sections 13000 et seq.

4.0 Injury Quantification and Restoration Planning Methods

The Oil Pollution Act NRDA regulations define injury as “an observable or measurable adverse change in a natural resource or impairment of a natural resource service.” The goal of an injury assessment is to determine the nature, extent and severity of injuries to natural resources, thus providing the technical basis for evaluating and properly scaling potential restoration actions to compensate for resource injuries. An impairment or loss of human uses of the natural resources, e.g., lost recreation, is compensable under the OPA NRDA regulations, as well. In contrast, natural resource damages are the monetary damages recoverable by natural resource trustees to compensate the public for the injuries to natural resources and the loss or impairment of human uses of natural resources resulting from an oil spill. Such damages include the cost to restore the injured natural resources, the monetary value of spill-related human use impacts, as well as the reasonable cost of the assessment.

For each of the injury categories evaluated following the spill and discussed in this DARP/EA, the Trustees, informed in part by the contributions of the responsible party, selected assessment procedures based on (1) the range of procedures available under section 990.27(b) of the OPA regulations; (2) the time and cost necessary to implement the procedures, and considering whether the additional cost of more complex procedures were related to the expected increase in the quantity and/or quality of the information to be acquired; (3) the potential nature, degree, and spatial and temporal extent of the injury; (4) potential restoration actions for the injury; (5) the relevance and adequacy of information generated by the procedures to meet information requirements of planning appropriate restoration actions; and (6) input from scientific experts. (15 C.F.R. § 990.27(c)).

4.1 Quantification of Damages

Each injury assessment focused on determining both the magnitude of the injury to a resource or a natural resource service (e.g., number of animals killed, acres impacted, or days of lost recreational opportunity) and the time to full recovery. This produced an estimate of the initial and interim (from the time of injury until full recovery) losses resulting from the oil spill.

The Trustees’ next task is to determine the scale of restoration actions that adequately compensate the public for the injuries resulting from the spill. For wildlife and habitat, the Trustees have used Resource Equivalency Analysis (REA) or Habitat Equivalency Analysis (HEA), an approach that quantifies both the injury from the spill and the benefits of potential restoration projects, such that they may be compared with each other. For human recreational losses, the Trustees have used a valuation approach, estimating the number of lost user days for various activities and locations, and then calculating the lost value, in dollars, of that lost use. These methods are further described below.

4.1.1 Equivalency Analysis

For the quantification of injuries to wildlife and habitat, the Trustees have relied on a service-to-service restoration-based approach, in accordance with 990.53(d)(2). In other words, the Trustees have sought appropriate restoration projects to both restore the injured resources and compensate for the interim losses between the time of the spill and full recovery to the conditions that would have existed had the spill not occurred (see NOAA 1997). Restoration scaling is the process of determining the appropriate size of a restoration project, so as to compensate for the injuries and lost services. These projects, because of their compensatory nature, are intended to restore, replace, rehabilitate, or acquire the equivalent resources “of the same type and quality, and of comparable value” as those injured (NOAA 1995). For this task, the Trustees relied upon equivalency methods, sometimes specified as HEA when applied to habitat injuries or REA when applied to resources in general. These methods are described in greater detail in Appendix C.

4.1.2 Value of Lost Human Uses

To quantify lost and impaired human uses resulting from the Incident, the Trustees, partially in cooperation with the responsible party, have gathered data regarding visitor use of impacted sites and associated activities. To value those lost uses the Trustees used a travel cost model for beach camping and are employing the benefits transfer method for other shoreline and offshore uses. In other words, the Trustees determined the lost monetary value of each lost trip, and multiplied the resulting value by the number of lost trips. To compensate for the lost and diminished human uses arising from the spill, the Trustees intend to solicit project ideas from public agencies, non-governmental organizations, as well as from the general public. The Trustees will then select restoration actions using a value to cost approach, by which the cost of the restoration actions is equivalent to the lost monetary value of human uses.

For a number of reasons, the value-to-cost method is the most commonly used approach to address lost recreational use in NRD cases across the nation. The Trustees’ determined that a value-to-value or service-to-service approach, which attempts to compare the value or benefits of specific restoration actions to the injury, would be impractical as the scope and/or number of studies required to implement either approach would be prohibitively time-consuming and expensive, and therefore less desirable under the assessment procedure criteria laid out in 990.27(c) and listed above.

A wide variety of recreational activities were affected by the spill. Examples include camping, sunbathing, beach combing, exercising, swimming, wildlife viewing, and dog-walking, as well as more specialized activities such as fishing, diving, boating, and surfing. Additionally, a wide variety of shoreline locations in Santa Barbara, Ventura, and Los Angeles Counties were impacted. The Trustees anticipate implementing a suite of restoration projects to compensate for impacts to various types of activities across the spill-affected area. The Trustees’ anticipate that multiple projects will compensate for recreational use impacts. Each project will require significant coordination among the landowner or manager where the projects will be

implemented, the local governments and the public. To properly implement a value-to-value or service-to-service approach in these circumstances would have required the Trustees to separately study, evaluate and determine the value and benefits of each individual proposed project in a range of locales. Such studies of the potential benefits of the proposed projects could easily take several years and cost several times more than the value-to-cost method employed by the Trustees.

4.2 Restoration Project Selection Criteria

The Trustees considered numerous restoration alternatives to compensate the public for spill-related injuries. Each restoration alternative presented in this plan was evaluated using the factors outlined in section 990.54 of the OPA regulations, as well as additional criteria deemed necessary to identify the optimal suite of restoration projects. The criteria are described below. Applying these criteria to the restoration project concepts received to date resulted in the Trustees' selection of preferred restoration alternatives described in this Final DARP/EA. All restoration alternatives submitted by the public or developed by the Trustees, other than Human Use projects, are presented in Section 5 and/or Appendix N. Appendix N includes both selected projects and second tier projects (that may be implemented if funding allows), as well as projects that did not meet the Threshold Criteria and were not further evaluated.

Threshold Criteria	If a project does not meet these criteria, it will not be considered further per OPA 990.53(a)(2).
1. Consistency with Trustees' Restoration Goals	<ul style="list-style-type: none"> • Does the project provide tangible benefits to plants, animals, and their habitats that were affected by the spill (e.g., shoreline habitats and resources, subtidal and fish habitats and resources, birds, marine mammals)? • Does the project provide tangible benefits for enhancing recreational opportunities that were affected by the spill?
2. Technical Feasibility	<ul style="list-style-type: none"> • Is the project technically and procedurally sound, and not already been funded or completed?
Evaluation Criteria	
1. Nexus between the Restoration Project and the Impacts of the spill on Natural Resources	<ul style="list-style-type: none"> • To what extent does the project benefit shoreline habitats and resources, subtidal habitats and resources, birds, marine mammals, or recreational opportunities and users that were affected by the spill? • To what extent does the project location or geographic scope of project benefits correspond to areas impacted by the spill?
2. Compliance with Applicable Laws	<ul style="list-style-type: none"> • Will the potential project implementer have the legal right to access the project site and conduct the project, including all necessary long-term maintenance? • Are there willing landowners who support the project?

	<ul style="list-style-type: none"> • How difficult and complex are the permitting processes required to implement the project? • How readily will the likely project implementer be able to meet all applicable laws and obtain all relevant permits.
3. Cost-Effectiveness	<ul style="list-style-type: none"> • Projects that deliver greater benefits relative to their costs will be preferred over projects that provide fewer benefits relative to their costs.
4. Range of Restoration Project Benefits	<ul style="list-style-type: none"> • Will the project benefit more than one natural resource and/or service? • Does the project fit within a total suite of selected restoration projects that address the geographic distribution and types of injuries or recreation impacts associated with the spill? • The Trustees consider the extent to which a project contributes to the overall restoration plan. This includes the degree to which a project may benefit any otherwise uncompensated spill injuries.
5. Time to Provide Benefits	<ul style="list-style-type: none"> • Projects that begin providing benefits to the target resource or public sooner are preferred to projects where the onset of benefits is not expected until far into the future. • For capital improvements, projects that are “shovel ready” will be preferred over those projects that are in the design or pre-design phases. Projects where permitting is completed (or otherwise straightforward) will be preferred to projects that require complex permitting processes that will take significant time. • For projects in general, those projects that can articulate how target resource benefits or public benefits will begin in the near future will be preferred to projects that cannot.
6. Duration of Project Benefits, and Maintenance Requirements	<ul style="list-style-type: none"> • Projects expected to have longer term benefits are favored over those that have shorter term benefits. • If long term benefits are expected, is there a mechanism in place to ensure that those benefits are realized and maintained through time? • Is there an entity that will be responsible for maintaining the project over time?
7. Avoidance of Collateral Injury from Project Implementation	<ul style="list-style-type: none"> • Project should not benefit one natural resource to the detriment of others. • A project that addresses ongoing diminishment of natural resources that resulted from the spill will be preferred.
8. Likelihood of Project Success	<ul style="list-style-type: none"> • Projects with a higher likelihood of successful implementation (e.g., obtaining necessary permits, constructing improvements, carrying out project-related activities), and that are otherwise more technically feasible are preferred.

	<ul style="list-style-type: none"> • Will there be objective indicators to measure project success and demonstrate that the project has provided natural resource benefits?
9. Total Project Cost and Accuracy of Estimate	<ul style="list-style-type: none"> • Trustees prefer the least costly project of otherwise equivalent alternatives • Projects with greater certainty of the costs related to successful implementation will be preferred over projects with high budget uncertainty.
10. Effect of Project on Public Health and Safety	<ul style="list-style-type: none"> • Projects that enhance public health and safety are preferred.
11. Opportunities for Collaboration	<ul style="list-style-type: none"> • Projects with matching funds are preferred to projects without matching funds.
12. Non-Duplication	<ul style="list-style-type: none"> • Projects funded through damages should not displace other funds. • Project should not duplicate other efforts already ongoing at the same location.
13. Education/Research Value	<ul style="list-style-type: none"> • Does the project have the potential for public education and outreach or to advance scientific knowledge for the benefit of natural resources management?
14. Cultural Value	<ul style="list-style-type: none"> • Does the project have the potential for cultural resources conservation and/or education?
15. Ability to Document Benefits to the Public	<ul style="list-style-type: none"> • The Trustees consider the ability to document receipt or delivery of benefits to the public as a result of a project or other use of funds.

5.0 Injury Quantification and Restoration Alternatives

This section describes the nature, extent, and severity of injuries to natural resources and human uses resulting from the spill, as well as potential restoration alternatives, including selected alternatives, to compensate for these injuries. This section is divided into the following resource categories:

- Shoreline Habitats;
- Subtidal and Fish Habitats;
- Birds;
- Marine Mammals; and
- Human Uses.

At the time of the spill, the Trustees created these categories to organize the assessment of injuries to natural resources. The Trustees used available information, field data, focused studies, and expert scientific judgment to arrive at their best estimate of the injuries. Scientific investigators included state and federal scientists, academic research scientists, consultants with damage assessment experience, and recognized experts within each resource category. During, and for some time following the spill, field teams were organized that included the investigators above, as well as one or more representatives of Plains (see Section 3.2.3).

In addition, the Trustees divided the spill footprint into four geographic zones (Zones A, B, C, and D) based on level of oiling (Figure 8). This was primarily done for purposes of assessing injury to shoreline and subtidal habitat.

Zone A

- Location: Gaviota State Park to Arroyo Hondo (approximately 6 miles of coastline)
- Level of oiling: moderately to lightly oiled

Zone B

- Location: Arroyo Hondo to Coal Oil Point (approximately 18 miles of coastline)
- Level of oiling: heavy to moderately oiled

Zone C

- Location: Coal Oil Point to the Santa Barbara Harbor (approximately 18 miles of coastline)
- Level of oiling: moderately to lightly oiled

Zone D

- Location: Santa Barbara Harbor to Long Beach (approximately 296 miles of coastline)
- Level of oiling: intermittent oil, characterized as moderate to no observed oil.



Figure 8. Exposure zones A-D defined for the Refugio Beach Oil Spill NRDA (black lines) with shoreline oiling categories documented during Shoreline Cleanup Assessment Technique surveys conducted by the Unified Command. See Appendix B for data associated with this figure.

The Trustees assessed injury by comparing oiled areas to “baseline” conditions, as that term is used in the OPA regulations. Baseline describes the ecological services that are present “but for” the oil spill, including factors such as the abundance, biomass, diversity, age classes of characteristic plants and animals, the availability of suitable habitat for shelter, foraging, and reproduction, and the availability of food items for fish and wildlife.

As discussed throughout this section, the Trustees concluded that the magnitude of the injuries caused by the spill has been sufficiently delineated through the various studies described herein to enable the Trustees to identify and scale appropriate restoration. While there is some uncertainty inherent in the assessment of impacts from oil spills, and while collecting more information may increase the precision of the estimate of the impacts, the Trustees believe that the type and scale of potential restoration actions would not substantially change as a result of more studies. Therefore, the Trustees sought to balance the desire for more information with the reality that further research would be costly and would delay the implementation of the restoration projects.

Each resource category section below begins with an overview of the studies conducted during the assessment and the results of those studies. The pathway of the oil and exposure are discussed and the conclusions of the injury assessment are then summarized, and the injury is quantified. Finally, the potential restoration alternatives are described, with the selected projects described in greater detail. The project descriptions include a discussion of the anticipated environmental impacts, or consequences, of the selected projects. The second tier projects are also listed and described, in lesser detail, as well (Appendix N). These projects may be

reconsidered and selected for implementation if funds become available or if selected projects prove to be infeasible. Potential cumulative impacts of implementing restoration projects are summarized in Section 6.0.

5.1 Shoreline Habitats

After the release, Line 901 oil mixed into the surf and coated Refugio State Beach and nearby beaches. Oil was also carried offshore and down shore by wave action, currents and winds. The oil spread along the Gaviota coastline and then stranded intermittently downcoast for over 155 miles, depositing oil from Gaviota State Park to the north-west, along Santa Barbara County, and intermittently throughout Ventura and Los Angeles Counties to the southeast. Affected shorelines were assessed for injuries and losses to natural resource services that they provide. For the purposes of the shoreline injury assessment, separate analyses were conducted for sand beach and rocky intertidal habitats. Each habitat assessment relied upon field data and a variety of literature sources to examine effects of the spill on shoreline biota and document the effects of oil on beaches and intertidal flora and fauna. Injuries occurring within each habitat type were quantified within distinct exposure zones (Figure 8) based upon proximity to the oil release point and oiling characteristics. Potential restoration projects also were identified and scaled appropriately based on injuries quantified within each exposure zone.

5.1.1 Overview of Data Collection and Studies

The list below summarizes various field studies, data collection tasks, and analyses used by the Trustees to assess shoreline habitat injuries.

Response Information - Compilation of Oiled Shoreline Data

Immediately after and throughout the duration of the spill, Shoreline Cleanup and Assessment Technique (SCAT) Teams were dispatched to document the location and severity of shoreline oiling and to develop cleanup recommendations. These response teams reported on details concerning the approximate location, thickness, and percent cover of oil on intertidal habitats throughout the spill-affected shorelines. This information is primarily collected to assist response crews in prioritizing cleanup decisions. Along with NRDA team member observations, the Trustees used SCAT information during their injury assessment to gain an understanding of the severity of oiling along the affected shoreline segments over time.

Extent of Oiling Quantification and Mapping

The SCAT data and supplemental information described below were compiled to create maps showing the geographical extent and maximum observed degree of oiling along each shoreline segment. The oiling of shoreline habitats was quantified in terms of area in acres and degree of oiling using SCAT descriptions (e.g. heavy, moderate, light, very light) and mapped according to shoreline type (rocky intertidal, sandy beach, mixed rocky sandy shoreline, etc.). The area of affected shoreline, in acres, was calculated for each oiling category and each habitat type (Nixon

2018). The Trustees used the compilation from this effort to define the exposure zones discussed above (Figure 8).

Oil Sample Collection and Analysis

Polycyclic aromatic hydrocarbons (PAHs) are a suite of chemical components found in petroleum products, and all oil sources display a “fingerprint” of the unique proportions of the different PAHs and other chemical markers. This enables forensic evaluation of the source(s). Forensic analyses were conducted on oil, tarballs, and tissues to confirm the shorelines affected by Line 901 oil (Stout et al. 2018).

Environmental Sample Collection and Chemical Analysis

The Trustees collected invertebrate samples (i.e., mussels, sand crabs, beach hoppers, sand-associated polychaete worms, see Section 2.3.4) and water samples (surf zone, sediment pore water, Figure 9) from a wide variety of intertidal locations within the spill-affected area and analyzed for PAHs and other components of oil. Samples were collected before and after Line 901 oil impacted the shoreline to confirm and provide estimates of degree and duration of exposure to shoreline fauna. PAHs are toxic to organisms, and some of the animal body burden concentrations were compared to toxicology literature values as an indicator for potential health effects to marine invertebrates. PAHs were elevated in all media collected at locations oiled by Line 901 compared to reference locations. Chemistry data are provided in Appendix B and results are further discussed herein, in Appendix D, and in “Shoreline data summary” (Donohoe and Joab 2018).



Figure 9. Sediment porewater sample location showing oil sheen on the surface. Photo Credit: Natural Resource Damage Assessment Trustees.

Sandy Beach Intertidal Invertebrate Population Surveys

Study sites were established by the Trustees to monitor changes in populations of beach hoppers. Sites were surveyed approximately 1 month after the oil spill, 4 months after the spill and again two years later to document changes in population abundance, biomass and size structure of these indicator animals. Data from previous surveys of populations of beach hoppers at a subset of the sites were also compared to post spill data. Study sites within the spill area showed reductions in population numbers, when compared to unoiled sites, indicative of oil spill-related impacts. For further information, see the report “Population survey results on talitrid amphipods for the Refugio Beach Oil Spill NRDA” (Dugan 2018).

Rocky Intertidal Habitat Photo Transect

The Trustees conducted Rocky Intertidal substrate surveys to monitor changes in abundances of sessile organisms, substrate, and “condition” (oil/tar presence, bleaching), within fixed plots established along vertical or horizontal shoreline transects over time (post spill and six/twelve months post-spill). Assessment sites were selected throughout the primary spill area, using a survey protocol developed for oil spills. Additionally, teams visited permanent Long Term Monitoring plots (<https://www.eeb.ucsc.edu/pacificrockyintertidal/index.html>) that occur within the approximate spill area footprint for comparison to historical data. Photos were collected at fixed plots along the transects, i.e., photoplots, and were then scored and analyzed for substrate, condition (oiling/bleaching), species composition and proportion within the photo plot. Sites were re-visited in Fall 2015, and Spring 2016, to examine for community differences, presence/absence, or proportional changes to communities or substrate. Study sites within the Zone B showed most of the species examined were more common in sites that did not experience oiling, with the exception of *Ulva* and *Porphyra*, shorter lived opportunistic seaweeds that are often associated with disturbance. For further information, see the report “Assessment of potential impacts to rocky intertidal community following the Refugio Beach Oil Spill, Santa Barbara County” (Raimondi, 2019).

Laboratory Tests with Shoreline Species

The Trustees performed laboratory studies (i.e., bioassays) with mussels and sand crabs to determine the aquatic toxicity of the Line 901 oil and its constituents. Results were then compared to the measured concentration of oil constituents in the surf zone and sediment porewater on sandy beaches. Toxicity of Line 901 oil was observed in juvenile sand crabs, mussel larvae, and larval silversides. Appendix E provides an overview of the Line 901 bioassays performed. Appendix D includes an evaluation of the toxic impacts of Line 901 oil on these organisms based on measured concentrations of PAHs in surf and pore water following the spill.

Shoreline Clean Up Data

Clean up activities, primarily beach trampling and wrack (kelp/seaweed) removal, contributed to shoreline injuries caused by the spill. The Trustees compiled information on effort, such as number of days of cleaning, mass of materials removed by cleaning teams, and the types of

cleaning expected to affect shoreline organisms as summarized in the report “Refugio Beach Oil Spill shoreline cleanup effort data report 30 Aug 2016” (Hubbard 2016)

5.1.2 Shoreline Injury

As mentioned in Section 4.1.1, the Trustees used the HEA method to estimate injury for each of the shoreline habit types⁸. Inputs to the HEA include the area of shoreline habitat impacted, the reduction in ecological services because of the spill, and time and trajectory for recovery of the affected environment. The degree of injury was related to the degree of oiling and quantified by zones (Figure 8). All rocky intertidal, sandy beach and mixed rocky sandy shorelines within the spill area were quantified in terms of acreages impacted by the spill. Degree of injury to the ecological services provided by each habitat and duration of injury until full recovery were estimated based on evidence from collected data including chemical, biological, and toxicological studies, inputs from scientific literature, and consultation with regional ecologists. Benefits of potential restoration projects were estimated and quantified in terms of their likely long-term ecological benefits. In this way, each project was “scaled” to be appropriate in size to the injury that incurred in each habitat type. Details are provided below and in Appendix F.

5.1.3 Sandy Beach Habitat Injury

Background

Much of the sandy shoreline affected by the spill is a mixture of cobble, sand, and boulders. For sandy beach environments, the Trustees chose to focus the assessment largely on invertebrates that dwell on and in sand and serve as prey items for both fish and birds, and to use these invertebrates as indicators of both exposure to and injury from the oil and its chemical components.

Line 901 oil from the release site at Refugio State Beach washed over and stranded along the Gaviota coast, and also stranded sporadically in Ventura County and some Los Angeles County beaches. Services provided by the sandy beach habitat to fish, birds and other wildlife were affected. In the most heavily oiled areas, there was smothering and fouling of invertebrates and other fauna. In areas of oil deposition, the entire intertidal zone was exposed to the oil, as it traveled back and forth with individual waves throughout the tidal cycle, until it either washed back out to sea, was stranded on the shore by the receding tides, or was buried by cycles of sand accumulation on the beach. Oil moved into the substrate as droplets, tarballs or dissolved liquid into sediment pore water as wave run-up percolated into pore spaces during higher tides. Larger oil deposits formed and persisted for long periods during periods of sand accumulation following the spill. Injuries resulting from the spill were attributed to direct contact (i.e., fouling) with oil, as well as the toxic effects of oil, including those attributed to PAHs.

In addition, shoreline cleanup efforts extended for many months and caused impacts to intertidal habitats and organisms over an extended period. In heavily oiled areas, the macrophyte wrack

⁸ Plains disagrees with the extent of shoreline injury assessed by the Trustees and asserts shoreline injury is materially lower than the Trustee’s estimate.

(stranded drift algae and surfgrass) was often oiled, and initially wrack was removed as part of cleanup operations. Wrack is of prime importance as food and habitat for a variety of invertebrate species that are a critical food source for higher trophic level organisms, including birds, fish, and crabs. Suspended detritus is another major food source for the masses of invertebrates living in the intertidal zone, and can be fouled by adhesion to oil particles or film. Conceptual diagrams shown in Figure 10 illustrate the movement of beach invertebrates and predators with tidal flux, as well as sediment porewater flow with oiling.

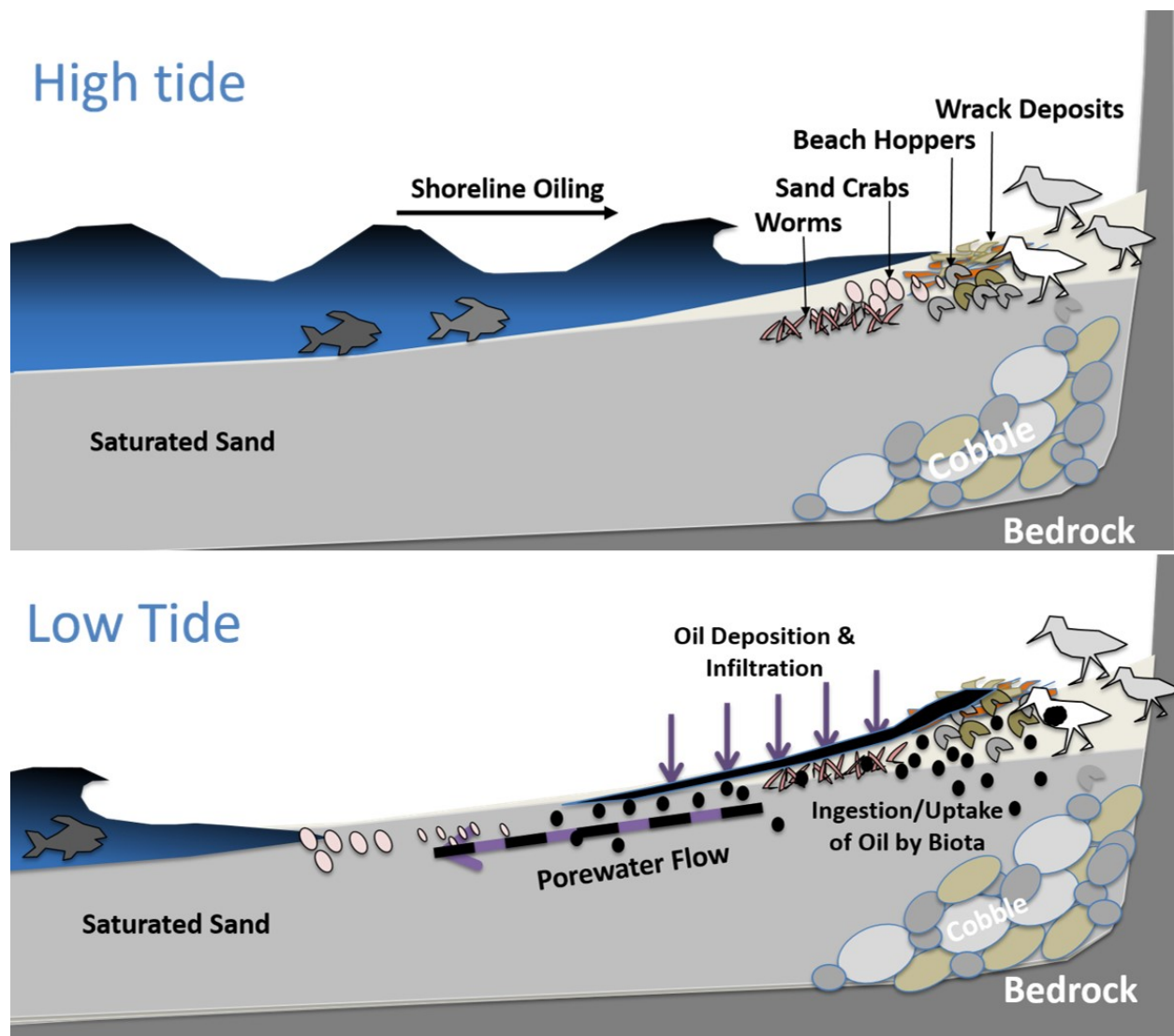


Figure 10. Conceptual diagrams of Refugio coast shoreline, sandy beach environments at high tide (top) and low tide (bottom). Sand crabs, polychaete worms, and beach hoppers are prey for birds and fish. Porewater flow down the beach profile is shown at low tide.

Sandy Beach Habitat Injury Assessment

Area of Impact

The Trustees split the area of impact into four geographic zones (Zones A through D, Figure 8) that covered the spill-affected area from west to east. Most data were collected in Zone B, the most heavily oiled zone. The area of affected shorelines within Zones A-D, in acres, was calculated based on beach width, tidal swell, and run-up data available during the oiling period. A summary of the shoreline acres affected and the duration of the injury is further discussed below and in Appendix F.

Baseline Conditions

The Trustees assessed injury by comparing oiled areas to baseline conditions, per the OPA regulations. The Trustees estimated those baseline conditions from the collection and chemical analysis of water and shoreline invertebrate samples, data on beach hopper populations from earlier studies, and other data and scientific literature pertinent to the occurrence and abundance of organisms by habitat type and location. These data were collected either before the spill, outside of the spill area or up to two years after the incident when the Trustees assumed continued exposure to Line 901 oil would have been eliminated or greatly reduced. For example, monthly to yearly sampling of sediment porewater and invertebrate tissues for chemical analysis over a two-year period in the spill area was used to estimate baseline conditions. See Appendix D for further details.



Figure 11. Oil on the shoreline at Refugio State Beach, May 19, 2015. Photo Credit: Natural Resource Damage Assessment Trustees.

Injury

The initial acute injury to sandy beach resources (direct smothering/fouling and toxicity) from the spill occurred over a period of many days. The incident started on May 19, 2015, at Refugio State Beach in Santa Barbara County, California, and the oil was transported up and down the coastline by winds and currents and deposited along the shoreline (Figure 11).

Near the end of May 2015, Line 901 oil from the spill eventually reached beaches in Ventura County and some beaches in Los Angeles County (i.e., Manhattan Beach and Redondo Beach). Spill impacts including impacts from cleanup were most severe and continued for months near the release site to El Capitan and then decreased downcoast. Mortality caused by the oil fouling and smothering of intertidal-associated organisms such as sand crabs and beach hoppers was also highest in areas near the release point to El Capitan and decreased downcoast (Figure 12; Figure 13).

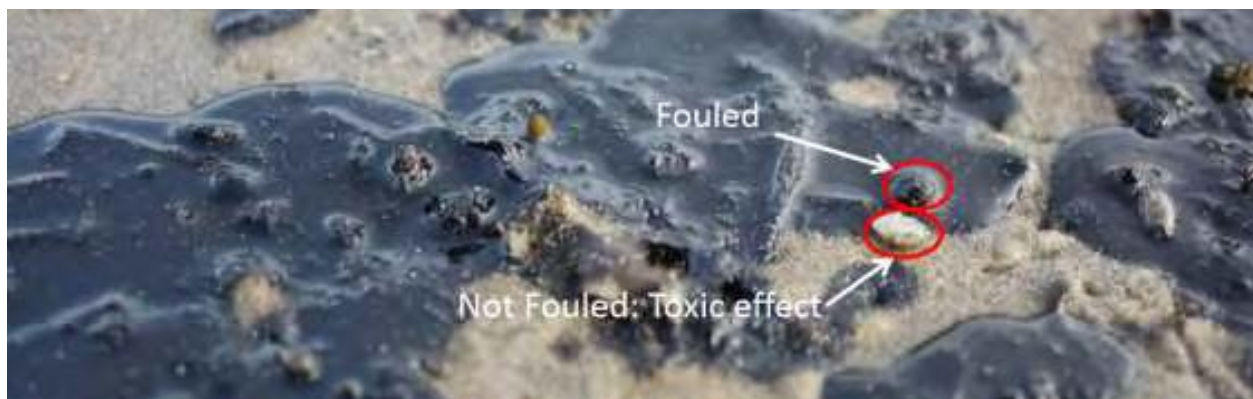


Figure 12. Oiled young sand crabs on Refugio State Beach, May 19, 2015. Photo Credit: Natural Resource Damage Assessment Trustees.



Figure 13. Oiled beach hoppers (talitrid amphipods) on Refugio State Beach, May 22, 2015. Photo Credit: Natural Resource Damage Assessment Trustees.

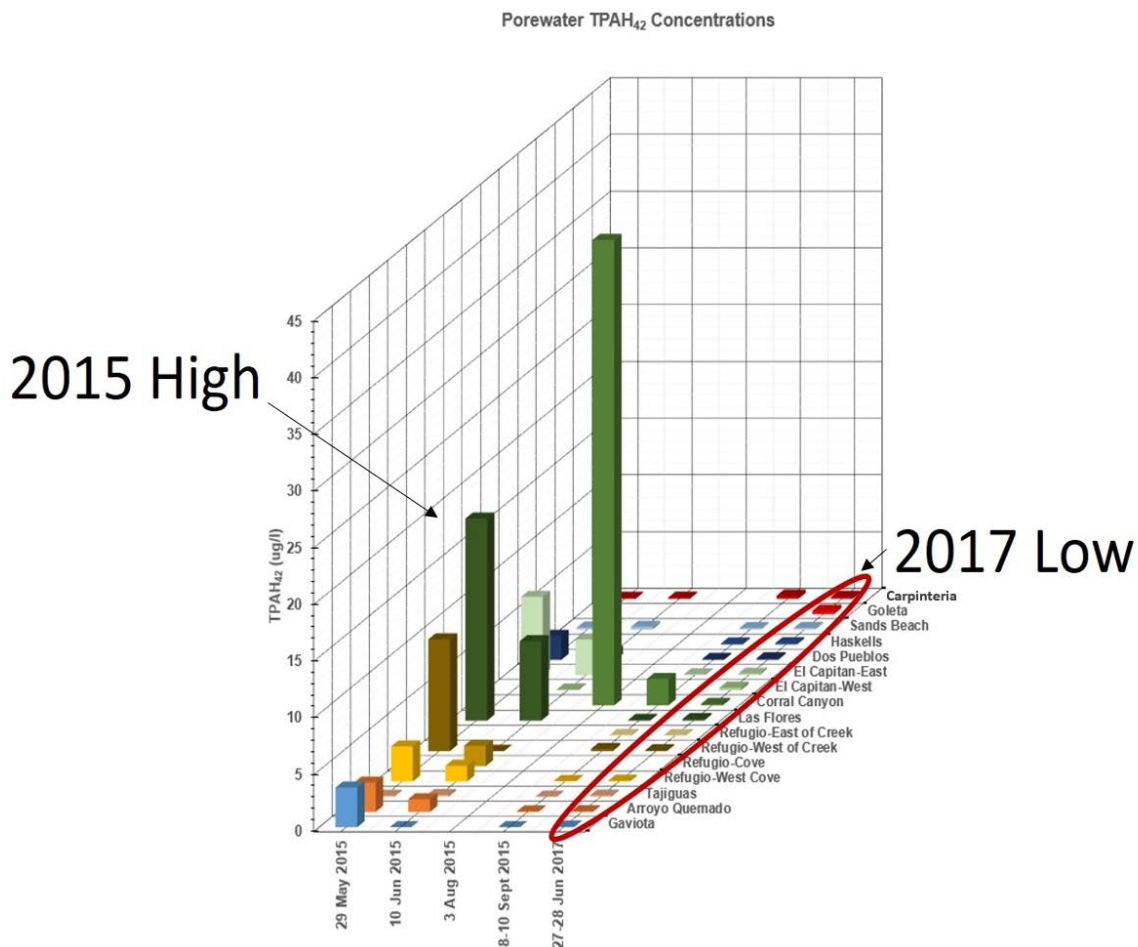


Figure 14. Total PAH concentrations in sediment porewater measured at several locations over time. 2017 values indicated by the red circle are representative of baseline conditions. See Appendix B for data associated with this figure.

Sediment porewater concentrations of PAHs between Gaviota and Haskell's along the Gaviota Coast became elevated soon after the spill and remained elevated months later, as shown in Figure 14. While seep oil is known to occur on shorelines in this area, the porewater data demonstrated a pattern over space and time that shows the spilled Line 901 oil increased the amount of PAHs in the porewater to an appreciable extent in May of 2015 and beyond. Initial PAH concentrations were highest at the locations closest to the release site and decreased as distance from the spill site increased. For example, porewater PAH concentrations decreased at locations between June and September of 2015, and by 2017, all locations were found to have very low (baseline) PAH concentrations (Figure 14). These trends suggest that the peak concentrations at the sampling sites were immediately following the spill, and then they began to decrease over time. Following a similar trend as porewater, Figure 15 shows elevated tissue concentrations of PAHs in beach hopper tissues immediately after the spill, with lower concentrations in 2016 and 2017 when compared to 2015.

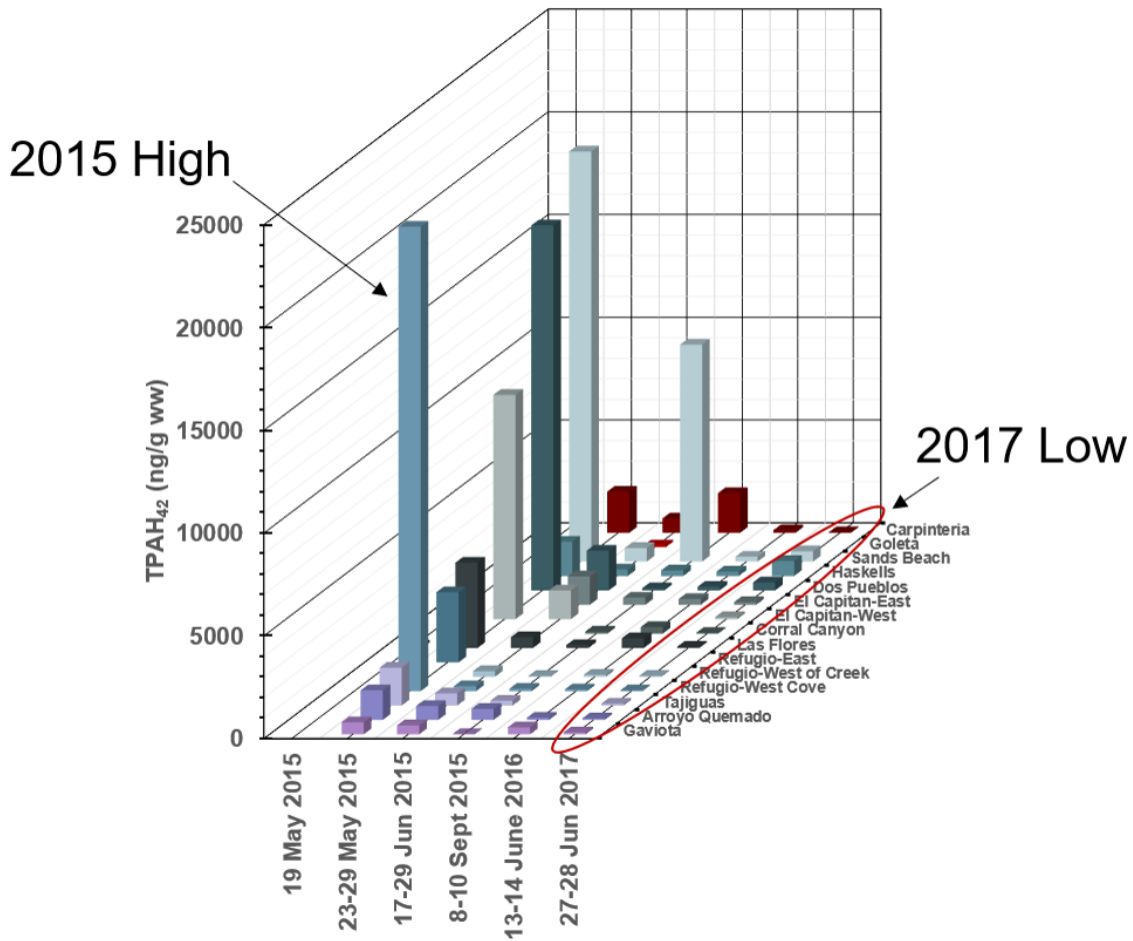


Figure 15. Total PAH concentrations in beach hopper tissue measured at several locations over time. See Appendix B for data associated with this figure.

Tissues of other shoreline organisms, including mussels, sand crabs, and sand-associated polychaete worms, also showed significant increases in tissue PAH concentrations (Appendix D, Donohoe and Joab 2018).

Sand crab toxicity thresholds for PAHs were exceeded in surf water, based on Line 901 bioassay results (Appendix D, Appendix E). Studies have shown that ultraviolet light (UV) from sunlight can enhance the toxicity of PAHs by a factor from 2-1000 (Barron 2017). Some PAHs in fish and invertebrate tissues are photo-activated by UV forming reactive products that cause oxidative damage. For the purpose of this evaluation, the Trustees adjusted LC₅₀ values by a 10-fold factor to estimate photo-enhanced toxicity.

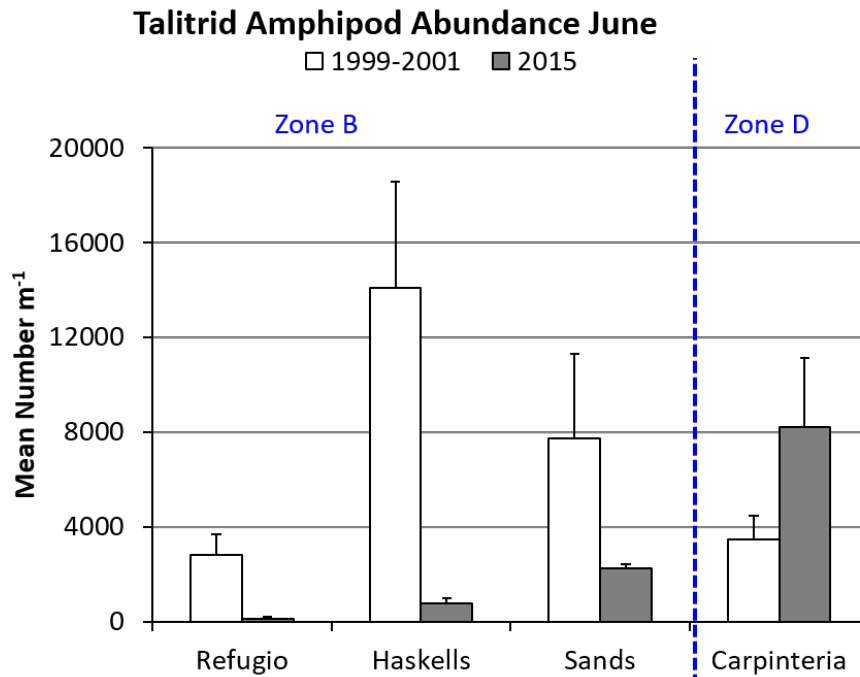


Figure 16. Mean values (+1 standard error) for population abundance of talitrid amphipods in June 1999-2001 and June 2015 at four sites on the spill-affected shoreline including three sites in Zone B, and one site in Zone D.

The shoreline assessment focused on two categories of impacts: 1) fouling and removal of beach wrack as well as other cleanup impacts and 2) oil exposure to intertidal invertebrate populations. Treatment or cleaning options for oiled wrack or stranded seaweed were limited. Oiling of wrack results in invertebrate contamination and mortality, leading to lessened and contaminated prey resources for birds. The removal of wrack material from the beach removes an exposure mechanism to the oil, but also removes the associated invertebrates and has long-term effects on foraging options for birds due to reduced invertebrate community abundance and biomass (Dugan et al. 2003; Beeler 2009). Both of these occurred in the aftermath of the spill as oiled wrack was collected and removed from heavily oiled beaches, but remained in place on more lightly oiled or unvisited stretches.

Sand crabs and beach hoppers dominate the invertebrate biomass on southern California sandy beaches (Dugan et al. 2003). As a defining ecological characteristic of lower intertidal communities, sand crabs were used to estimate and describe injury to lower intertidal habitats. Beach hoppers were selected as a proxy for assessing impacts to the upper intertidal community, as they are an important part of the sandy beach ecosystem. Beach hoppers process organic matter such as wrack. In addition, they make up a significant portion of the diet for several shorebird and other bird species. Finally, because they dominate the upper-intertidal invertebrate community it was relatively easy to assess their populations through field sampling.

Large decreases in the abundance of beach hoppers (talitrid amphipods) were documented in Zone B as well, as can be seen in Figure 16. A similar trend was apparent with biomass measurements of these organism (Dugan 2018).

The degree of injury resulting from fouling, toxicity and cleanup was estimated by the Trustees within subzones (i.e., further described as “micro-zones” in Appendix F) of Zone B. The Trustees focused on Zone B for logistical reasons and because this was the zone where oiling was the heaviest and cleanup activities were the most intense. Injury was estimated separately for lower intertidal fauna and for upper intertidal fauna. Upper and lower intertidal results were then averaged to estimate ‘whole-beach’ injury for a given zone. The sandy beach injury and much of the resulting HEA details are shown in Figure 17 and in Table 1. In Zones A and C, injury per acre was estimated as a fixed percent of the average per-acre injury found in Zone B: 20% in Zone A and 25% in Zone C. Those percentages approximate impacts associated with a lesser amount of oiling in Zones A and C when compared to Zone B. Zone D was estimated to be 5% injured in year one only, with no injury in subsequent years. Impacts in Zone D were lower because they were primarily based on removal of organisms by direct contact with oil or tarballs and other cleanup activities, along with the removal of a portion of the wrack material during cleanup activities.

Recovery

The Trustees estimates of recovery time for injured sandy beach communities were based on literature values and life history patterns of California sandy beach species, as well as monitoring data. First consideration was given to recovery of heavily disturbed sites in which there was evidence that representative fauna (sand crabs and beach hoppers) had been substantially impacted (a large percentage of mortality in several age classes). Cleanup and driving impacted some sandy beaches through at least January 2016, approximately eight months after the spill. The animals on sandy beaches have highly seasonal reproduction and will take several years to re-establish populations with full size and age structures and biomass. In addition, some sandy beach animals are more sensitive to disturbance and can take much longer to recover from severe disturbances (i.e., Pismo clams, olive snails, upper beach isopods).

Recovery to baseline is the attainment of 100% of the ecological services that would be present but for the spill, including abundance, biomass, diversity, and age classes of organisms in the affected habitats. Time to recovery was based on monitoring data, observations, and the life histories of the specific flora and fauna present in each habitat type, and relative to the degree of initial acute injury.

Sand crabs lost substantial proportions of three age classes during the Refugio Beach Oil Spill incident, and because recruitment is seasonal and episodic, recovery time for lower intertidal portion of sandy beaches was assessed as approximately three years in Zone B.

Most of the upper beach species have life histories that do not include planktonic larval stages (i.e., beach hoppers, beetles, isopods). This means there is no recruitment from planktonic

sources to replenish their populations. These species rely exclusively on the reproduction of resident individuals for population replenishment. If local populations of these taxa are extinguished or severely depressed, population recovery will be protracted. Recovery time for upper beach species (i.e., beach hoppers) was therefore assessed as approximately four years in Zone B.

Habitat Equivalency Analysis Results

As previously described, injury in Zones A and C was estimated to be a percentage or fraction of the injury determined in Zone B, since the same mechanisms of injury were present, just with lesser amounts of oil and generally less severe impacts present. In Zone D, farthest from the spill location, injury resulted from contact with oil and the resulting fouling of organisms, as well as the cleanup activities, and was much more limited (Table 1, Figure 17).

Table 1. Summary of Sandy and Mixed Sand/Rocky Substrate Injury (losses) and Habitat Equivalency Analysis results by zone.

Zone - Predominant max. oiling category	Acres exposed	Fraction of Zone B	dSAY¹ lost/ acre	Acre – years for compensation (dSAYs)
Zone A – Moderate/Lightly Oiled	63.2	0.2	0.2954	18.66
Zone B – Heavily Oiled	345.8	1	1.4771	510.70
Zone C – Moderately Oiled	191.3	0.25	0.3693	70.64
Zone D – Lightly Oiled	888.0	0.034	0.0500	44.40
Total	1488	---	---	644.4

¹dSAY = discounted service acre-year. See Appendix C.

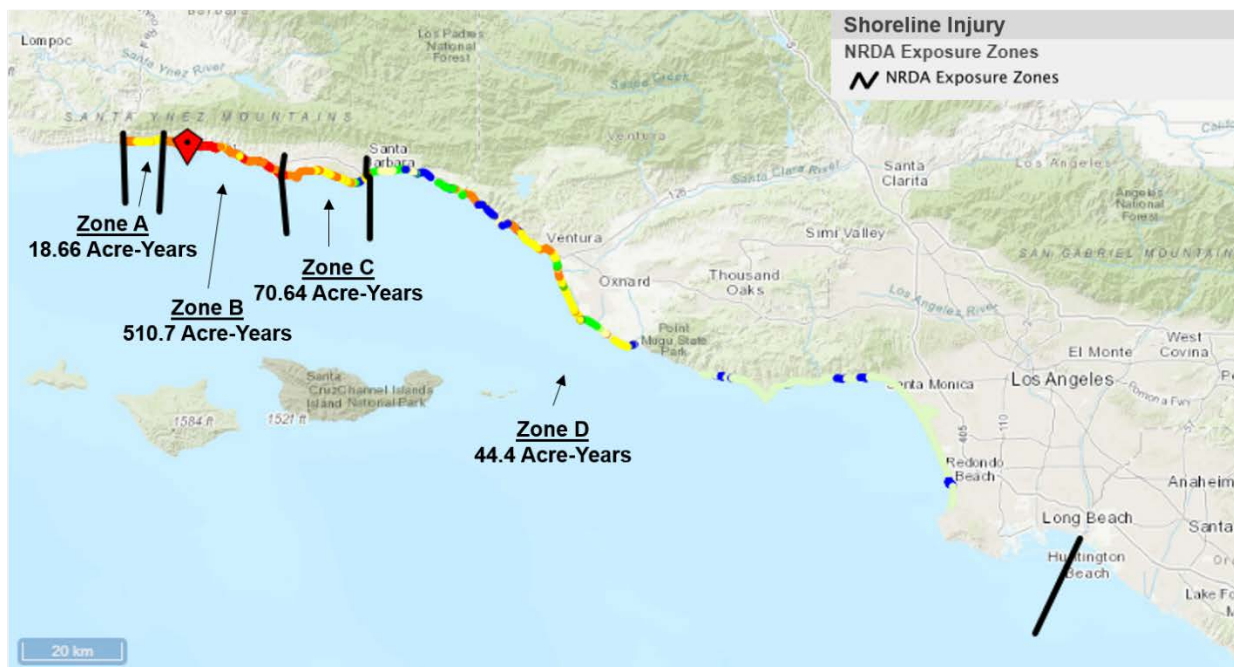


Figure 17. Map showing the summary of shoreline injury by zones. See Appendix B for data associated with this figure.

A total of 1,488 acres of sandy beach habitat was exposed to and injured by the oil spill and is expected to recover within approximately four years, depending on oiling level. Appendix D provides additional information on the injury assessment and quantification of sandy beach habitat injuries, and the scaling details are further described in Appendix F.

5.1.4 Rocky Intertidal Habitat Injury

Background

The shoreline habitat within the area affected by the Refugio Beach Oil Spill includes a variety of rocky and mixed rocky/sand substrates, ranging from artificial to natural and an approximately six-foot tidal range. Substrates investigated by the Trustees included bedrock, boulder, cobble, and some man-made riprap and seawall. The habitat used by biota is three dimensional, with organisms on the surfaces of rocks, as well as along the sides, undersides, and between substrates. The biota present on these substrates vary depending upon tidal elevation. Figure 18 shows the conceptual diagrams of the rocky intertidal habitats and some of the immediate and longer-term impacts of oil exposure.

Rocky Intertidal Habitat Injury Assessment

Area of Impact

The Trustees quantified the number of impacted acres by using SCAT data, as described above. Injury categories were subdivided based on regional differences in biota and exposure and by differences between more natural rocky substrates and rip-rap as described below. The Gaviota Coast shoreline includes a mixture of sandy and rocky intertidal habitat. Sand migrates significantly throughout the year, burying boulders and rock outcroppings, a process that tends to scour any sessile organisms and prevent them from forming significant communities. The Trustees assessed that a total of 5.4 acres of pure rocky intertidal habitat was injured in the HEA (Appendix F), with the remainder of the shoreline (mixed rocky/sandy and sandy beach) included in the sandy beach assessment and quantification.

Baseline Conditions

The Trustees evaluated pre-spill data that provides a quantitative description of rocky intertidal biota within the spill-affected area. Historical long-term monitoring data, generated by the Multi-Agency Rocky Intertidal Network (MARINE) program, were used to determine general “pre-spill” conditions. Historical data are located at <https://www.eeb.ucsc.edu/pacificrockyintertidal/index.html>.

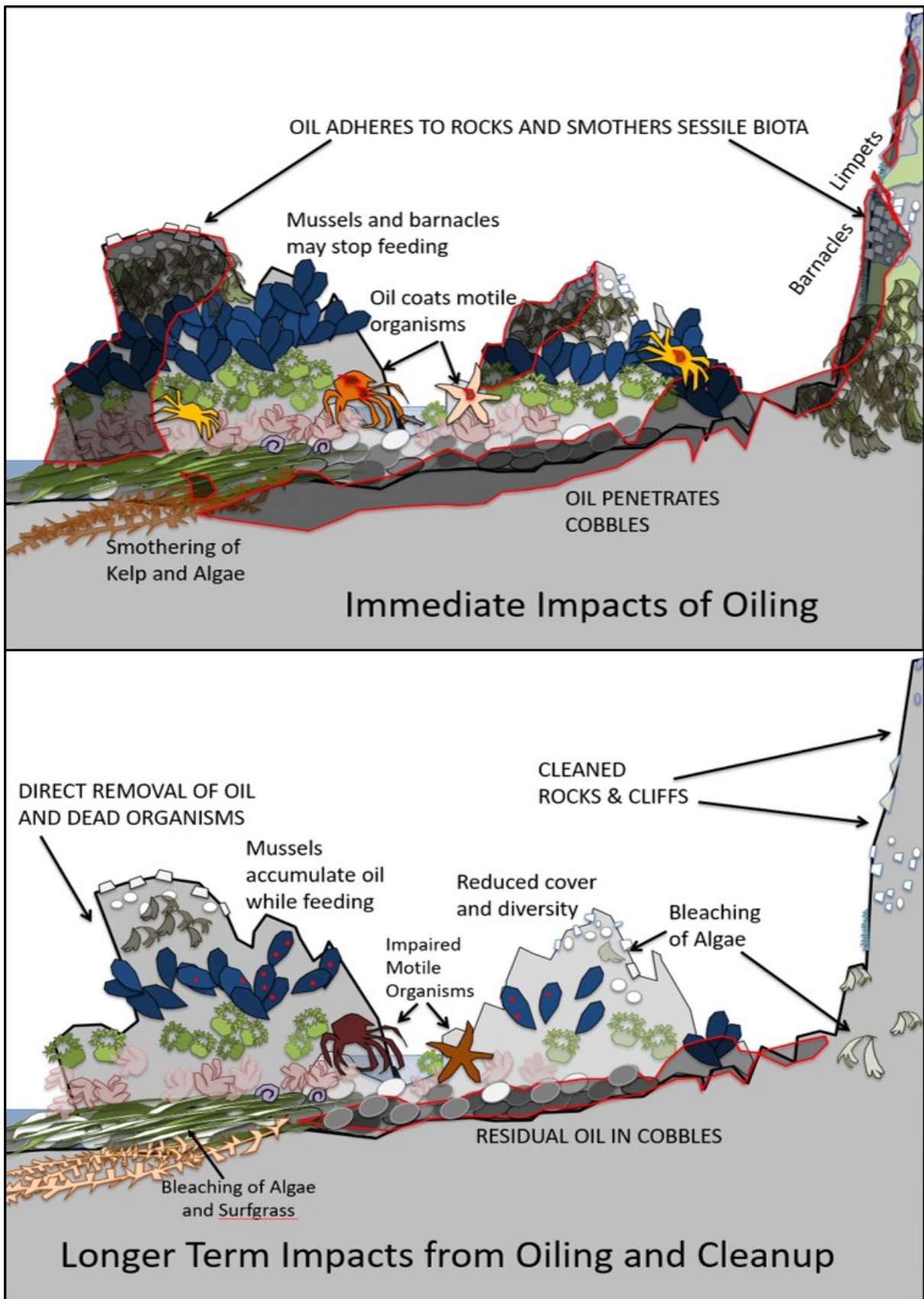


Figure 18. Conceptual model of oil immediate effects (top) and long-term effects (bottom) of oil in rocky intertidal habitats.



Figure 19. Photographs of oiled rocky habitat and organisms following the spill. Photo Credit: Natural Resource Damage Assessment Trustees.

Injury

The Trustees determined that the degree of impacts varied with the amount of oiling. The most significant fouling was noted in locations directly adjacent to the release site (rocky outcrops adjacent to Refugio, Corral Canyon, and El Capitan, Figure 19). Impacts to rocky intertidal habitat were assessed through a number of field-based studies. Similar to the sandy beach habitat, the degree of oiling was classified in rocky intertidal habitat based on descriptors used in the SCAT data. In addition to the field studies conducted after the oil spill, the Trustees also relied on other monitoring programs (e.g., MARINe) that had pre-existing, long-term monitoring data in locations affected by the spill. The Trustees determined that the initial acute injury was caused by direct smothering/fouling and toxicity of individual organisms and habitats at those

locations nearest to the oil release site. Subsequent injury was the result of tissue necrosis/bleaching of the sessile organisms populating these habitats within the same locations. Furthermore, injury due to trampling (from spill assessment and cleanup activities), physical cleaning of rocky intertidal habitats, and sublethal effects from exposure to PAHs were evaluated.

The Trustees collected mussels from intertidal habitats throughout the spill-affected area for PAH analysis, both immediately after the release and several weeks later. This provided an indication of those shorelines most significantly fouled by the oil, as well as the duration of exposure. Mussels collected soon after the spill from rocky shores adjacent to Refugio beach and El Capitan contained the highest PAH concentrations of all samples and continued to contain the highest concentrations two weeks later (Appendix B).

The Trustees conducted rocky intertidal photo-plot surveys to monitor changes within fixed plots over time. These were conducted at nearby long-term monitoring sites and compared to sites selected in the spill-affected area. The sites were re-visited in Fall 2015, and Spring 2016, to survey for community differences or proportional changes to communities or substrate. Study sites within the heaviest oiling areas (Refugio, El Capitan, and Coal Oil Point) documented oiled organisms and substrate after the spill. Further, community changes in follow-up surveys, potentially indicative of oil-related impacts, were noted when compared to less impacted sites away from the heaviest oiling area (Raimondi et. al., 2019).

Recovery

The Trustees based recovery on the life histories of affected biota and on notable increases of “disturbance indicator” species (sea lettuce and the red algae, *Porphyra*) quantified during anniversary surveys at the most impacted sites. In addition, recovery estimates were based upon the recovery time of key intertidal assemblages (fucoid, barnacle, mussel, and mid-intertidal red algae) following disturbance. Recovery was also estimated based upon key intertidal assemblages (fucoid, barnacle, mussel, and mid-intertidal red algae) as summarized in a UC Santa Cruz disturbance study (Conway-Cranos 2012).

Habitat Equivalency Analysis Results

The Trustees estimated that a total of 5.4 acres of rocky intertidal habitat was exposed to and injured by the oil spill and is expected to have recovered after two years (Table 2). Appendix F provides additional information on the injury assessment and quantification of these habitat injuries.

Table 2. Summary of Rocky Intertidal Injury (losses) and Habitat Equivalency Analysis results

Zone - Predominant max. oiling category	Acres exposed	dSAY¹ lost/acre	Acre – years for compensation (dSAYs)
Zone B– Heavily oiled	5.4	0.34	1.83
Total	5.4	---	1.83

¹dSAY = discounted service acre-year. See Appendix C.

5.1.5 Summary of Injury

Shoreline habitats were subject to heavy oiling near the spill site in the days following the oil spill on May 19, 2015. Rocky (bedrock and cobble), sandy beach, and mixed shores received heavy coatings of liquid oil that were transported up and down the shore by waves and spring high tides. In the splash zone, oil was deposited much higher than the reach of the tides.

The oil remained in the environment in the weeks and months after the spill, attaching to rocky habitat, settling into intertidal cobble beds, and percolating into, or being buried by, accumulating sand on sandy beaches. As a result, beach porewater retained elevated concentrations of PAHs much longer than the surf zone water, with elevated values continuing for weeks and months after the spill.

Shoreline plants and animals at all intertidal levels were exposed to Line 901 oil and were fouled by it. Toxic effects on a variety of intertidal marine species were evident in field observations as well as in toxicity tests run in the laboratory with shoreline invertebrates.

Shoreline animal tissues sampled before the spill had low concentrations of PAHs. These concentrations increased dramatically after exposure to Line 901 oil and then declined over weeks to months.

Some elements of the shoreline cleanup continued until January 2016. Clean up involved removing oil, sand, and wrack from the shoreline, scraping, blasting, shoveling, sifting and driving on shoreline habitats. Two of these activities, removing wrack and driving, have significant impacts on beach ecosystems.

As the spill spread more than 155 miles east and southward, the character of the oil changed. The oil that landed on Los Angeles County beaches⁹ was less liquid but still sticky and buoyant. It was deposited with kelp and other wrack in the intertidal zone where abundant beach organisms live. The decision was made that it should be removed from the shoreline. This cleanup effort removed oil, wrack, and the animals associated with that material.

⁹ Tarballs matching Line 901 oil landed on two South Los Angeles County beaches – Manhattan Beach and Redondo Beach.

Recovery of the impacted shoreline zones is expected to vary from one to four years, varying by zone, and based on the severity of the initial acute injury.

5.1.6 Selected Restoration Projects

The Trustees selected four projects described below to compensate for injuries to sandy beach and rocky intertidal habitats caused by the oil spill (Table 3).

For the shoreline habitats, no single preferred restoration project was able to compensate for all the injury. For this reason, four restoration projects were selected. These projects ranked as providing the greatest benefits to the injured ecosystem.

Table 3. Four selected projects to compensate for shoreline injury

ID#	SELECTED PROJECTS	BENEFITS
SHORE-1	Ellwood Seawall Removal	shoreline habitats, sandy beach
SHORE-2	Ventura County Dunes Restoration	shoreline habitats, sandy beach
SHORE-3	Santa Monica Dune and Beach	shoreline habitats, sandy beach
SHORE-4	Black Abalone Restoration and Relocation	shoreline habitats, rocky intertidal

Ellwood Seawall Removal (SHORE-1)

The goal of this project is to restore sandy beach and mixed shoreline ecosystems and dynamics in Zone B, the area where the greatest impacts of the spill were realized. This project will also benefit subtidal and fish habitats offshore of the seawall (section 5.2.3). The project site is Ellwood Beach in Goleta, CA (Santa Barbara County). A wooden seawall currently constrains natural functioning of the ecosystem as well as lateral access along the shoreline at high tide.

Affected Environment

The project will have impacts to intertidal shoreline (currently sandy beach, mixed rocky habitat, sandy shore, artificial structures, creosote preserved timber bulkhead, and rock/concrete rubble revetments), coastal bluff and shallow subtidal habitats.

Environmental Consequences (Beneficial and Adverse)

Overall, this project is anticipated to have only minimal adverse environmental consequences and multiple beneficial impacts. In reaching this conclusion, the Trustees evaluated several types of potential impacts, as described below.

1. *Biological Impacts* – The removal of the armoring structure will allow overall intertidal habitat to increase in width, functions and diversity, specifically restoring upper beach and supralittoral zone habitats that are currently absent from the armored coastline. Intertidal zones that have been lost will be restored along with ecosystem functions and biota dependent on those zones, including wrack deposition and processing, invertebrate abundance and diversity, bird abundance and diversity, and grunion spawning habitat.

There is potential adverse biological impact to vegetation and habitat established on the bluff faces and tops during the removal activities and from the removal activities and the expected erosion that takes place once the intact portions of the seawall are removed. During the removal activity there will be crushing of some of the sandy beach organisms, such as invertebrates in and under the surface of the sand, from the machinery used in the processes of removal. Birds are expected to temporarily be disturbed on the affected shoreline while removal activities are undertaken. These impacts are anticipated to affect a small number of organisms for a limited amount of time, and will have long-term beneficial effects for these biological resources.

2. *Physical Impacts* – Longer term, post removal, the beach is expected to be wider than it is currently where the seawall is intact, and there will be a reduction of reflective processes that remove sand from the beach. Removal will also eliminate the source for creosote-contaminated debris along the shoreline as the wall deteriorates and is broken up by wave action. Movement of equipment and machinery needed to remove the seawall is expected to temporarily block some portions of this shoreline and temporarily compact the substrate. Noise from this activity will be present in the short term, until the removals are completed. Short-term adverse effects from construction activities (potentially higher turbidity, sediment transport) are expected to be minimal but may occur. Longer term impacts will include a return to natural bluff erosion rates and mobilization of loose material at the bluff toe during extreme high tides.
3. *Human Impacts* – Lateral access to people along the shoreline at high tide is expected to increase where the seawall is currently intact. Temporary disturbance to recreation in the demolition area will occur during removal activities. Human uses of any land on the slope to and on top of the bluff, near the edge that is expected to erode, will be changed as erosion occurs; however, the removal of the seawall allows for the potential future installation of pathways to access the beach from the bluff. Overall, there will be a small temporary loss of beach use by the public during the construction, but an overall long-term increase in public access in the area where the seawall will be removed. Overall, there will be a small temporary loss of beach use by the public during the construction, but an overall increase in public access to the beach in the area where the seawall will be removed.

Probability of Success

Project success is likely as the implementation actions will lead to immediate adjustments in the physical properties of the shoreline. Project implementation will require a high level of planning and coordination to work within short tidal periods; however these factors have been considered and planned for, and the probability of success is high. Ecological services should respond within a few years of the physical changes. Longer term responses will depend on the balancing of sediment supply, bluff erosion and sea level rise. While the exact progression of bluff erosion is uncertain over the long term, this project removes a barrier that is interfering with natural coastal dynamics in the area, and removing that barrier is anticipated to benefit ecological resources.

Performance Criteria and Monitoring

The success of the restoration project will be evaluated by assessing metrics associated with natural resource functions and services. Metrics will be compared with: 1) initial conditions at the project site and/or 2) conditions at an appropriate nearby natural reference site or sites. The restoration of natural coastal dynamics at the restoration project site should allow for recovery of physical and ecological functions and services over time. Monitoring efforts should track indicators associated with the structure and function of the restored ecosystem. In addition, the responses of bluff topography, profile and vegetation should be monitored to document shoreline evolution at the site. Key physical and ecological indicators will be measured and monitored regularly at the project and reference site or sites for five years.

Performance criteria may include:

- Intertidal beach habitat area: area and distribution of ecological habitat zones;
- Marine subsidies: standing crop of marine macrophyte wrack;
- Sandy intertidal invertebrates: diversity, biomass and abundance of key taxa by intertidal zone; and
- Bird use: use of beach zones by shorebirds, gulls, roosting seabirds, other species.

Performance criteria will be calculated based on multiple surveys at an appropriate reference site or sites or multiple transects within the site.

Evaluation

The Trustees have evaluated this project using the threshold and additional screening criteria developed to select restoration projects and concluded that this project aligns favorably with these criteria. This type and scale of project will effectively provide appropriate compensation for injured sandy intertidal habitat because of the spill, and the Trustees have therefore selected this project as one of four preferred alternatives.

Ventura County Dune Restoration (SHORE-2)

Three dune enhancement projects at Ormond Beach, San Buenaventura and McGrath State Beaches in Ventura County will reduce invasive plant abundance and restore native plants, dune forms and processes that will support rare coastal species. These projects are all located in Zone D.

Affected Environment

The project site will include intertidal sandy beach and degraded (trampled and invaded by non-native plants) dune habitat. Portions of the three project sites are nesting and brood-rearing areas for special status birds: western snowy plovers and California least terns.

Environmental Consequences (Beneficial and Adverse)

Overall, this project is anticipated to have only minimal adverse environmental consequences and multiple beneficial impacts. In reaching this conclusion, the Trustees evaluated several types of potential impacts, as described below.

1. *Biological Impacts* – The project will restore a higher level of ecological functioning to degraded dune habitat. The current ecosystem services of the degraded dune area are reduced by high cover of non-native plants, altered physical processes and trampling in un-fenced areas. Removal of invasive plants will increase the amount of useable nesting areas for the western snowy plover (threatened) and, in some locations, the California least tern (endangered) and reduce cover for predators of eggs, chicks and adult birds. The presence of workers to implement the non-native plant removal in the dunes, along with their equipment, may temporarily disturb or displace birds and other wildlife. These temporary adverse effects are anticipated to be minor, and the overall long-term biological impacts are anticipated to be make a tangible improvement in the habitat quality for listed birds and other coastal wildlife.
2. *Physical Impacts* – Enhancement of native vegetation also permits the development of more natural dune dynamics that promotes the maintenance of more suitable slope faces and important material exchanges between the dunes and the intertidal sandy beach that can buffer erosion on beaches. This allows the dunes to provide a physical benefit to the intertidal sandy beach. Any adverse physical impacts during the implementation of the project are expected to be negligible, and long term benefits to the physical environment are anticipated upon completion of the project through restoration of dune habitats and processes.
3. *Human Impacts* – The Trustees do not anticipate noteworthy impacts from this project on socio-economics, aesthetics, health and safety, historical properties, etc. Increased bird use, such as by western snowy plover or California least tern could be expected to increase birdwatching interest in the restored dune areas. Dunes could become somewhat less stable and allow for movement to a greater extent than this sand currently does. If such movement affects parking, driving, or other developed areas, this may be undesired.

Probability of Success

The project is very likely to succeed in all three project sites. The proposed restoration methods—weed control and fencing to reduce trampling disturbance—have been shown to be effective in nearby sites and elsewhere in southern California as well as throughout the State.

Performance Criteria and Monitoring

The success of the restoration project will be evaluated by assessing metrics associated with natural resource functions and services. Metrics will be compared with: 1) initial conditions at the project site and/or 2) conditions at an appropriate nearby natural reference site or sites. Key ecological indicators to be measured and monitored include cover of native and non-native vegetation, as well as nest monitoring of western snowy plovers and California least terns. These efforts will be compatible and complementary with existing monitoring programs and continue for a period of up to five years to evaluate the ecological integrity of the site following implementation of restoration.

- For dunes, the target goals may include but are not limited to:
 - Restoring and increasing resiliency of dune habitat;
 - Reducing non-native vegetation cover to <99% in project area during lifetime of project; non-native vegetation cover should remain at <1% throughout project monitoring phase; and
 - Increasing native dune vegetation in areas where non-natives have been removed; native vegetation should persist into project monitoring phase.
- For bird use, the project will include monitoring the following attributes up to a period of five years:
 - Number of nests per year;
 - Number of fledglings per year; and
 - Comparison with baseline assessment.

Evaluation

The Trustees have evaluated this project using the threshold and additional screening criteria developed to select restoration projects and concluded that this project aligns favorably with these criteria. The dune restoration projects in Ventura County are located within the spill-affected area, and are the closest option that the Trustees have identified for this type of restoration. This type and scale of project will effectively provide appropriate compensation for sandy beach habitat injured as a result of the spill, and the Trustees have therefore selected this project as one of four preferred alternatives.

Santa Monica Bay Beach and Dune Restoration (SHORE-3)

The goal of this project is to restore sandy beach and coastal dune habitat that has been degraded by intensive mechanical grooming. The project site is a public beach in Santa Monica Bay in Zone D (Los Angeles County).

Affected Environment

The project site will include intertidal sandy beach and degraded (unvegetated) coastal strand and dune habitat.

Environmental Consequences (Beneficial and Adverse)

Overall, this project is anticipated to have only minimal adverse environmental consequences and multiple beneficial impacts. In reaching this conclusion, the Trustees evaluated several types of potential impacts, as described below.

The project will restore ecosystem function of sandy beach, coastal strand and dune habitats by protecting approximately five acres from the daily disturbance caused by mechanical beach grooming with heavy equipment and vehicle traffic and by planting upland portions of the site with native dune plants. The project will restore a high level of ecological functioning to degraded beach and dune habitat. The current ecosystem services of the degraded dune area is close to zero due to mechanical grooming activities, and those of the beach habitat is severely depressed.

1. *Biological Impacts* – By eliminating intense regular disturbance with heavy equipment, this restoration project will allow natural coastal processes to reshape the topography and ecology of the site, promoting the recovery of natural biodiversity and function. With appropriate stewardship, hummocks and vegetation will develop on the shoreline supporting native plants, birds and invertebrates that are currently extirpated at the site. The restored habitat will retain macrophyte wrack subsidies, increase intertidal and invertebrate abundance and diversity, increase the abundance and diversity of birds and will be more suitable for grunion spawning. No adverse biological impacts are anticipated, as the restoration area has very low sandy beach ecological services currently. Following restoration, the area is expected to increase in ecological functionality due to the foundational habitat that will be replaced where none currently exists.
2. *Physical Impacts* – The topography is expected to change at the restored site, with the formation of natural hummocks which is consistent with increased resilience to sea level rise. Fencing around the site will be present once the restoration is underway. Any adverse physical impacts during the implementation of the project are expected to be negligible, and long term benefits to the physical environment are anticipated upon completion of the project.
3. *Human Impacts* – The Trustees do not anticipate noteworthy impacts from this project on socio-economics, aesthetics, health and safety, historical properties, etc. Fencing will restrict the access through and around the restored site to some extent, but human access will continue on the site, although the types of recreational activities may change somewhat toward wildlife viewing. Increased plant, floral, and wildlife activity on the site may attract increase interest from bird watchers and others interested in the flora and fauna that will repopulate the site.

Probability of Success

The project is very likely to succeed in both of the target habitat zones. Cessation of grooming has been shown to be an effective beach restoration technique. The dune restoration plan will be based on a pilot project currently underway in Santa Monica. This model has been effective through planning and early implementation phases.

Performance Criteria and Monitoring

The success of the restoration project will be evaluated by assessing metrics associated with natural resource functions and services. Metrics will be compared with: 1) initial conditions at the project site and/or 2) conditions at an appropriate nearby natural reference site or sites. Project site selection will likely be based on very low initial function level (mechanically groomed with no vegetation or dunes, low nutrient beach sand). Ecological responses to restoration actions will likely begin slowly and increase over the five-year monitoring period. Performance criteria may be expressed as trajectories of increasing function over time and divergence from groomed reference sites.

Performance Criteria may include the following key physical and ecological indicators:

- Project Area: acres measured each year to ensure project is not encroached upon.
- Topography/elevation/profile:
 - Dune and hummock building (sand storage, increased topography and resilience);
 - Increased elevations of topography and sand storage;
 - Altered profile (formation of foredune); and
 - Criterion: maximum elevation of dune features to increase across the site to increase at 0.1 m per year in the first five years.
- Vegetation:
 - Absolute cover of native dune plant species;
 - Absolute cover of non-native plant species (less than 1%); and
 - Native dune plant species richness.

Evaluation

The Trustees have evaluated this project using the threshold and additional screening criteria developed to select restoration projects and concluded that this project aligns favorably with these criteria. The Santa Monica Bay beach and dune restoration project is conceived to be implemented within Los Angeles (LA) County. Since shoreline resources were the largest area of habitat impacted by the oil spill, implementing this restoration in LA County offers an opportunity to compensate for injured resources near the ends of the spill-impacted area. This type and scale of project will effectively provide appropriate compensation for sandy intertidal habitat injured as a result of the spill, and the Trustees have therefore selected this project as one of four preferred alternatives.

Black Abalone Restoration and Relocation (SHORE-4)

The goal of this project is to aid in restoration of intertidal black abalone populations in areas affected by the spill. The project is comprised of four tasks: (1) characterization of the genetic structure of the donor and recipient population, (2) clearing areas of fouling organisms and placing recruitment modules to make habitat suitable for transplanted post-emergent black abalone and for settlement of larval black abalone, (3) transplantation of post-emergent black abalone from a donor population, and (4) adaptive assessment and management of transplants.

Affected Environment

Locations will be identified throughout the Gaviota coast, which are suitable for abalone. These will have the specific habitat attributes associated with abalone occupation (in general, deep cracks and crevices within the tidal range of black abalone).

Environmental Consequences (Beneficial and Adverse)

Overall, this project is anticipated to have only minimal adverse environmental consequences and multiple beneficial impacts. In reaching this conclusion, the Trustees evaluated several types of potential impacts, as described below.

1. *Biological Impacts* – This project seeks to ameliorate current conditions in suitable intertidal habitat, by preparing the substrate for better recruitment, while also transplanting adults to augment the likelihood of future recruitment. Recovery of a species from massive decline requires successful recruitment of new individuals into areas where local populations were impacted. Recruitment is dependent on both an available supply of new individuals and specific environmental conditions required to induce settlement. The goal is to restore a viable population of black abalone in suitable intertidal locations that are selected. Areas will be cleared of fouling organisms, leaving clean surfaces in the cracks and will be maintained until donor individuals are transplanted. The impacts of clearing the fouling organisms from the transplant areas are anticipated to be negligible to the ecosystem function, and will result in long term ecological benefits when viable populations of black abalone are reestablished.
2. *Physical Impacts* – The Trustees do not anticipate major impacts to the physical environment, such as water, air, sediment, etc. Any adverse physical impacts are expected to be negligible. Areas will be cleared of fouling organisms, leaving clean surfaces in the cracks and will be maintained until donor individuals are transplanted.
3. *Human Impacts* – The Trustees do not anticipate noteworthy impacts from this project on socio-economics, aesthetics, health and safety, historical properties, etc.

Probability of Success

Project implementers have been monitoring regional black abalone populations for nearly 25 years, and have been assessing the recruitment of new individuals and the biogenic habitats required for successful recruitment. The project implementers will strive to maximize the probability of success based on their knowledge and experience with black abalone.

Performance Criteria and Monitoring

The success of the project will be evaluated by assessing metrics associated with natural resource services. An important step towards recovery is the aggregation of abalone at densities high enough for successful fertilization, through both success of transplantation and aggregation of individuals, and recruitment of new juveniles. Because black abalone larvae have never been reared successfully in the lab to settlement stage, a field approach is required. Metrics for success include maintenance of an appropriate density of adult individuals (approximately 2 individuals per square meter), and the other is the recruitment of new juveniles. Based on previous studies, recruitment modules, consisting of small stacked tiles that mimic small crevice features of boulder fields, may be used to effectively attract new recruits. These modules may then be used to attract larvae to restored habitat areas, or move newly settled juveniles from sites with recruitment, to areas where recruits are absent. These modules will allow easy monitoring of recruitment and growth, for up to 10 years, to determine success of the project.

Success may be assessed relative to controls. Should greater recruitment occur in areas subjected to restoration via translocation of adults than in control areas, we would conclude the

translocation enhanced repopulation of black abalone. The ratio of recruitment in restored areas relative to controls could be a quantitative metric of enhancement value. Should no recruitment occur in either control or restoration areas we will compare results to other areas not demographically affected by withering disease. If recruitment occurred over the 10-year period in the unaffected sites but not in the restored areas, then the effectiveness of the restoration will be called into question and methods for future restoration efforts will be modified accordingly.

Evaluation

The Trustees have evaluated this project using the threshold and additional screening criteria developed to select restoration projects and concluded that this project aligns favorably with these criteria. The Trustees believe that this type and scale of project will effectively provide appropriate compensation for rocky intertidal habitat injured because of the spill and have therefore selected this project as a preferred alternative.

5.1.7 Second Tier Restoration Projects Considered

The Trustees also considered the following projects (Table 4), and determined that many are valid projects that would provide benefits to shoreline habitat. However, these projects were not selected as preferred for various reasons described below. These projects may be reconsidered if a selected project cannot be implemented or if remaining funds allow.

Table 4. Second tier shoreline restoration projects that may be implemented if funds allow.

ID#	OTHER PROJECTS CONSIDERED	BENEFITS
SHORE-5	Surfer’s Point Phase II	Sandy beach
SHORE-6	Matilija Dam removal	Sandy beach, riparian
SHORE-7	Gaviota Creek Watershed Restoration	Riparian, lagoon, sandy beach
SHORE-8	El Capitan State Park Concrete Removal Project/Bike Path and Rip Rap Removal	Sandy beach
SHORE-9	Santa Barbara County Seawall Removals	Sandy beach
SHORE-10	Coastal Hazards Removal, Goleta Beaches from hazards removal, Arroyo Hondo to Coal Oil Point	Not clear. Sandy beach
SHORE-11	Coal Oil Point Research and Education	Coal Oil Point Preserve
SHORE-12	Devereux Slough Restoration	Slough and meadow
SHORE-13	Funding a Quick Reaction Cleanup Crew for Tar Found on Beaches	Sandy and rocky shoreline
SHORE-14	BEACON, San Ysidro and Cold Springs/Montecito Creek, and San Antonio Creek Debris Basin Removal Projects to Improve Sediment Transport for Beach Nourishment. Removal of Unnecessary Sediment Basins from the Gaviota Coast	Sandy beach

SHORE-15	Refugio and Gaviota Coast Human Impact Mitigation and Protection Program (Tajiguas, Mariposa Reina South, and Vista) Human Impact Mitigation	Sanitation, recreational
SHORE-16	Other Dune Restoration Projects, including but not limited to, Hollywood Beach, Ellwood Invasive Plant Restoration, Ventura City Beaches, Vandenberg AFB	Sandy beach
SHORE-17	Coal Oil Point Pilings and Debris Removal	Lagoon, human safety, possible sandy beach
SHORE-18	Classroom Education and Outreach	Rocky intertidal
SHORE-19	Refugio and El Capitan Rocky Intertidal Docent Program	Rocky intertidal
SHORE-20	Increase Substrates for Rocky Intertidal Species	Rocky intertidal
SHORE-21	Cessation of Beachgrooming	Sandy beach
SHORE-22	Rindge Dam Removal	Sandy beach, riparian

Surfer’s Point Phase II (SHORE-5)

This project includes infrastructure and habitat enhancements to the Surfer’s Point shoreline area in Ventura. It is not currently among the preferred projects as its focus is on recreational use rather than ecological benefit. Therefore, it does not appear feasible at the time of this plan, unless it receives support from recreational use funding from the Trustees or other sources. Ecological restoration costs would be expected to be a small part of the total project.

Matilija Dam Removal (SHORE-6)

This project is the removal of Matilija Dam, which is full of sediment and does not function as a drinking water reservoir which was its intended purpose. Removal of the dam would restore natural sediment flows, which enrich beaches through sand deposition. This project was not selected, as it is not yet clear if it is technically feasible, and due to the very high cost associated with the project (estimates over \$100 million). Also, this project is too early in the planning and environmental review phase to be properly evaluated at the time this restoration plan was prepared.

Gaviota Creek Watershed Restoration (SHORE-7)

This project includes the relocation of the Gaviota State Park entrance road along with riparian/estuarine enhancements. The relationship to injured resources directly on the shoreline is more tenuous, though it may have recreational benefits to human uses. The time to provide benefits to sandy beach resources is potentially distant. Also, while this project meets some sandy shore restoration goals as a beach nourishment project, it is not a preferred approach to achieving these benefits. The duration of benefits is projected to be short for the sandy beaches and the costs are relatively high (estimated at approximately \$10 million). This project was not selected to be carried forward for implementation at this time because the project does not

contain sufficient information for the Trustees to understand the benefits to shoreline resources injured by the spill.

El Capitan State Park Concrete Removal Project/Bike Path and Rip Rap Removal (SHORE-8)

This project involves the removal of large rip-rap boulders and concrete that are located at the base of a portion of the bicycle trail between Refugio and El Capitan State Parks. The concept is to remove legacy rip-rap (currently serving no purpose) outside of the area where riprap currently exists to protect the Exxon-owned pipeline located there. Removal of legacy rip-rap may partially restore a segment of this shoreline to a more natural and unarmored condition. Feasibility and cost-benefit of this project has not been fully assessed.

Santa Barbara County Seawall Removals (SHORE-9)

This project would involve the removal of concrete seawall structures located in Santa Barbara County to restore the shoreline to a less armored condition. The Trustees evaluated selected sites proposed by the County and determined that seawall removal could cause structural compromises to the railroad infrastructure. As of the release of this plan, no formal written proposal has been submitted or reviewed on this effort, so it is not clear if this is a fully developed plan or project.

Coastal Hazards Removal, Goleta Beaches Extending From Arroyo Hondo To Coal Oil Point (SHORE-10)

This project would involve removal of coastal hazards other than the Ellwood seawall. The elements evaluated to date by the Trustees, such as iron material protruding from the shoreline surface, would not provide any tangible benefits to plants, animals, and their habitats that were affected by the spill. The State Lands Commission, the proponent of this project, has successfully pursued other funding sources for this work, primarily as an effort to reduce hazards to humans. The nexus to restoring shoreline resource services that were injured during the spill event is unclear, so this project is not currently among the selected projects.

Coal Oil Point Research and Education (SHORE-11)

This is a proposal to fund staff to provide research and education at the Coal Oil Point Preserve. The elements evaluated to date by the Trustees, such as funding an endowment for the education coordinator at Coal Oil Point Preserve, would not provide any direct benefits to plants, animals, and their habitats that were affected by the spill. Any identified benefits to the impacted resources would be indirect.

Devereux Slough Restoration (SHORE-12)

This is a proposal to restore Devereux Slough through acquisition of a former golf course to expand the slough to a greater portion of its historical extent. The elements evaluated to date by the Trustees, such as habitat enhancement and monitoring in the former golf course, while beneficial to some natural resources, would not provide any tangible benefits to the shoreline natural resources that were affected by the spill. While no slough or meadow habitats were injured by the spill, this project may, however, provide broad ecosystem benefits for multiple

species that utilize shoreline habitats and its proximity to shoreline habitats creates ecosystem connectivity that may benefit coastal resources that were affected by the spill.

Funding a Quick Reaction Cleanup Crew for Tar found on Beaches (SHORE-13)

This proposal is to fund a personnel that would respond quickly to perform cleanup duties on the shoreline when tar is found. The Trustees have concerns that the likelihood of success for this would be very difficult to determine. Cost effectiveness is likely to be low, and benefits to the public would be challenging to quantify. Duplication would also be high in the event of an oil spill incident, given that the spill response effort oversees the task of oil removal and cleanup. Hazardous material handling and disposal cost and liability questions are also significant considerations.

Removal of unnecessary sediment basins from the Gaviota coast (SHORE-14)

This is a proposal to remove sedimentation basins to allow more natural transport of materials to the shorelines for the purposes of beach nourishment. Only basins that are deemed no longer necessary to protect public safety and property would be considered for removal. Recent fire and flow events call into question the viability of removing sediment basins along the Gaviota coast.

Refugio and Gaviota Coast Human Impact Mitigation (SHORE-15)

This proposal aims to reduce human waste material on the Refugio and Gaviota shoreline by providing portable toilet facilities. The Trustees considered this to be less a sandy beach or shoreline restoration project and more of a sanitation project, given that it that would install restroom services. It does not provide significant tangible benefits to plants, animals, and their habitats that were affected by the spill. Any benefits that might exist would be challenging to quantify and primarily human sanitation and recreational in nature.

Other Dune Restoration Projects (SHORE-16)

These are dune restoration projects similar to the other ones listed in the selected project section, but in different locations. Some of these projects lack owner consent, have a need for partner funding, or are not proximal to the spill area. Those with owner consent, funding resources, permitting in place, long term stewardship, and well described costs within the spill area have been selected as preferred. The remaining dune restoration projects would require more details to be better understood, or need more clarification regarding technical feasibility before being considered preferred projects. However, these projects may be considered at a later time, as more information on these projects is gathered or if the selected dune restoration projects become infeasible.

Coal Oil Point Pilings and Debris Removal (SHORE-17)

This project involves removal of pilings and debris from a lagoon area. However, it appears to have benefits associated with human use and safety rather than the injured shoreline resources. There also appears to be some permitting issues associated with the removal effort that may disturb sensitive natural resources located at or near the lagoon. Much of the identified debris is associated with the lagoon habitat rather than shoreline, making the nexus to the injured

resources weaker. Benefits would be challenging to quantify and scale for the injured resources. Both ecological benefits and the cost benefit need to be more clearly understood before the Trustees would reconsider funding this project.

Outdoor Classroom Education and Outreach (SHORE-18)

Building on the successful implementation of the Channel Islands Marine Sanctuary's Rocky Intertidal Protection Program, students from local schools would be engaged to learn about the ecology of rocky intertidal habitats, including hands-on implementation of rocky intertidal monitoring. Students would also be engaged in docent programs to share their knowledge of rocky intertidal habitats with the public at popular tidepool areas. Benefits would be less direct, as they would rely on an overall change in behavior and attitudes by users of rocky intertidal areas.

Refugio and El Capitan State Beach Rocky Intertidal Docent Programs (SHORE-19)

This project involves the development and implementation of a docent program at rocky intertidal sites at Refugio and El Capitan State Beaches to educate and oversee visitors and contact law enforcement personnel, if needed. Benefits would be less direct and would rely on an overall change in behavior and attitudes by users of rocky intertidal areas.

Increase Substrate for Rocky Intertidal Species (SHORE-20)

This project involves the creation of new shoreline habitat or modification of existing habitat to increase substrate for rocky intertidal species. Examples include wrapping pier pilings, or creating "living walls" at hardened shoreline structures such as breakwaters. No viable locations or methods were identified as of the drafting of this plan, but the concept may be viable in the future.

Cessation of Beachgrooming (SHORE-21)

This project involves the cessation of beach grooming along beaches in Los Angeles and Ventura Counties. No specific locations identified as of the drafting of this plan. There is a need for a project proponent and partnerships that do not currently exist.

Rindge Dam Removal (SHORE-22)

This project is the removal of the Rindge Dam and/or dams upstream. The Rindge Dam is full of sediment and does not function as a water reservoir which was its intended purpose. Removal of the dam would restore natural sediment flows, which enrich beaches through sand deposition. This has a very high cost associated with the project (estimates over \$100 million) and is too early in the planning and environmental review phase to be properly evaluated at the time this restoration plan was prepared.

5.2 Subtidal and Fish Habitats

In the initial days and weeks after the Refugio Beach Oil Spill, the Trustees investigated the potential for injuries to subtidal fish, invertebrates, and aquatic vegetation. Animals and plants may be harmed by oil spills if they are exposed directly to the oil, to the fraction of the oil that dissolves into the water, or if they eat oil-contaminated prey. When the Line 901 oil reached the ocean, wave action actively mixed the oil throughout the water column within the surf zone. In addition, the oil was transported offshore and along shore by wind and currents (Figure 2). Offshore, much of the oil floating on the surface was mixed into the water column as oil droplets or particulates, some fraction of the oil dissolved into the water column, and some was taken up into the food chain (Figure 20).

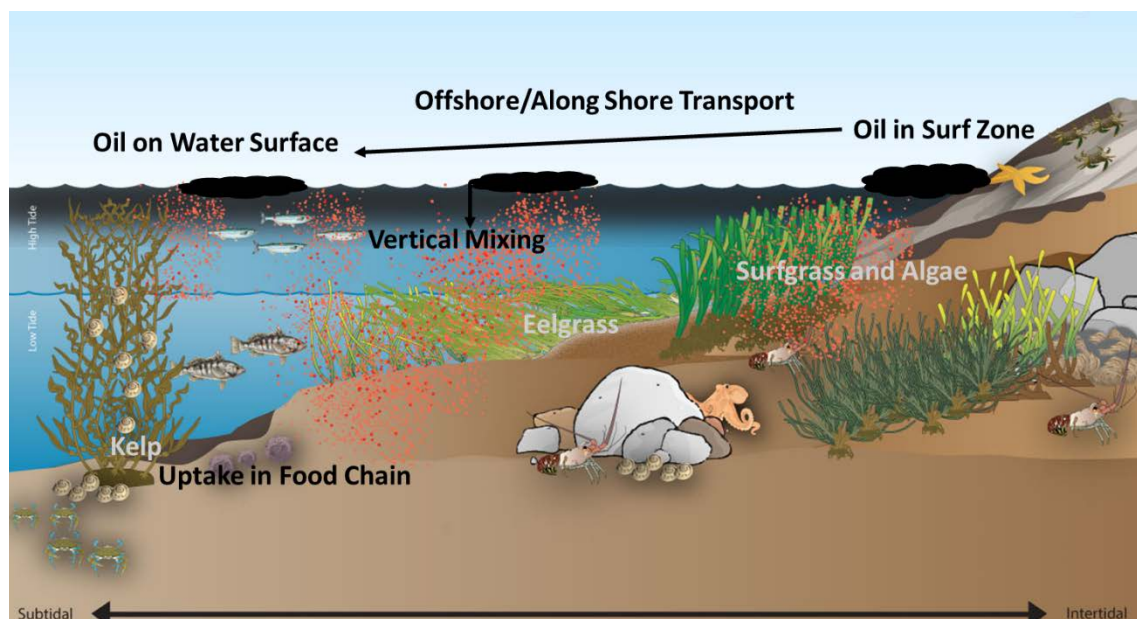


Figure 20. Oil exposure in subtidal habitats.

As discussed in Section 2, the spill occurred along the Gaviota coast. Ocean waters in this area are generally in a transition zone where warmer waters off southern California mix with cooler waters off northern and central California. The Gaviota Coast subtidal habitats include sensitive rocky reefs where plants, such as kelp and surfgrass, provide a physical structure that connects the ocean floor to the sea surface. These habitats support diverse communities of plants and animals, and several are designated as Essential Fish Habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act. Other subtidal habitats include eelgrass beds and sand bottom. Given the ecological importance of rocky reef habitats, the Trustees conducted an in-depth assessment of the potential for injuries to coastal subtidal habitats.

Aquatic vegetation was used as a proxy for determining the health of subtidal habitats¹⁰. Surfgrass, eelgrass, and kelp provide essential food and habitat for a diverse group of fish and

¹⁰ Plains does not agree with a number of Trustee interpretations in the subtidal and fish habitats section. In particular, Plains does not agree with Trustees use of a seagrass proxy for the deeper water column injury and does not agree that grunion are a valid indicator species for determining subtidal injury since grunion eggs are exposed on the beach.

invertebrate species. Fish in these habitats include California sheephead, kelp bass, rockfishes, red urchins, California spiny lobster, and sea cucumbers. These rocky reef habitats also serve as spawning and nursery grounds for fish and invertebrates. Early life stages of many species were present during the time of the spill and are expected to be sensitive to the effects of oil.

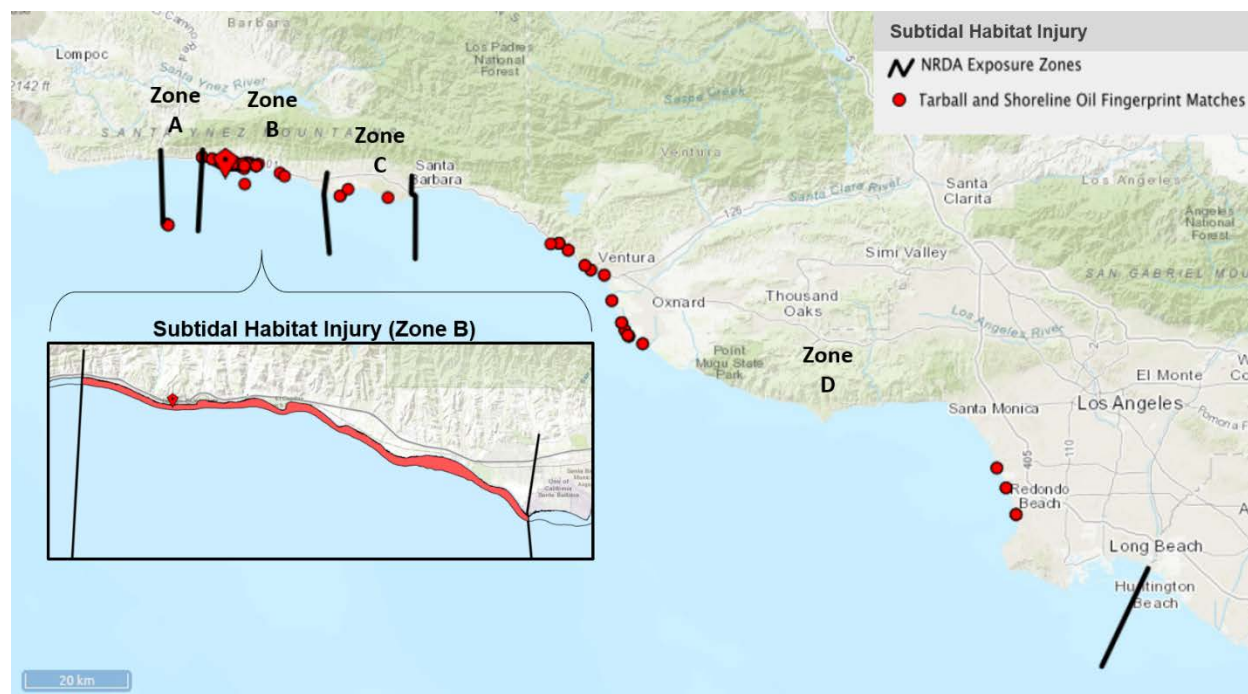


Figure 21. Exposure Zones defined for the Refugio Oil Spill NRDA showing shoreline tarball fingerprint matches (red circles). Zone B is the area of heaviest oiling and the extent of subtidal habitat injuries assessed. The inset shows the subtidal assessment area identifying the 10 m depth offshore extent of injury (red polygon). See Appendix B for data associated with this figure.

In the shallower, nearshore environment (0-3 m depth interval) within Zone B (Figure 21), surfgrass and many algal species were visibly coated with oil. Farther offshore (3-10 m depth interval) within Zone B, eelgrass beds and giant kelp attached to rocky reefs were exposed to oil in the water column, and there was documentation that the surface of the kelp forest canopy was oiled.

5.2.1 Overview of Data Collection and Studies

The list below summarizes the various field studies, data collection tasks, and analyses used to assess subtidal and fish habitat injuries.

Fish and Invertebrate Mortality Observations

Immediately following the spill, and for several days after, dead fish and invertebrates were observed on the beaches along the Gaviota coast within Zone B. From May 19 to June 19, 2015, the Trustees deployed boxes as repositories for response crews to deposit dead animals during beach cleanup operations. Thereafter, on a daily basis, the Trustees photo-documented, counted, and identified the dead animals in the boxes (Figure 22). Dead fish and invertebrates were also recorded, when feasible, on wildlife search effort log forms and NRDA daily field forms. Fish and invertebrate species comprising well over 30 taxa that inhabit surfgrass, eelgrass, kelp and

open sand habitats were found dead on the beaches, primarily during the first week after the spill from Refugio State Beach to El Capitan State Beach. These dead animals indicate that subtidal fish and invertebrates were injured as a result of the spill, but the relatively opportunistic collection method and the limited number of collection times and locations prevented rigorous injury quantification from these data.

Table 5. Dead fish and invertebrates found in 2015 during the spill, and one year later in 2016.

Dead Fish and Invertebrates (abridged)	2015	2016
Sand crabs	Y	N
Rock crabs	Y	Y
Shore crabs	Y	N
Kelp crabs	Y	Y
Spiny lobster	Y	Y*
Beach hopper	Y	N
Urchins	Y	N
Starfish	Y	N
Octopus	Y	N
Limpets	Y	N
Sea Hare	Y	Y
Skate/rays	Y	Y
Rockfish	Y	N
Kelp greenling	Y	N
Surfperch	Y	N

**One lobster was identified that may or may not be a molt, all others were molts.*

In June 2016, the Trustees conducted a follow-up survey of dead organisms along the Gaviota Coast. While direct comparisons using statistical methods (comparing 2015 to 2016 data) were not possible due to differences in study designs, it appears that the species composition and apparent abundance of dead fish and invertebrates found on the beaches was substantially lower in 2016 than in 2015, supporting the conclusion that the oil spill caused acute mortality of fish and invertebrates (Table 5). For example, intact dead lobsters were frequently found during the 2015 collections; however, only one dead lobster was found in the 2016 survey, and may or may not have been a molt (see Table 5). A more detailed summary of the findings is presented in Appendix G-1.

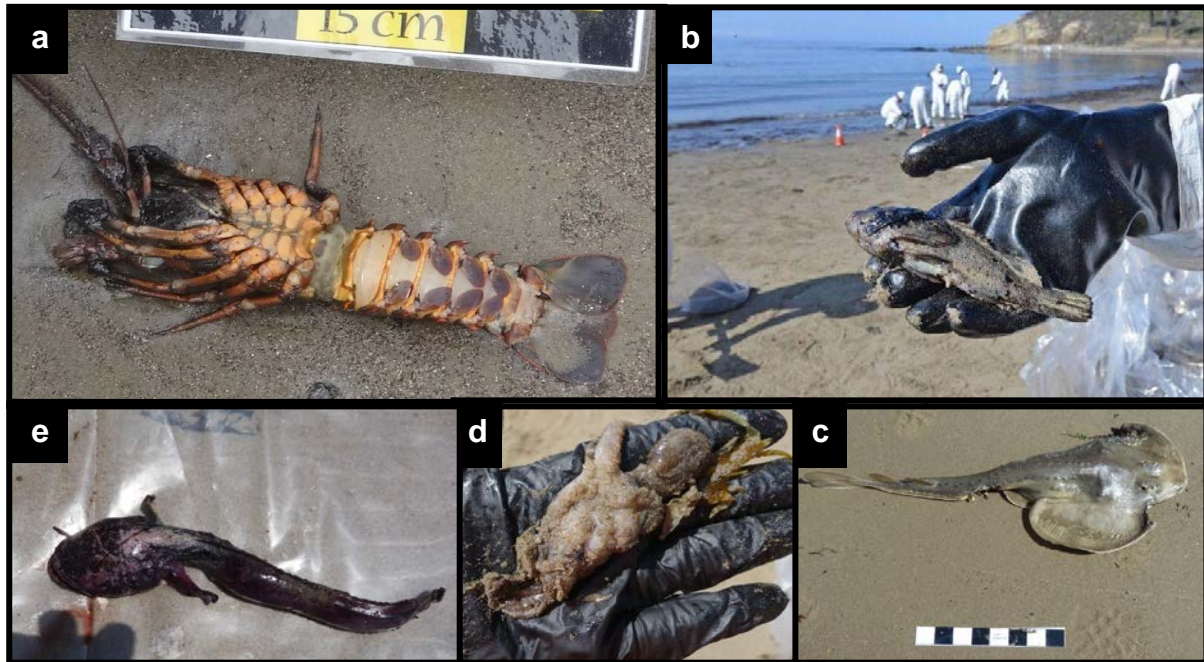


Figure 22. Examples of unprecedented diversity of dead, oiled fish and invertebrates from diverse subtidal habitats found in the days immediately following the Line 901 spill (clockwise): a. spiny lobster; b. rockfish; c. guitarfish; d. octopus; e. midshipman. Photo Credit: Natural Resource Damage Assessment Trustees.

California Grunion Assessment

California grunion were spawning on some beaches in the spill-affected area during and after the spill (May – September). During semi-lunar high tides these fish bury their eggs in the sand where they incubate until hatching approximately two weeks later during the next semi-lunar high tide (Martin, 2015) (Figure 23). Following the spill, adults and newly hatched larvae would have been exposed to oil in the surf zone, and the incubating eggs may have been adversely impacted by oil stranded on the beach or by cleanup activities (such as raking, machinery, trampling) disturbing nests. In addition to observing and evaluating direct impacts of Line 901 oil on grunion, the life history and accessibility of grunion early life stages make them an ideal model for evaluating the impacts of Line 901 oil on marine fish early life stages in field conditions. Accordingly, the Trustees studied grunion as an indicator of injury.

Grunion spawning was observed at oiled beaches (Refugio State Beach and El Capitan State Beach) and relatively unoiled beaches (East Beach and Topanga Beach) during 2015 and 2016. Based on predator behavior during the days of and immediately following the spill, adult grunion were staging for spawning runs at Refugio State Beach on those evenings. However, the Trustees were not able to access the beach to collect samples of eggs prior to shoreline oiling and/or cleanup activities, therefore, when the trustees attempted to collect eggs, none were found and were presumed to have been removed by cleanup activities. In areas where the Trustees were able to collect eggs from the observed spawning locations, eggs were incubated in the laboratory (Figure 23).

Following the two-week incubation period, hatching was triggered by agitation in seawater and hatching rates and larval survival were recorded. Grunion collected from oil-exposed beaches had a higher rate of mortality than those collected from relatively unoiled beaches. Study results are detailed in Appendix G-2.

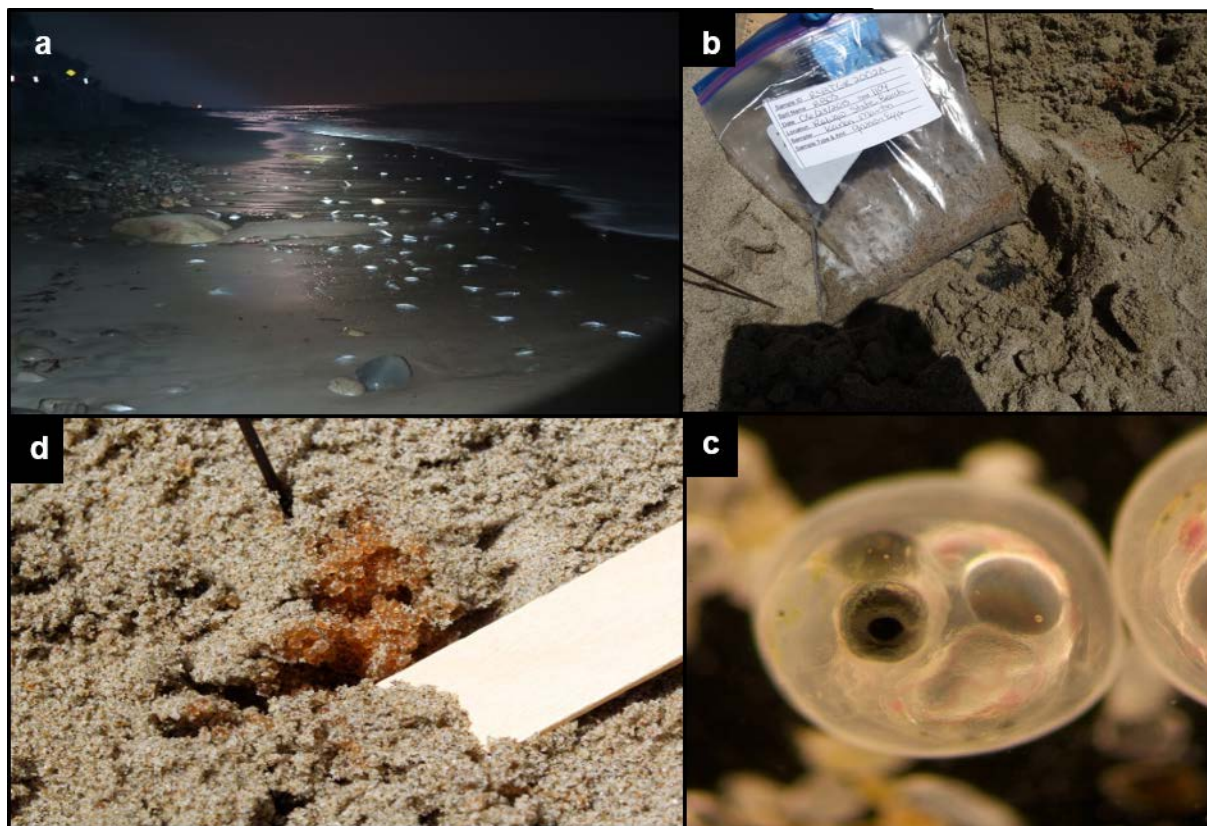


Figure 23. Grunion sampling and analysis from June 2015 (clockwise): a. grunion spawning on beach in Zone B; b. sands collected around grunion eggs; c. developing grunion eggs under magnification; d. grunion eggs in the field.

Surfperch Assessment

The surf zone in the spill-affected area supports relatively large populations of fish such as silversides, surfperches, croakers, flatfishes, and rays. The Trustees selected surfperches as a representative fish group to study due to their abundance in the area and because mature females give birth to live young during the time of year that the spill occurred. As such, sensitive early life stages of fish may have been exposed to oil. Surfperch were sampled five days after the spill and one year later at Gaviota State Park, Refugio State Beach, and Campus Point Beach. Fish rapidly take up and metabolize oil in their food and environment, then excrete that oil in their bile. Surfperch bile samples were collected and analyzed for PAH metabolites to quantify exposure. Significantly higher levels of PAH biliary metabolites were found in surfperch collected from Refugio State Beach in 2015 (heavily oiled), compared to Gaviota (not yet oiled at time of sampling) and Campus Point (lesser oiled) beaches. Mean concentrations in bile were higher than reported in other large oil spills. One year after the oil spill, there was no spatial

Water Chemistry and Effects to Fish and Invertebrate Early Life Stages

In order to evaluate the toxicity of the spilled oil, the Trustees conducted bioassays using early life stages of inland silversides and sand crabs and exposed them to different concentrations of Line 901 oil. The bioassay was a seven-day exposure study for fish or a six-day exposure study for sand crabs to evaluate survival and growth (Appendix E). The inland silverside is representative of nearshore fish in the spill-affected area. It is in the same family as grunion and topsmelt, both common surf zone fish in the Santa Barbara area. Sand crabs are prey species of surfperch and other fish and birds in the Santa Barbara area. The bioassay studies quantified the relationships between PAH water concentrations and mortality for both juvenile fish and early life stage invertebrates. Bioassay results also were compared to PAH concentrations measured in surf water during the first two months after the spill. Surf water chemistry results were compared to crude oil bioassay results with other fish and invertebrate species that have been reported in the scientific literature. Surf water concentrations following the spill exceeded lethal PAH concentrations for fish and invertebrate early life stages. See Appendices D, E and G for more information.

As discussed previously, the Trustees also considered the potential for enhanced toxicity caused by exposure to UV light. Studies have shown that ultraviolet light (UV) from sunlight can enhance the toxicity of PAHs by a factor from 2-1000 (Barron 2017). Some PAHs in fish and invertebrate tissues are photo-activated by UV forming reactive products that cause oxidative damage. Oil sheen exposure was documented throughout the spill-affected area and is known to cause toxicity to fish and invertebrate early life stages. A summary of the evaluation is provided in Appendix G-4.

Subtidal Habitat Exposure Assessment

Divers from the University of California at Santa Barbara (UCSB) reported patches of oil and heavily oiled wrack on the seafloor in Refugio Bay four days after the spill occurred (Michel 2015). In response to this reported sighting of sunken oil, the Unified Command conducted a sunken oil assessment in Refugio Bay between 11 and 13 days after the spill. Methods included multi-beam sonar surveys, side scan sonar surveys, videos and photographs from a remotely operated vehicle and diver inspections at priority sites. The area surveyed was from near the shoreline to depths of 10m from the spill origin, north of Refugio State Beach, to El Capitan State Beach. Thirteen days after the spill, the divers only observed small tarballs near El Capitan Beach (Michel 2015). The Trustees also sent a team of divers to Refugio Bay 13 days after the spill to collect sediment, vegetation, and invertebrates from three habitat types: kelp bed habitat, eelgrass habitat, and surfgrass habitat in the bay. Tissues samples were analyzed for PAHs, and fingerprinting analyses were conducted (Stout, 2018). In each habitat type, oil (as PAHs) was detected in vegetation and fingerprinted to Line 901 oil. A variety of invertebrate species in the kelp and surfgrass habitats had detectable oil (as PAHs) that was consistent with Line 901 oil. Additionally, NOAA modelers estimated that, based on wave, wind and temperature conditions, dissolved oil and oil droplets likely mixed to a depth of approximately 14 m in this area. Overall,

the study showed that these subtidal habitats were exposed to Line 901 oil. A summary of the results is presented in Appendix G-6.

PAHs in Nearshore Fish and Invertebrate Tissues

On May 19, 2015, the California Office of Environmental Health Hazard Assessment (OEHHA) recommended that CDFW initiate a fishing and shellfish harvesting closure for the coastal area near Refugio Beach. A closure was therefore initiated by CDFW on May 19, 2015, extending from approximately 1 mile upcoast of Refugio Beach to 1 mile downcoast of the beach, from the shoreline to one quarter mile offshore. The closure area was expanded on May 21, 2015, based on aerial observations and oil trajectory models, to include the coastal areas from Canada de Alegria downcoast to Coal Oil Point, and extending from the shoreline to 6 miles offshore (approximately 138 square miles). Between May 24 and June 18, 2015, OEHHA collected and analyzed several species of commonly caught fish and invertebrates, as well as kelp, to determine levels of contamination and safety for human consumption. After the last sampling period, benzo(a)pyrene PAH carcinogenic equivalents had fallen below the limit of concern for human health, and the closure was lifted on June 29, 2015 (OEHHA 2015). For the purposes of evaluating exposure of fish and invertebrates in the spill-affected area, the sum of 45 PAHs in the sampled tissues were evaluated. Elevated PAH concentrations were detected in drift kelp consumers (urchins and sea cucumbers) that were collected from fishing blocks close to the release point. PAH concentrations in tissue samples from animals collected from less than 10 m depth were higher than tissue samples collected from animals greater than 10 meters depth, supporting the conclusion that exposure was highest in the 0-10 m subtidal habitats near the spill origin. The analysis is provided in Appendix G-7.

Surfgrass and Algae Surveys

Approximately two months after the spill, discolored and dead surfgrass was observed at Refugio State Beach and El Capitan State Beach—both areas of heavy oiling (Figure 8). Based on these

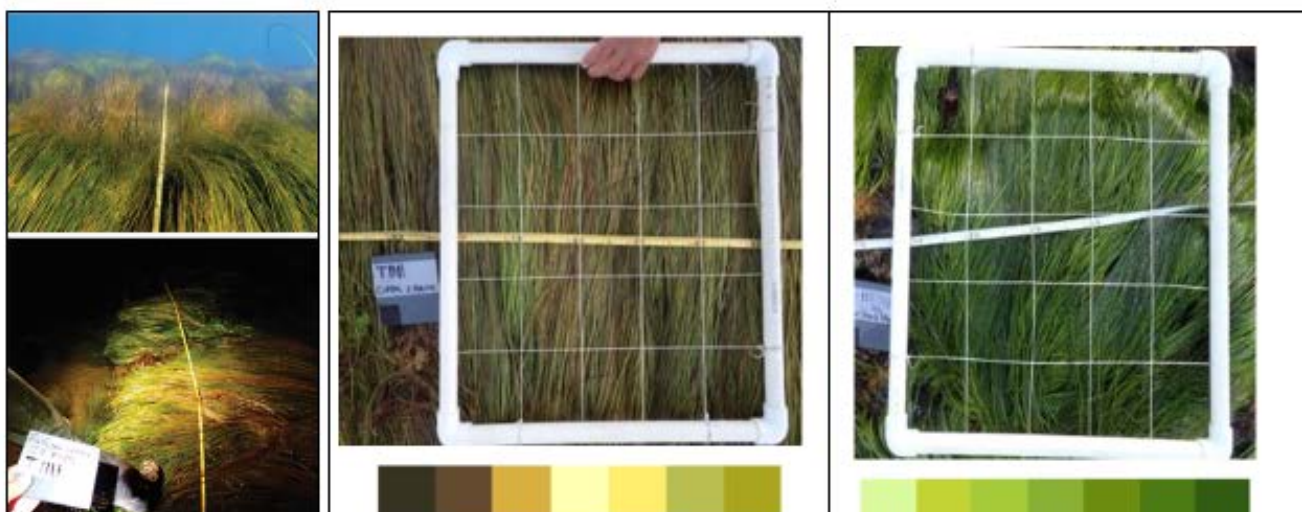


Figure 24. Surfgrass injury studies (left to right). The first two pictures show an example of how brown and necrotic surfgrass looked in the field. Middle picture shows an injured experimental plot. Far right shows a reference plot with bright green, healthy plants. Photo Credit: Natural Resource Damage Assessment Trustees.

observations, additional intertidal and subtidal surveys were initiated to quantify the extent of discolored surfgrass and algae. Condition and abundance of surfgrass and algae were assessed at eight sampling sites over several dates from July 2015 to June 2016. Oil-related injuries, including bleaching, necrosis, loss of biomass, cellular death and loss of surfgrass leaf tensile strength, occurred throughout the range of surfgrass habitats within Zone B (Figure 24). During the August 2015 survey, the proportion of dying surfgrass ranged from 37.4% at Arroyo Hondo to 82% at Corral Canyon, compared to 2.2% at the reference site (Mussel Shoals located in Zone D where shoreline oiling was absent, sporadic or light-to-moderate). For algae, the cover of dead and dying plants ranged from 86.1% at Coal Oil Point to 99.2% at Corral Canyon, compared to 6.1% at the reference site. An area-weighted average of the percent area of dead and dying plants was used to quantify injury for subtidal habitats. By the 2016 field season, surfgrass was not fully recovered at the heavily oiled Arroyo Hondo site. Survey methods and results are detailed in Appendix G-5.

5.2.2 Subtidal and Fish Habitat Injury

Area of Impact

Due to the nature of the Refugio oil release into the surf zone, the nearshore coastal processes and the physical properties of the oil, the Trustees concluded that exposure of aquatic organisms was likely to be highest in nearshore, relatively shallow subtidal habitats¹¹. Therefore, the Trustees focused the subtidal injury assessment within Zone B where oiling was heaviest, for depths of up to 10 meters (m) (Figure 21). The Trustees selected 10 m depth as the outer boundary for subtidal resources within Zone B based upon the following considerations:

1. Submerged oil droplets and masses were observed within Zone B to 10 m depth;
2. Ten meters is the depth at which there was fairly high confidence that oil would mix throughout the water column to the bottom (Appendix A);
3. There was direct evidence that animals and plants in the near shore environment within Zone B were injured and/or exposed to oil (Appendix G), and
4. Aquatic vegetation such as kelp or seagrass provide critical foundational subtidal habitat, and rarely extends beyond 10 m deep.

Baseline Condition

The Trustees assessed injury by comparing oiled areas to baseline conditions, per the OPA regulations. The Trustees estimated those baseline conditions by using unoiled reference sites in 2015 (for grunion studies, surfgrass studies and surfperch exposure studies) and by repeating one-year, post-spill anniversary studies (grunion studies, surfperch studies and mortality observation studies), when the Trustees assumed continued exposure to Line 901 oil would have been eliminated or greatly reduced.

¹¹ Plains disagrees with the extent of subtidal injury assessed by the Trustees and asserts subtidal injury is materially lower than the Trustee's estimate.

Injury Determination and Quantification

For injury determination, the Trustees considered the presence and species composition of dead, oiled fish and invertebrates in mortality observation studies, the observed reduction in hatching success in grunion, the poor health of oiled macroalgae and seagrass, and a large number of recent toxicity studies on the effects of crude oil to early life stages of fish and macroinvertebrates. These provided, at a minimum, qualitative evidence for the Trustees to conclude that there was injury to natural resources in the shallow subtidal (0-10 m depth) area in Zone B.

For injury quantification, the Trustees used injury observed from surfgrass and algae studies as a proxy for general injuries to subtidal benthic¹² and water column habitats, and their associated biota. The Trustees determined that surfgrass/algae habitat (surfgrass habitat) was a reasonable proxy for other similar vegetated subtidal benthic habitats (e.g., kelp and eelgrass) because: (1) surfgrass is a foundational habitat for a highly diverse group of fish and invertebrates species that occupy the 0-10 m depth interval; (2) surfgrass habitat includes all of the major taxa found in other subtidal habitats (vascular plants, red and brown algae); and (3) surfgrass habitat is more accessible for the comprehensive surveys needed to quantify injury.

Surfgrass and algae surveys were conducted throughout Zone B (Figure 8) to identify the percent cover of discolored, dead, and dying surfgrass and algae (Figure 24). Injury was defined as the area-weighted average across all study sites, representing a maximum injury of 54%. This was used as the basis for the injury assessment for subtidal habitat (Figure 25), with weighting factors for relative habitat types and depth strata (i.e., 0-3 m versus 3-10 m depth interval):

0-3 m Depth interval

For the 0-3 m depths, the Trustees applied the weighted average 54% injury to all eelgrass, rocky reef, kelp, and surfgrass habitats within Zone B. Because sand bottom habitats are less biologically productive, the Trustees applied an ecological injury of 5.4%, representing one tenth of the injury of vegetated and rocky reef habitat (Appendix H).

3-10m Depth interval

For the 3-10 m depth interval, the Trustees assessed injury separately for benthic habitats, for surface water (top 2 m of water column), and for midwater (2-10 m depth interval) (Figure 26).

¹² Benthic means relating to the bottom of the ocean and to the organisms that live there.



Figure 25. The surfgrass and algal injury quantification was driven by studies where the area of discolored, dead and dying plants were assessed. Injury was defined as the percent cover of discolored, dead and dying surfgrass and algae at a study site. The overall area-weighted average percent injury was 54%. Green dots are sampling sites.

For the benthic habitat the Trustees calculated losses based on areal dispersion of submerged oil across the benthic footprint of Zone B to a depth of 10 m. Sunken oil would not necessarily dilute out into the water column, but would persist as small sediment-laden oil particles and droplets and spread across the sea bottom due to wave action and currents. Sunken oil also has a high likelihood of being trapped in or slowed by the bottom vegetation. The Trustees considered that injury to the benthic community would decrease linearly with distance from the shore. This would range from an 54% injury in the nearshore (0-3 m depth) to 0% injury at the 10 m depth, after calculating average offshore distances to the 10 m depth stratum. This resulted in the application of a 13% injury across the 3-10 depth range for benthic rocky reef, surfgrass, kelp, and eelgrass habitats. As with the 0-3 m zone, for sand bottom habitats in this depth stratum the Trustees are claiming one tenth of that loss due to lower productivity/services associated with sand bottom habitats. This resulted in a 1.3% loss for sand bottom habitats (Table 6). More detailed discussion of the injury quantification is presented in Appendix H.

For the top 2 m of the water column in the 3-10 m depth interval (Figure 26, light blue area), exposure would have primarily come from the short term exposure of surface oil in the approximately 2 weeks post spill. The Trustees determined there were short-term losses to the biota in the water column, ranging from 54% loss (determined by using surfgrass as a proxy) to 80% loss (based on literature). Studies in recent years have demonstrated high mortality (approximately 80%) to fish early life stages and planktonic organisms at low levels of PAH exposure, especially when exposed to UV light (Morris et al. 2015). The Trustees also assessed injuries to fish and planktonic organisms in the mid-water column of the 3-10 m depth stratum, at a 5% loss (Figure 26, dark blue area). The midwater injuries are based on the concept of oil

mixing from the surface and from the bottom, but with a recognition that dilution, weathering and dispersion will greatly reduce exposure, and thus, the level of injury (Table 6).

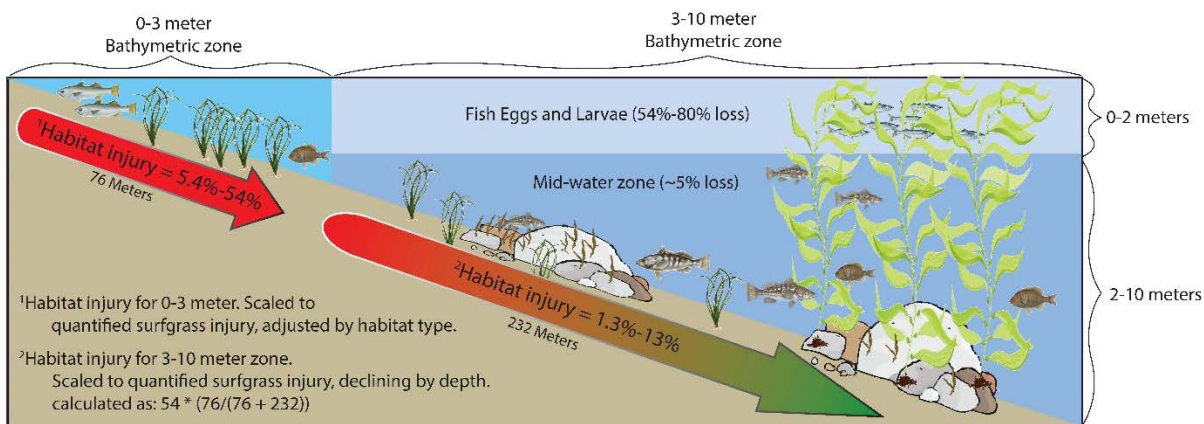


Figure 26. Summary of subtidal injury quantification. The average distance offshore from the 0 to 3 m depth range is 76 m. The average distance from 3 m to 10 m depth range is 232 m. The benthic habitat injury of 13% in the 3-10 m depth range was calculated by multiplying the injury in the 0-3 m depth range (54%) by the proportion of the offshore linear distance 0-3m depth compared to the total offshore linear distance of 0-10 m depth.

Habitat Equivalency Analysis Results

The Trustees used HEA (Appendix C) to scale compensatory restoration for the subtidal benthic injury. The HEA was based on the percent injury for the various components of the subtidal environment, which in turn were based on the documented injury to surfgrass and algae. For the recovery component, the HEA calculations take into account the rapid initial loss that occurred in the first 6 months of the spill. This was evidenced by a high percentage of discolored, dying surfgrass and algae in August of 2015 and January 2016. Recovery was assumed to be rapid, - 88% recovered after a year (consistent with 2016 study observations), 94% after two years, and 100% after 5 years. Applying the injury levels discussed above, this analysis resulted in a loss of 178.5 acre-years in the 0-3 m depth interval and 117.4 acre-years in the 3-10 m depth interval (Appendix H).

The Trustees considered how to address injuries to the upper- and mid-water zones of the 3-10 m depth interval and ultimately chose not scale restoration for these areas because the restoration projects selected to benefit benthic resources will likely provide significant benefits to water column resources as well. In addition, the injury to fish early life stages, while significant, would also have been ephemeral and the Trustees were unable to readily identify restoration projects that were both targeted to water column species and highly scalable to the estimated injury. Given these facts, the Trustees decided to defer until later a determination on how best to compensate for any remaining injury to water column species. The Trustees anticipate having subtidal restoration funds available after the completion of the projects discussed below. If selected, these projects should yield additional information on their beneficial impacts. The Trustees will then decide whether remaining funds should be spent to augment an existing subtidal project or implement a new water column-focused project.

Table 6. Subtidal injury (losses) and Habitat Equivalency Analysis results.

Depth Zone	Habitat type	Max injury (% Loss)	Recovery time (years)	Habitat area (acres)	Acre – years for compensation (dSAY¹)
Nearshore Benthic Habitats (0-3 m depth zone)	Rocky reef, kelp canopy, seagrass, and sand bottom	54%	5	514	178.5
Offshore Benthic Habitats (3-10 m depth zone)	Rocky reef, kelp canopy, seagrass, and sand bottom	13%	5	1657	117.4

¹dSAY = discounted service acre-year. See Appendix C.

5.2.3 Selected Restoration Projects

The Trustees identified four categories of restoration activities (abalone restoration, eelgrass restoration, kelp restoration, and seawall removal) to compensate for losses to subtidal habitats caused by the release of Line 901 oil. Subtidal projects were selected and prioritized by their ability to enhance and restore subtidal habitats in the region affected by the spill. Projects within Zone B were heavily prioritized over other projects that were located in the region affected by the spill but outside Zone B. These projects are discussed below in order of priority (Table 7).

Table 7. Subtidal selected restoration projects.

ID#	SELECTED PROJECTS	BENEFITS
SubT-1	Abalone Restoration	Rocky reef habitats and associated fish and invertebrates
SubT-2	Coastal Eelgrass Restoration	Eelgrass habitats and associated fish and invertebrates
SubT-3	Sand-dwelling Kelp Project	Kelp habitats, and associated fish and invertebrates
SubT-4	Ellwood Seawall Removal	Rocky reef habitats

Abalone Restoration in Naples Reef and Campus Point MPAs (SubT-1)

The goal of this project is to enhance the function of rocky reef habitats within the two Marine Protected Areas (Campus Point and Naples Reef) off the Gaviota Coast that were directly affected by the spill. This project would supplement abalone populations through outplanting of juvenile abalone and translocating adult abalone from a nearby system.

To maximize success, the Trustees propose applying multiple approaches when possible (e.g., adult translocation and juvenile captive propagation and outplanting) over a multi-year period, with repeated outplanting and translocation events. The Trustees propose a 10-acre restoration project (5 acres within each of the Marine Reserves) that will be implemented over a 5-year period and subsequently monitored for an additional 5 years.

Affected Environment

The restoration sites to which abalone will be translocated or outplanted comprise over 5 acres at each of the Naples Reef and Campus Point Marine Protected Areas. The donor population for adult abalone translocation is from San Miguel Island or another similarly robust southern California population. The Trustees will work with the appropriate local, state, and federal agencies, as well as abalone experts and NGOs to identify appropriate commercial or research abalone farm(s) for juvenile abalone outplants.

Environmental Consequences (Beneficial and Adverse)

Overall, this project is anticipated to have only minimal adverse environmental consequences and multiple beneficial impacts. In reaching this conclusion, the Trustees evaluated several types of potential impacts, as described below.

1. *Biological Impacts* - The long term biological impacts of this project to the marine protected areas are highly beneficial to the public, as abalone become re-established. Red abalone are an iconic resident of California kelp forests. Ecologically, abalone are grazers that keep rocky habitat available for diverse algal and benthic invertebrate occupants of rocky reefs. Abalone are competitors with sea urchins, but are less destructive grazers than sea urchins, thus abalone promote a healthy rocky reef system. There is the potential for minor adverse biological impacts to the abalone population of San Miguel Island or other selected donor population through the removal of abalone adults. In addition, there is the potential for injury to the translocated abalone. However, any removal will be done under permit, using best practices, and carefully planned to avoid any injury to translocated abalone or adverse reduction to the donor population or associated habitats. In addition, the project proponents are fully aware of the potential for disease in abalone populations and will use local abalone experts to screen and test outplants and transplants to avoid any chance of introducing disease into a wild population.
2. *Physical Impacts* – The Trustees do not anticipate major impacts to the physical environment, such as water, air, sediments, etc. Any negative physical impacts (e.g., harm to reef structure) would be unlikely and, at worst, would likely be mitigated by the use of best practices. Ultimately, any adverse physical impacts are expected to be negligible.
3. *Human Impacts* - The Trustees do not anticipate noteworthy impacts from this project on socio-economics, aesthetics, health and safety, historical properties, etc. There is likely a benefit to human recreational use as the presence of abalone and a more robust rocky reef/kelp habitat create a more diverse, healthy ecosystem, which will benefit divers and other recreational users of the MPAs.

Probability of Success

This project has high likelihood of success if implemented at this scale. In addition, abalone outplanting and translocation presents few environmental risks that are easily mitigated through established best management practices (BMPs). The CDFW has already developed many of

these BMPs as part of the red abalone outplanting work they have initiated in Los Angeles and San Diego Counties. Furthermore, abalone outplanting and translocation require no on site construction or physical modification of the sea floor, so permitting requirements will be limited to scientific collection and stocking permits, which will allow for a streamlined implementation process.

Performance Criteria and Monitoring

The success of the restoration project will be evaluated by assessing metrics associated with natural resource functions and services. Metrics will be compared with: 1) initial conditions at the project site and 2) conditions at an appropriate nearby natural reference site or sites. The success of this project will be measured through up to 10 years of post-transplant/outplant monitoring of abalone population density and size structure, as well as an evaluation of rocky reef ecosystem for success.

Specifically, the Trustees may use the following measures to determine the effectiveness of the restoration:

- Number and size of abalone deployed to site per outplanting event as compared to pre-project levels pre-outplanting;
- Density of abalone present on site over time as compared to pre-project levels pre-outplanting; and
- Rocky reef ecosystem response will be measured through kelp density and stipe counts and fish, invertebrate and algae and habitat characterization surveys.

Evaluation

The Trustees have evaluated this project using the threshold and additional screening criteria developed to select restoration projects and concluded that this project is consistent with and meets the objectives of these selection factors. This type and scale of project will effectively provide appropriate compensation for injured subtidal habitat as a result of the spill, and the Trustees have therefore identified this project as a preferred alternative.

Refugio Bay Eelgrass Restoration (SubT-2)

The goal of this project is to enhance habitat services within Zone B through the restoration of eelgrass. There are limited opportunities for coastal eelgrass restoration within Zone B because of depth, substrate and wave energy limitations. However, the Trustees have identified a subtidal site where the substrate, depth and wave energy are likely to support eelgrass, but which is far enough from existing beds that natural recruitment is unlikely (Altstatt, personal communication).

Affected Environment

The project includes creating additional eelgrass habitat in areas in or adjacent to Refugio Bay, including the southeastern portion of the Gaviota Coast, an area that was directly and heavily impacted by Line 901 oil. This would be accomplished through harvesting of plants from a donor site and transplanting them to the project site.

Environmental Consequences (Beneficial and Adverse)

Overall, this project is anticipated to have only minimal adverse environmental consequences and multiple beneficial impacts. In reaching this conclusion, the Trustees evaluated several types of potential impacts, as described below.

1. *Biological Impacts* – This project would provide long-term beneficial biological impacts to the environment. Eelgrass habitat provides unique and critical ecosystem services to the shallow subtidal component of the California coastal shelf. Eelgrass beds are an important source of primary productivity and create 3-dimensional biogenic habitat that is used by a diverse assemblage of fish and invertebrates as nursery and foraging habitat. Eelgrass habitat is also identified by NOAA as a Habitat of Particular Concern under the Magnuson-Stevens Fishery Conservation and Management Act. There is a slight possibility of adverse biological impacts if the project implementer takes too much eelgrass from donor sites. However, given the Trustees' experience and expertise in eelgrass restoration, this risk is extremely small. The Trustees, in addition to having implemented similar projects successfully in the past, would draw on the expertise of local experts in implementing this project.
2. *Physical Impacts* – The Trustees anticipate only minor impacts to the physical environment. The project will likely create beneficial impacts because eelgrass provides a three-dimensional habitat for fish and invertebrate species and stabilizes sediments, reducing scour and enhancing light penetration in the water column. Any adverse impacts would be associated with implementation (i.e., project implementers moving in and around the donor and transplant sites) and are expected to be negligible.
3. *Human Impacts* – The Trustees do not anticipate any impacts from this project on socio-economics, aesthetics, health and safety, historical properties, recreational use, etc.

Probability of Success

Eelgrass restoration in southern California has proven successful in many coastal locations. However, most of these projects were conducted with estuarine species. Because this project focuses on the coastal species, the Trustees are proposing to implement the restoration based on the successful methods used by Altstatt (2014). Based on that work, it is expected that full maturation of the restored eelgrass bed may take 7-10 years.

Performance Criteria and Monitoring

The success of the restoration project will be evaluated by assessing metrics associated with natural resource functions and services. Metrics will be compared with: 1) initial conditions at the project site and 2) conditions at an appropriate nearby natural reference site or sites. The project includes up to 10 years of monitoring for restoration success. The specific details of the monitoring actions will be outlined in the project monitoring plan

Specifically, the Trustees may use the following measures to determine the effectiveness of the restoration:

- Acres restored;
- Density of eelgrass shoots, cover, and blade length before and after; and
- Ecosystem response measured through fish and invertebrate and habitat characterization surveys.

Evaluation

The Trustees have evaluated this project using the threshold and additional screening criteria developed to select restoration projects and concluded that this project is consistent with and meets the objectives of these selection factors. This type and scale of project will effectively provide appropriate compensation for injured subtidal habitat as a result of the spill, and the Trustees have therefore identified this project as a preferred alternative.

Sand-Dwelling Kelp Restoration (SubT-3)

The goal of this project is to support an existing effort to re-establish sand-dwelling kelp canopy to the Goleta Beach area. There are no other opportunities for direct kelp forest restoration within Zone B. The existing project is currently underway under separate funding, initiated by a small group of dedicated citizen scientists who are attempting to restore the kelp forest that once existed in Goleta Bay. While there is no rocky reef habitat in the bay that typically supports kelp forests, it has been speculated that the kelp had once established itself on tube-forming worm colonies that frequent open sand habitats (e.g., colonies of the tube worms belonging to the genus *Diopatra*). The project aims to restore these “sand-dwelling” kelp plants by inserting small granite columns into the sediment, exposing the top 10-20 cm of the column to kelp recruitment. The ultimate goal of this project is that kelp holdfasts will spread beyond the area occupied by the granite column and form a kelp forest of sufficient density to support kelp canopy.

The scope of the NRDA project is to extend the existing project by expanding the permits associated with the current one-acre project and to implement a systematic monitoring program. At this time, the Trustees are not proposing a larger scale buildout of this project because the results are still preliminary, and the longer-term viability of the approach is unknown. However, if the project continues to show success, the Trustees will consider expansion, subject to permits and other considerations.

Affected Environment

The location of the project currently encompasses sand bottom offshore of Goleta Beach, just outside of Zone B, the heaviest oiled area. The project would re-introduce sand-dwelling kelp to the area. There are limited opportunities for other kinds of kelp restoration due to lack of rocky reef habitat.

Environmental Consequences (Beneficial and Adverse)

Overall, this project is anticipated to have only minimal adverse environmental consequences and multiple beneficial impacts. In reaching this conclusion, the Trustees evaluated several types of potential impacts, as described below.

1. *Biological Impacts* - The Trustees' proposal regarding this project does not include any additional active restoration work. Rather, it covers only an extension in the duration of the existing project and associated monitoring activities. Extending the current project will have no negative effects to the environment and may have beneficial effects, as the project currently provides some ecosystem benefits to fish and invertebrates. Kelp also provides food to subtidal, intertidal and beach communities (e.g., a large component of beach wrack is produced by giant kelp). If the Trustees extend the time period of the project, the beneficial impacts will increase accordingly. As the monitoring activities would be the Trustees' only physical interaction with the project, any adverse impacts are expected to be negligible.
2. *Physical Impacts* – As with biological impacts, the Trustees expect any physical impacts from this project to be negligible.
3. *Human Impacts* - The Trustees do not anticipate any impacts from this project on socio-economics, aesthetics, health and safety, historical properties, recreational use, etc.

Probability of Success

The project was implemented as a pilot project, and to date has shown some success, in that kelp plants have recruited to a number of the granite columns. Longer-term monitoring of the existing project will help the trustees evaluate success, especially from consequences of large storm events.

Performance Criteria and Monitoring

The success of the restoration project will be evaluated by assessing metrics associated with natural resource functions and services. This time series of metrics will be compared with: 1) initial conditions at the project site and 2) conditions at an appropriate nearby natural reference site or sites. This proposal calls for 5 years or more of monitoring for success of the pilot project. The specific details of the monitoring actions will be outlined in the project monitoring plan.

Specifically, the Trustees may use the following measures to determine the effectiveness of the restoration:

- Density of kelp plants as compared to pre-project conditions;
- Kelp stipe counts and canopy cover compared to pre-project conditions; and
- Ecosystem response will be measured through fish and invertebrate and habitat characterization surveys.

Evaluation

The Trustees have evaluated this project using the threshold and additional screening criteria developed to select restoration projects and concluded that this project is consistent with and meets the objectives of these selection factors. This type and scale of project will effectively provide appropriate compensation for subtidal habitat as a result of the spill, and the Trustees have therefore identified this project as a preferred alternative.

Ellwood Seawall Removal (SubT-4)

This project will benefit shoreline (sandy beach) resources and is discussed in Section 5.1.6 (Shoreline) above. However, the Trustees agree that there are likely benefits to subtidal resources offshore of the existing structure. The subtidal component of this project consists of pre- and post-removal monitoring to confirm and document benefits.

Affected Environment

The project site is Ellwood Beach in Goleta, CA. A wooden seawall currently constrains natural functioning of the ecosystem as well as lateral access along the shoreline at high tide.

Environmental Consequences (Beneficial and Adverse) (to the subtidal environment)

This project will only be undertaken if it is ultimately selected to compensate for sandy beach injuries, as discussed in Section 5.1.6 above. Accordingly, its status as a preferred alternative to compensate for subtidal injuries will have no impact on the potential environmental impacts described above. The only additional activity associated with the subtidal “component” is non-invasive monitoring, which the Trustees anticipate will have negligible, if any, environmental impacts.

1. *Biological Impacts* – The project is expected to benefit the environment by reducing scour and turbidity to the nearshore environments (due to the reduction in reflective wave energy after removal of the seawall). Scour inhibits settlement and success of algal and seagrass species, as well as benthic invertebrates. Turbidity inhibits algal and seagrass growth. Reduction in scour is expected to increase species diversity and habitat function in the affected offshore area. Short-term adverse effects from construction are expected to be negligible with respect to the existing offshore environment.
2. *Physical Impacts* – The benefits to subtidal habitats include an expected reduction in turbidity and scour in the offshore habitats resulting from the reduction in reflective wave energy that will occur after the seawall has been removed. Short term adverse effects from construction activities (potentially higher turbidity, sediment transport) are expected to be negligible.
3. *Human Impacts* - The Trustees do not anticipate any impacts from this project on socio-economics, aesthetics, health and safety, historical properties, recreational use, etc. in the offshore environment.

Probability of Success

The Trustees consider this project to have a good likelihood of success in providing benefits to the nearshore subtidal habitats because wave reflectivity and scour will be significantly reduced compared to current conditions.

Performance Criteria and Monitoring

The success of the restoration project will be evaluated by assessing metrics associated with natural resource functions and services. Metrics will be compared with: 1) initial conditions at the project site and 2) conditions at an appropriate nearby natural reference site or sites. The project envisions up to 10 monitoring events, pre- and post-removal over a five-year period. The specific details of the monitoring actions will be outlined in the project monitoring plan

Specifically, the Trustees may use the following measures to determine the effectiveness of the restoration:

- Presence of sessile macrofauna and macroalgae sensitive to scour relative to pre-project conditions; and
- Decrease in turbidity relative to pre-project conditions.

Evaluation

The Trustees have evaluated this project using the threshold and additional screening criteria developed to select restoration projects and concluded that this project is consistent with and meets the objectives of these selection factors. This type and scale of project will effectively provide appropriate compensation for injured subtidal habitat as a result of the spill, and the Trustees have therefore identified this project as a preferred alternative.

5.2.4 Second Tier Restoration Projects Considered

The Trustees also considered the following projects (Table 8) and determined that many are valid projects that would provide benefits to subtidal and fish habitat. However, these projects were not selected for various reasons described below. These projects may be reconsidered if a selected project cannot be implemented or if remaining funds allow.

Table 8. Second tier subtidal restoration projects that may be implemented if funds allow.

ID#	OTHER PROJECTS CONSIDERED	BENEFITS
SubT-5	Net and Trap Removal (marine debris)	Fish, some benefit to benthic invertebrates
SubT-6	Artificial Reef	Fish and subtidal habitats
SubT-7	<i>Undaria</i> Removal at Anacapa Island	Subtidal habitat
SubT-8	Marine Protected Area Management and Stewardship Program	Subtidal habitat
SubT-9	Grunion Habitat Restoration and Education	Beach, subtidal and fish
SubT-10	Slough and Salt Marsh Restoration	Early lifestage fish
SubT-11	Kelp Restoration in Santa Barbara Channel Area	Subtidal habitat
SubT-12	Sargassum Removal	Early lifestage fish
SubT-13	Lobster Restoration	Lobster
SubT-14	Boater Outreach to Reduce the Spread of Invasive Algae	Subtidal habitat
SubT-15	Gaviota Creek Fish Barrier Removal	Fish

Net and Trap Removal (marine debris) (SubT-5)

This project was considered because marine debris removal, particularly derelict fishing gear, can have some benefits to marine habitats and can also reduce mortality of marine fish, birds, invertebrates and mammals. Marine debris removal is identified as a lower priority for a number of reasons. The degree of benefit that fishing gear removal has to each of these resources depends greatly on the location and habitat from which the gear is removed, and the nature of the items removed. While there are some opportunities to remove fishing gear from the greater southern California Bight, opportunities to remove gear from Zone B have proven to be limited. Thus, direct benefits of gear removal to the benthic marine habitats that were injured by the spill are also limited. Gear removal would be more likely to address injuries to water column species, so the Trustees may reconsider this project if they determine later that it is appropriate to conduct water column species-specific restoration (as opposed to using remaining funds to expand habitat projects with water column species benefits).

Artificial Reef (SubT-6)

The Trustees considered proposed artificial reef creation via reef balls or imported rock near Bird Island. Artificial reef creates new hard structure, promoting rocky reef habitat enhancement, potentially including kelp establishment. However, for the purposes of NRDA, the Trustees determined that significant barriers, such as permitting and maintenance issues, exist. These barriers will lessen the likelihood of timely implementation of the project. Therefore, the Trustees dropped this project from further consideration at this time.

Undaria Removal at Anacapa Island (SubT-7)

Undaria pinnatifida is an Asian seaweed of the intertidal and shallow subtidal zone, which was first discovered invading Anacapa Island in 2016. Invasive seaweeds crowd out native seaweeds

and potentially introduce co-occurring invertebrates, with potential for cascading effects to the ecosystem. The proposed project would implement an *Undaria* removal program in subtidal areas around the Channel Islands. Although the Trustees consider this a beneficial project, in general, there was concern that the project had high costs that may not achieve lasting benefits to subtidal habitats. Further, the habitat and ecosystem benefits occur outside of the subtidal area affected by the spill.

Marine Protected Area Management and Stewardship Program (SubT-8)

This project focuses on ecological and human use monitoring to support adaptive management and agency enforcement of MPA regulations. This project may include cleanup of marine debris identified within MPAs, removal of invasive kelps, and education and outreach to promote awareness, compliance, and stewardship of MPAs. The project is heavily focused on monitoring, and the tangible subtidal benefits are undefined, making it a less attractive project for implementation than those listed as “preferred” in Table 7. The Trustees will consider whether this project can be combined with the abalone restoration project that is also focused within MPAs.

Grunion Habitat Restoration and Education (SubT-9)

This project focuses on developing management practices that restrict grunion capture and other impacts to Grunion until after the first 2-3 days of spawning. Public outreach to raise awareness would be a necessary component of the project. Also, increased public awareness of this species' presence at Refugio and El Capitan State Beaches is directly attributed to the Refugio Beach Oil Spill cleanup, and an interpretive program would help to mitigate expected increased fishing pressure for grunion at these locations. Also, increasing the number of grunion greeters and/or increased CDFW enforcement would help protect grunion. The Trustees consider these measures to be beneficial to grunion. However, there are several other projects targeting shoreline restoration that provide significant benefits to grunion spawning habitat. This project would require a change in the current regulatory framework by the Fish and Game Commission, which is outside the authority of the Trustees. Thus, a specific grunion shoreline project is not preferred at this time.

West Goleta, Carpinteria and Devereux Slough Restoration Projects (SubT-10)

These are three separate projects considered for wetland, tidal marsh and upland restoration to benefit estuarine and marsh habitats. These habitats benefit early life stage fish and crab species by serving as refugia and feeding habitat. While the habitat injured by the oil spill was marine, shallow subtidal habitats, these projects may provide broad ecosystem benefits and contribute to subtidal health by supporting early life stages of subtidal species and through indirect effects to subtidal habitats such as water quality improvement.

Kelp Restoration in the Santa Barbara Channel Area (SubT-11)

Restoration of kelp could lend to protection of shoreline habitats from storms, provide habitat for prey of marine mammals and birds, provide additional habitat for fish, provide wrack for sandy beach, and improve recreational diving. However, the project lacked specific descriptions,

locations, and timelines to gauge its feasibility. The Trustees believe that the abalone project and the sand kelp project (identified as “selected” projects) meet the goals of restoring kelp habitat. The Trustees will continue to monitor opportunities and feasibility for such projects for the future.

Sargassum Removal (SubT-12)

Sargassum is an invasive, floating kelp that has recently invaded southern California. Invasive seaweeds crowd out native seaweeds and potentially introduce co-occurring invasive invertebrates, with potential for cascading effects to the ecosystem. The Trustees agree that *Sargassum* establishment and dispersal in Santa Barbara Channel is a concern, but there was no project proposed that specified activities, timeframe, locations or scope to gauge feasibility for a *Sargassum* removal project. This project was not selected to be carried forward for implementation at this time because the project does not contain sufficient information for the Trustees to understand the benefits to subtidal resources injured by the spill.

Lobster Restoration (SubT-13)

This project concept involves multiple methods for conducting lobster restoration including various studies, purchasing Global Positioning System units for permit holders, fishermen surveys, enforcement assistance, and education programs. The benefits of these projects are indirect to subtidal habitats and to lobsters. The ecosystem-level benefits from the projects listed as “selected” in Table 7 are anticipated to also provide benefits to lobsters.

Boater Outreach to Reduce the Spread of Invasive Algae (SubT-14)

This project involves educating boaters about reducing the spread of invasive algae by sending educational materials to boaters along with their registration information, and providing resources for removing algae from boats at launch locations. The benefits of this project are anticipated to be less than would be achieved through direct restoration of habitat, and the effectiveness of education in reducing the spread of invasive algae is uncertain.

Gaviota Creek fish barrier removal (SubT-15)

This project involves removing numerous fish barriers along the Gaviota Creek watershed. Some of these barriers restrict the ability of fish to migrate upstream while others interfere with the creek’s natural functions. This project will benefit Southern California steelhead and other aquatic organisms that live within the Gaviota Creek Watershed. The removal of steelhead barriers is focused on one species that was not documented to be injured by the spill, therefore it did not rise to the level of a “selected” project. Furthermore the commencement of watershed-wide restoration is contingent on the relocation of the access road to Gaviota State Beach and Hollister Ranch, and removal of the current road that comprises a substantial impediment in the watershed. The scale of this project exceeds the resources that could be provided through NRDA settlement funds; however, the Trustees have included this as a second tier project.

5.3 Birds

Birds are especially vulnerable to oil spills, as the oil compromises the ability of their feathers to keep them warm in the cold ocean water (Moskoff 2000). For a species that forages in the water, even a relatively small amount of oil (e.g., the size of a nickel) may result in death. Like a hole in a wetsuit, the oil destroys the feathers' ability to insulate the bird, thus allowing cold ocean water to spread against the bird's skin. Birds which contact oil typically die of hypothermia. With their rapid metabolism, birds also suffer starvation when they cannot forage for a few days (Oka and Okuyama 2000). They can also ingest toxic amounts of oil while preening, as they attempt to clean themselves. Finally, larger amounts of oil can smother birds, affecting their mobility and ability to survive.

A total of 269 birds were collected live and dead after the oil spill, encompassing at least 28 species. The Trustees structured our assessment of bird injury into three injury categories based on the birds' behavior patterns and location of the affected species. These categories are:

- Brown pelicans;
- Western snowy plovers; and
- All other bird species.

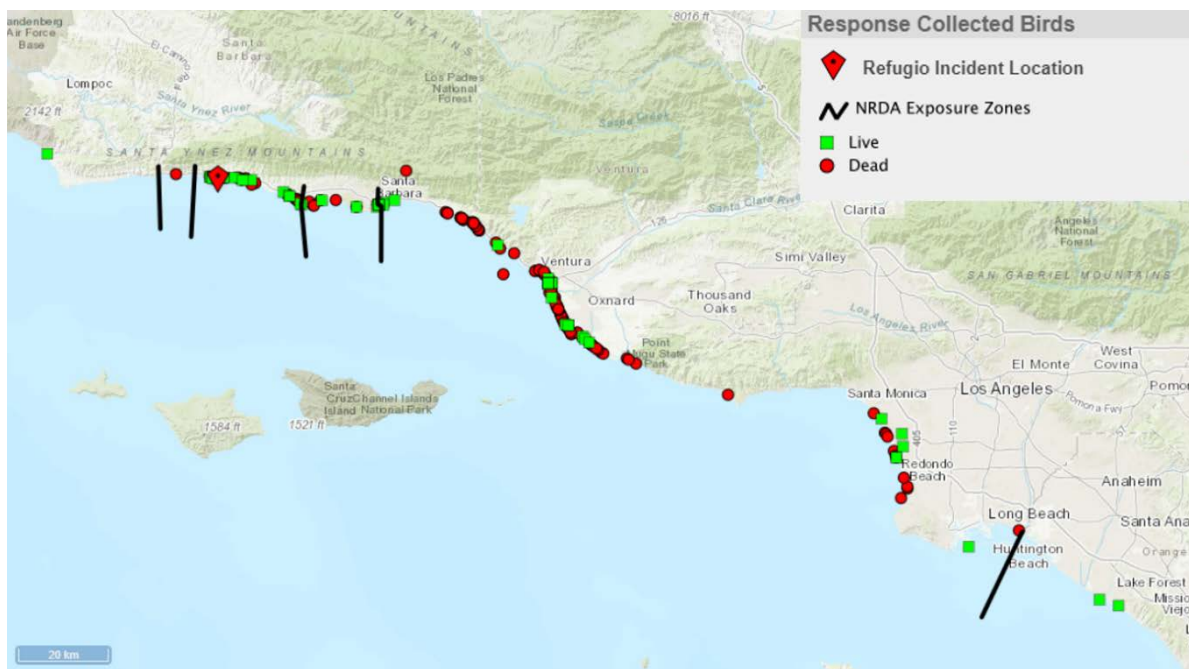


Figure 27. Location of live and dead birds recovered during wildlife operations. The back lines show the NRDA Exposure Zone boundaries for reference; however these boundaries were not used in the quantification of injury to birds.

5.3.1 Overview of Data Collection and Studies

This section describes the data that were collected or analyzed by the Trustees in order to assess injury to birds resulting from the spill. These data were generated by several efforts, including studies that were conducted by the spill cleanup, data collected by the NRDA team, and studies that were not specifically developed for the spill but that provide relevant information for

understanding and determining injuries to birds resulting from the spill. These studies are listed below and described in more detail in Appendix I.

Wildlife Reconnaissance Aerial Surveys

On May 21, 2015, aerial surveys for pelagic birds were conducted roughly between Point Conception and the City of Goleta. The objective of these surveys was to understand the general location and quantity of seabirds in the vicinity of the spill-affected area in order to inform spill response activities. These surveys, conducted by the Unified Command, documented at least 13 unique pelagic bird species in groups ranging in size from a single individual to 120 individuals.

Live and Dead Bird Intake Data

Documentation of live and dead birds was collected as a normal part of the spill response. These data describe the collection of each bird, with such information as date, location, species, condition of bird, degree of oiling, etc. Locations of live and dead birds collected are shown in Figure 27, and the species collected are identified in Table 9. During spill response operations all live distressed birds were taken to rehabilitation centers for further care. All dead birds encountered within the spill area were collected. A total of 66 live birds and 203 dead birds comprised of over 28 species were collected between May 20, 2015 and June 24, 2015 (OWCN 2015).

Table 9. All birds collected live and dead by species (or closest known taxon).

Species	Collected Live	Collected Dead	Total
Black storm-petrel	0	1	1
Barn owl	0	1	1
Black skimmer	0	1	1
Brandt's cormorant	2	11	13
Masked/Nazca booby	0	1	1
Brown pelican	47	26	73
California gull	1	5	6
Cassin's auklet	0	1	1
Clark's grebe	0	2	2
Common loon	0	3	3
Common murre	5	33	38
Cormorant sp.	0	4	4
Double-crested cormorant	0	14	14
Domestic duck sp.	0	2	2
Eared grebe	0	1	1
Elegant tern	0	1	1
Forster's tern	0	1	1
Grebe sp.	0	3	3
Heermann's gull	0	3	3
Loon sp.	0	5	5
Mew gull	0	1	1
Northern fulmar	0	5	5

Pacific loon	6	17	23
Pelagic cormorant	0	2	2
Pigeon guillemot	0	1	1
Rhinoceros auklet	0	2	2
Rock pigeon (feral)	0	1	1
Red-throated loon	1	12	13
California scrub-jay	0	1	1
Shorebird sp.	0	1	1
Sooty shearwater	0	16	16
Surf scoter	1	2	3
Western grebe	1	8	9
Western gull	2	9	11
Unknown	0	6	6
TOTAL	66	203	269

Search Effort Data Compilation

Understanding how well beaches within the spill area were searched is important to estimating how many carcasses may have been missed. The Trustees compiled and analyzed records from SCAT teams, wildlife reconnaissance teams, cleanup crews, and NRDA operations to understand the geographic extent and frequency of beach searches that would have had the potential to identify live and dead birds during the cleanup period.



Figure 28. Western snowy plover at Coal Oil Point during cleanup operations. Photo Credit: Coal Oil Point Reserve, UCSB.

Western Snowy Plover Studies

Western snowy plovers utilize several sandy beaches within Santa Barbara and Ventura Counties for nesting, including Coal Oil Point Reserve, San Buenaventura State Beach, McGrath State Beach, Mandalay State Beach, Ormond Beach, Hollywood Beach, and on Naval Base Ventura County at Point Mugu. Routine monitoring of plovers nest numbers and nest success were conducted at each of these beaches during the 2015 nesting season (Coal Oil Point Reserve 2015; Hartley 2015; Barringer 2015; Frangis and Cox 2015). All nesting beaches are located in Ventura County, with the exception of Coal Oil Point Reserve in Santa Barbara County, which was subject to elevated oil exposure and extensive cleanup operations (Figure 28).

Anacapa Island Brown Pelican Surveys

Anacapa Island is home to the largest breeding colony of California brown pelicans in the United States. The only other significant U.S. breeding colony is located on Santa Barbara Island, which is much farther from the mainland and was unlikely to be heavily impacted by the spill. A much larger number of pelicans breed in Baja California, Mexico. After breeding, many of these birds migrate north and make up the majority of pelicans in the state in summer and fall. During the oil spill, many of the Baja pelicans were already migrating north, due to a failed breeding season in Mexico, and were passing through the spill-affected area. A reconnaissance level, boat-based survey of the nesting colony on Anacapa was conducted by Channel Islands National Park staff on June 5, 2015 during the initial cleanup effort, and no oiled pelicans were observed (Larramendy et al. 2018); however, the survey did not include direct, on-island access. Ground

surveys were conducted later on September 20 and 21, 2015 (following the end of the nesting season).

Hundreds of nests were inspected for oiling. Evidence of oiling was limited to one juvenile brown pelican carcass on Middle Anacapa Island, in which a small amount of weathered oil was found on several wing tips, and a few specks on the downy feathers around its shoulder (Larramendy et al. 2018). The survey team estimated the bird was about 6 weeks of age at the time of death, which is essentially full grown.

Brown Pelican Roost Surveys

Due to their large size, pelicans can survive for many days after oiling. In order to assess the extent of oiling of brown pelicans, surveys of known pelican roost sites on the mainland from Morro Bay to Los Angeles were performed in the days immediately after the spill (Jaques et al. 2015). Surveys were conducted by ground and by boat to evaluate the proportion of pelicans at each roost site that showed visible oiling. An aerial survey of pelican roosts were conducted on May 27, 2015 (Jaques et al. 2015). Aerial surveys are ideal for documenting the total number of individuals at each roost by taking photographs and counting brown pelicans (which are easily distinguishable from other birds due to their body size) at each roost. Because no single survey method is able to detect both the proportion of oiled individuals at any given roost and the total number of individuals at the roost, the Trustees analyzed these datasets together to estimate the total number of oiled pelicans at each roost site.

Brown Pelican Rehabilitation Survival Studies

The Oiled Wildlife Care Network (OWCN) assisted with wildlife operations during the spill, including rehabilitation of oiled birds. In order to understand the survival rate of rehabilitated oiled wildlife, the OWCN and other collaborators tracked rehabilitated pelicans to determine their survival and distribution relative to birds that were not oiled and rehabilitated during the spill (Fiorello et al. 2017). Several individuals traveled >5000 km, migrating to northern California or central Oregon in late summer and early fall. In the spring, most birds traveled south, some as far as Baja California. It appeared that both pelicans from Anacapa and Baja were impacted because they flew to those locations after being released. Mortality was documented among both rehabilitated and control birds.

Sandpiper Pier Cormorant Colony Surveys

Brandt's cormorants in the spill-affected area nest in a single colony on four nesting platforms that were constructed offshore of Ellwood Beach in Santa Barbara County. Surveys were conducted from the shore to assess the number and status of nests throughout the 2015 breeding season (Figure 29). Based on these observations, the Trustees concluded that nests were not abandoned and chicks successfully hatched during the spill period at a normal rate. Adverse effects from exposure to oil were not visibly apparent during these surveys. However, health effects from ingestion of oil may not have culminated during the survey period, and cannot be easily assessed based on a visual survey.



Figure 29. Cormorant nests on platform 1 during a May 22, 2015 survey. Red circles indicate nests that were monitored during the May and June surveys. Photo Credit: Natural Resource Damage Assessment Trustees.

Baseline Carcass Deposition Surveys

Information about the baseline rate of bird deposition on beaches throughout the spill-affected area is available from information collected through the Beach Coastal Ocean Mammal and Bird Education & Research Surveys (BeachCOMBERS) program. The program utilizes highly trained citizen scientists to conduct monthly beach surveys using a dedicated protocol for documenting the number and status of beached birds and mammals within each survey segment. Data collected includes species identification, decomposition state, observations of carcass scavenging, observations of carcass oiling, and other factors. All carcasses encountered during a survey are marked to identify whether the carcass has been observed on previous surveys (a new mark is made each month). The goal of the BeachCOMBERS program is to establish long-term data on baseline bird and mammal stranding rates, so that when unusual mortality events occur (e.g., oil spills, disease events, etc.), resource managers can understand and explore the magnitude and cause of the bird and/or mammal mortality. The spill occurred within the South Coast Chapter of BeachCOMBERS which began collecting monthly data in January 2013.

5.3.2 Brown Pelican injury analysis

Background

The California brown pelican is a subspecies of brown pelican that ranges throughout the west coast of North America. It nests in Mexico and on the Channel Islands. The brown pelican was delisted as a protected species by the State in June 2009 and by the federal government in December 2009. During the spill, brown pelicans were nesting on the Channel Islands, and many were migrating north through the spill area following breeding failure in Mexico. Brown pelicans typically forage in relatively shallow coastal waters, feeding almost entirely on surface-schooling fish caught by plunge diving. Brown pelicans are rarely found away from salt water and do not normally venture more than 32 kilometers (20 miles) out to sea. During the non-breeding season, brown pelicans roost communally on offshore rocks and structures such as piers and wharfs. Brown pelicans have wettable plumage so they must have roost sites to dry after feeding or swimming (Jaques and Anderson 1987). Roost sites are also important for resting and preening. The essential characteristics of roosts include: nearness to adequate food supplies; presence of physical barriers to protect the bird from predation and disturbance; sufficient surface space for individuals to interact normally; and adequate protection from adverse environmental factors such as wind and surf (Jaques and Anderson 1987).

Brown Pelican Injury Assessment

Brown pelicans were the most numerous bird species to be found alive and dead during the spill period. Of the birds collected during the spill, 72% of the live birds (n=47), and 13% of the dead birds (n=26) were brown pelicans. Not all of the live and dead brown pelicans affected by the spill were captured or collected. Brown pelicans are capable of long-distance flights and oiled individuals can survive for several days to weeks before becoming weak and either succumb to their exposure or become lethargic enough to be captured. To estimate the total number of brown pelicans injured by the spill, the Trustees applied the following methodology which is discussed in detail in Appendix I.

- 1) Determine brown pelican distribution during the spill;
- 2) Determine brown pelican oiling rate;
- 3) Calculate brown pelicans injured within the cleanup zone;
- 4) Calculate brown pelicans injured outside the spill cleanup zone;
- 5) Adjust for rehabilitated birds; and
- 6) Calculate total number of brown pelicans injured.

Summary of Brown Pelican Injury

Based on the number of brown pelicans recovered live and collected dead during the cleanup, the estimated number injured by the spill but missed by the cleanup, and the rehabilitation success of pelicans that were treated and released, the Trustees estimate that a total of 319 brown pelicans were injured by the spill (Table 10)¹³.

¹³ Plains disagrees with the Trustee estimate of brown pelicans injured by the spill.

Table 10. Total Brown Pelican injury from the Refugio Beach Oil Spill.

Brown pelicans injured within the spill cleanup zone	72
Brown pelicans missed by the spill cleanup	+ 279
Rehabilitation credit	- 32
TOTAL Brown Pelican Injury	319

5.3.3 Western snowy plover injury analysis

Background

When the spill occurred, federally threatened western snowy plovers, were in the midst of their breeding season, with many chicks recently hatched and foraging on sandy beaches. Western snowy plovers are among very few species that nest directly on sandy beaches, which makes them vulnerable to conflicts with human activities. In the spill-affected area, there are several locations where plovers nest: Coal Oil Point Reserve (COPR) at University of California Santa Barbara, San Buenaventura State Beach, McGrath State Beach, Mandalay State Beach, Hollywood Beach, Ormond Beach, and Point Mugu (Figure 30). All of the beaches shown in Figure 30 received oiling and/or tar balls in varying degrees during the spill. The maximum amount of oil observed by SCAT teams ranged from heavy at COPR to very light at Ormond Beach. The presence of cleanup crews corresponded to the degree of oiling.

As COPR was exposed to the greatest oiling and most intense cleanup activities of any western snowy plover breeding sites within the spill-affected area, it was also the most intensively studied to determine injury to plovers from oil exposure and cleanup actions. Injury to plovers from cleanup actions, wrack removal, and food web impacts at McGrath Beach, Hollywood Beach, and Ormond Beach are incorporated into the assessment of shoreline habitat injury described in Section 5.1 of the DARP/EA.

Western Snowy Plover Injury Assessment

Effects of the spill on western snowy plovers were assessed using the following methodology, which is described further in Appendix I.

- 1) Determine effect of the spill on western snowy plover population size at COPR;
- 2) Determine effect of the spill on behaviors and breeding success at COPR in 2015;
- 3) Determine amount of body oiling on western snowy plovers at COPR during the spill;
- 4) Conduct a literature review to identify risk of toxicity from oil ingestion;
- 5) Determine effects of the spill on western snowy plover fertility at COPR; and
- 6) Estimate western snowy plover injury.



Figure 30. Refugio oil spill release location relative to nesting western snowy plover nesting sites.

Estimate of Western Snowy Plover Injury

Western snowy plovers at Coal Oil Point Reserve in Santa Barbara County, and various locations within Ventura County, were exposed to Line 901 oil during the Refugio Beach Oil Spill. The spill occurred during the breeding season, and at the time of the spill many nests had been formed and eggs had been laid. COPR was exposed to heavy oiling and extensive cleanup actions, and the Trustees determined that an assessment of injury to this population was warranted.

All western snowy plover populations in Ventura County were also exposed to some level of tarball oiling and disturbance from cleanup actions. Due to the relatively low injury expected from this oiling and disturbance, these effects are captured as part of the shoreline habitat injury assessment which considers impacts to western snowy plover's prey base and disturbances to their habitat from cleanup actions.

Cleanup workers and land managers at COPR worked closely together to minimize impacts to western snowy plovers from oil spill cleanup actions. Managers documented oiling on western snowy plovers at COPR and disturbances to the birds from the presence of cleanup crews; however, no mortality was recorded and hatching and fledging rates met or exceeded long term averages. Therefore no injury to western snowy plovers at COPR was estimated in 2015, above impacts to food webs (through depressed beach invertebrate populations) and cleanup impacts that are quantified as part of the shoreline injury assessment.

The year following the spill (2016), western snowy plover infertility substantially increased compared to the long term average, with a total of 12 infertile eggs, none of which contained embryos. Background infertility under normal conditions is around 2%, therefore, of the 12

infertile eggs, two would be expected to occur without the effects of the spill. The additional 10 infertile eggs cannot be explained by background infertility rates. These infertilities were likely caused by oil exposure to western snowy plover adults during the 2015 breeding season. Adults were observed with oil on their plumage and beaks, which they preened and ingested. Adults were also observed foraging within oiled wrack, and their prey species (e.g., sandy beach invertebrates such as sand crabs) were documented to have increased hydrocarbons in their tissue. In 2017, the infertility rate reduced to a level that is within the range of normal variation. Based on typical hatching and fledging rates at COPR, the Trustees anticipate that of the 10 infertile eggs documented at COPR in 2016, four would have hatched and fledged. Therefore, we assert that at least four western snowy plovers at COPR were injured through reproductive injury from the Refugio Beach Oil Spill. Additional injury to western snowy plovers may have occurred from direct oil exposure, prey reduction, and impacts from cleanup operations. Effects to plovers from injuries to their habitat are captured in the shoreline injury analysis.

5.3.4 Other Bird Injury Analysis

Background

This category includes all birds other than brown pelicans and western snowy plovers that were impacted by the spill. This category includes at least 29 species of seabirds, shorebirds, and landbirds. Table 9 lists all the birds by species collected alive and dead during the spill cleanup. Figure 31 groups the species into related categories. After pelicans, impacts were spread among a variety of marine waterbirds. Because the spill occurred during the nesting season for most North American birds, and most affected species do not nest locally, the impacts to other birds were largely limited to non-nesting individuals, such as sub-adults that were likely over-summering in the area. Had the spill occurred in winter, many more individuals from these species groups would have been impacted.

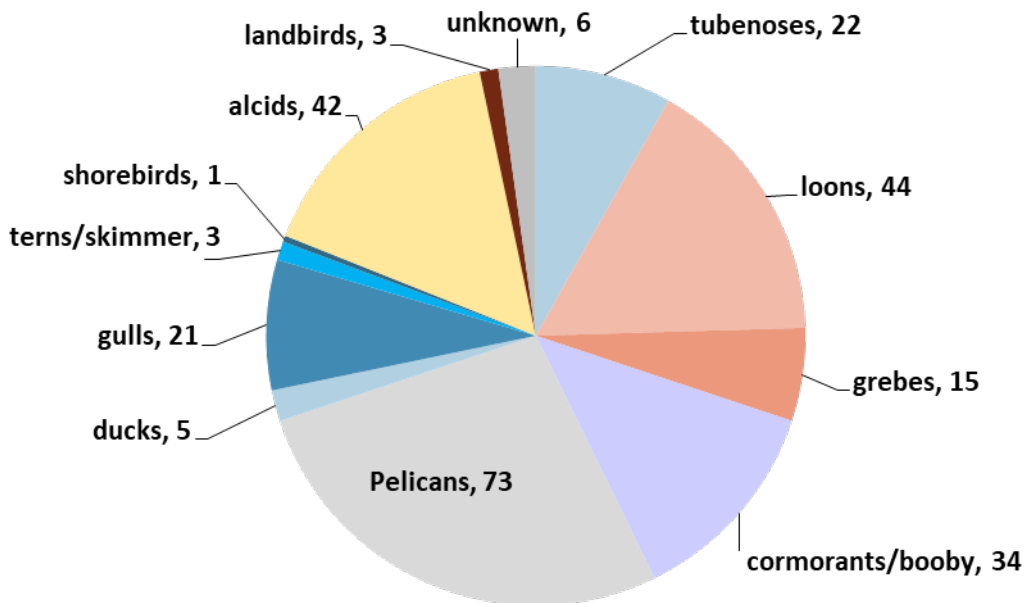


Figure 31. Total live and dead birds captured and collected following the spill.

Other Bird Injury Assessment

In order to estimate mortality for these species, the Trustees applied the following methodology, which is described in Appendix I.

- 1) Determine which of the collected birds were related to the spill:
 - a. Identify species and numbers of birds collected;
 - b. Identify number of oiled and non-visibly oiled birds;
 - c. Oiled dead birds – adjust for baseline oiling from natural seeps; and
 - d. Non-visibly oiled dead birds – adjust for background deposition.
- 2) Use the Beached Bird Model to identify how many birds were missed:
 - a. Determine carcass persistence on beaches;
 - b. Determine search effort and efficiency; and
 - c. Calculate total injury.

Beached Bird Model

As with the pelican assessment above, it is very likely that the actual number of other species impacted by the spill exceeds the number collected and attributed to the spill. Birds impacted by an oil spill may not be collected for a variety of reasons:

1. They may travel outside of the response area. As described above, this occurred with the large number of pelicans migrating north.
2. They may die at sea, sink, or be carried away from beaches that were searched.
3. They may come ashore on inaccessible beaches that cannot be searched.
4. Once on the beach, they may be removed by other animals scavenging on the beach.

5. For carcasses that do make it to accessible beaches and are not removed by scavengers, searchers may miss them.

In this case, with the non-pelican species, it is difficult to assess the first two reasons. Some species, such as loons, were migrating north, but most non-pelican species may have been more acutely debilitated by the oil, limiting their dispersal distance. Because the spill was nearshore, substantial loss of birds at sea was unlikely. Given these caveats, we did not specifically apply any correction factors for these first two reasons for non-pelican bird species.

The remaining three factors, inaccessible beaches, carcass removal, and search efficiency, can be incorporated into a Beached Bird Model in order to estimate total mortality. The model is based on the number of birds recovered, the probability of a beached bird persisting over a given time interval, and the likelihood that searchers will detect a beached bird. Derivation of the basic equation is from Ford et al. (1996) and Page et al. (1990). This approach has been used for most major oil spill bird mortality events for several decades. Using a simplified example, if the probability of a bird being removed by a scavenger in the course of a day is 50 percent, and the probability of it being overlooked by a searcher is 50 percent, then the probability of it being recovered is 25 percent. This would imply that, for every one bird found, three more are missed. This would result in a “beached bird multiplier” of four. That is, one bird found implies that four birds were impacted.

Estimated Injury to Other Birds

The final results of the Beached Bird Model, incorporating scavenging, search efficiency, and unsearched areas, were that 236 birds, not including pelicans and western snowy plovers, were killed by the spill (Table 11).

Table 11. Summary of estimated mortality of “other birds” based on the results of the Beached Bird Model.

Bird Taxon	Total Carcasses Collected¹	Total Estimated Mortality
Alcids	42	56
Loons	44	53
Procellarids/Boobies	23	35
Gulls/Terns/Skimmer	24	33
Cormorants	33	24
Grebes	15	21
Surf Scoter	3	6
Other/Unknown	9	8
TOTAL	193	236

¹ Not including pelicans, domestic ducks, rock pigeons, and three birds collected live, rehabilitated and released. Note that a proportion of these carcasses were found to not be spill-related.

5.3.5 Summary of Bird Injury

In summary, the assessment of injury to birds from the Refugio Beach Oil Spill was conducted by dividing all affected birds into three categories: brown pelicans, western snowy plovers, and all other birds. The assessment methods for each category were designed around the species' life history strategy and feasible methods for quantifying injury. Table 12 shows the overall summary of estimated bird mortality by species group.

Table 12. Summary of total estimated bird mortality caused by the Refugio Beach Oil Spill.

Bird Taxon	Total Estimated Mortality
Brown Pelicans	319
Western Snowy Plovers	4
Alcids	56
Loons	53
Procellarids/Boobies	35
Gulls/Terns/Skimmer	33
Cormorants	23
Grebes	21
Surf Scoter	6
Other/Unknown	8
TOTAL	558

5.3.6 Selected Restoration Projects

Restoration alternatives for brown pelicans fall into two broad categories: improvement or protection of nesting habitat, and reduction of human-caused mortality during the non-breeding season. Selected projects that benefit brown pelicans are listed in Table 13 below.

The Trustees selected brown pelican colony protection at Anacapa Island as the primary restoration project for brown pelicans. The Trustees also selected a project to reduce or prevent injury to seabirds from recreational fishing to restore brown pelicans. This project will also benefit other seabird species, and is the restoration project selected for other birds. To address injury to western snowy plovers, the Trustees selected a project to fund management actions at Coal Oil Point Reserve that protect western snowy plovers from human activities and predators during their nesting season. Each of these projects are described further below. Other proposed second tier projects (Table 14) were not selected due to concerns over feasibility or lower anticipated benefits, but could be implemented if funds allow.

Table 13. Selected restoration projects for birds

ID#	SELECTED PROJECTS	SPECIES BENEFITS
BIRD-1	Brown Pelican Colony Protection at Anacapa Island	Brown Pelican
BIRD-2	Prevention of Injury to Seabirds Related to Recreational Fishing	Seabirds
BIRD-3	Western Snowy Plover Management at Coal Oil Point Reserve	Western snowy plovers

Brown Pelican Colony Protection at Anacapa Island (BIRD-1)

This project is intended to protect the largest United States breeding colony of California brown pelicans, on Anacapa Island, from nest displacement and loss caused by invasive Cape ivy.

The goal of this project is to eradicate the Cape ivy infestation on West Anacapa Island. Methods will include: 1) initial assessment of infested areas and baseline vegetation, along with pelican surveys, 2) two initial herbicide treatments to infested areas via helicopter and hand application in the first year, 3) follow-up treatment for the following 4 years, and 4) follow-up vegetation and pelican surveys. As part of the project, a water cache will be installed to allow for follow-up treatments over a longer timeframe. Treatments will occur outside the pelican breeding season, during fall/early winter when native vegetation is dormant and before winter rains.

Affected Environment

Anacapa Island is composed of a series of narrow islets, with the three main islets being East, Middle and West Anacapa. Despite its small size, Anacapa Island supports nearly 200 types of native plants from 50 plant families (Junak and Philbrick 2018). There are several infestations of Cape ivy on the north side of West Anacapa Island. This invasive plant displaces native vegetation and reduces the amount of available nesting and roosting habitat for pelicans. The largest infestation is in Summit Canyon (Figure 32). Anacapa Island has the largest breeding colony of the California brown pelican in the United States, and one of the only three in California. Middle and West Anacapa Islands serve as critical breeding and roosting habitat for the California brown pelican. Anacapa Island also supports the largest western gull (*Larus occidentalis*) colonies in the Channel Islands. A total of 17 landbird species are also known to breed on Anacapa Island (Davidson et al. 2014).



Figure 32. Project location for the brown pelican colony protection at Anacapa Island, the grey outline indicates a nesting area where Cape ivy is expanding and may decrease habitat suitability.

Environmental Consequences (Beneficial and Adverse)

Overall, this project is anticipated to have only minimal adverse environmental consequences and multiple beneficial impacts. In reaching this conclusion, the Trustees evaluated several types of potential impacts, as described below.

1. *Biological Impacts* –This project will benefit brown pelicans by enhancing nesting and roosting habitat through controlling invasive Cape ivy. By targeting active areas of infestation, the project will reduce the non-native cover and allow for native vegetation recovery and use by brown pelicans. The eradication of this species will protect nesting habitat and the native plant community which brown pelicans use to construct and support its nests. An increase in suitable habitat will allow for an increase in the number of nesting birds and subsequent fledglings on Anacapa Island.

In addition, control of this invasive plant at its current locations will prevent its spread and additional loss of adjacent occupied habitat for brown pelicans. Additionally, the eradication of Cape ivy will protect the native flora and fauna on West Anacapa Island, and will also help prevent the introduction to the other Anacapa islets, as well as the other northern Channel Islands where Cape ivy is currently not found. The eradication of Cape ivy on West Anacapa Island will also protect rare plants found throughout the islets, which are currently outcompeted by this invasive plant. Overall, a diverse assemblage of native flora and fauna depend on intact vegetation communities. This project will benefit a range of species, including nesting seabirds (in particular the brown pelican and western gull), terrestrial songbirds, migratory birds, rare plants, and invertebrates that depend on the native vegetation communities.

Herbicide applications for invasive plant treatments are covered under a NPS Categorical Exclusion (NPS 2019). Herbicide treatments can have impacts to non-target native vegetation within the treatment area. To reduce potential impacts, efforts will be made to minimize over spray and drift onto non-target species, including spot treatment of invasive plants adjacent to intact native vegetation. Herbicides will be applied by a certified applicator and in accordance with application guidelines and the manufacturer label. Although there may be short-term impacts to native plants within the treatment area, the long-term, negative consequences of not treating the Cape ivy or other invasive plant species far outweigh impacts to individual plants. Another potential adverse consequence of this project could be the unintentional spread of invasive plants from the treatment sites to other parts of the island via due to foot traffic. In order to reduce this potential, extreme caution will be used to reduce the spread of seeds via clothing and footwear by implementing existing biosecurity protocols for the Channel Islands. Also, in order to avoid impacts to nesting birds, including seabirds and resident terrestrial birds, herbicide treatment and vegetation monitoring will occur in fall/early winter, well before nesting season begins. Overall, any biological impacts from the implementation of the project are anticipated to be

minor in comparison to the overall long-term beneficial impacts from restoring the native plant community to protect brown pelican nesting habitat.

2. *Physical Impacts* – The Trustees do not anticipate major adverse impacts to the physical environment, such as water, air, sediments, etc. Any negative physical impacts would be unlikely and, at worst, would likely be mitigated by the use of best practices. Ultimately, any adverse physical impacts are expected to be negligible.
3. *Human Impacts* – The Trustees do not anticipate adverse impacts from this project on socio-economics, aesthetics, health and safety, historical properties, etc. There is likely a benefit to the public as the sustained or increased presence of brown pelicans would create more opportunities for wildlife viewing.

Probability of Success

With the relatively small footprint of Cape ivy on West Anacapa Island (1-2 acres as of September 2018), the probability of successfully eradicating this species from this location is high. This multi-year, sustained effort would enable successive treatments over a six-year period as needed. This continued follow-up after initial treatment is critical to retreating any sprouts and ensuring success.

The control of other invasive species (Russian thistle, ice plant, etc.) in the project area also has a high probability of success. Herbicide treatment and manual removal are proven techniques to help control populations and limit the spread of invasive weeds. The eradication and control methodologies proposed have been tested and utilized successfully on the Channel Islands.

Performance Criteria and Monitoring

The success of the restoration project will be evaluated by assessing metrics associated with natural resource functions and services. Metrics will be compared with: 1) initial conditions at the project site and/or 2) conditions at an appropriate nearby natural reference site or sites. The success of this project will be measured with a minimum of three monitoring events are proposed which will be outlined in project monitoring plan. Additional monitoring of brown pelicans will continue post project as part of Channel Islands National Park's Inventory and Monitoring Program. Specifically, monitoring may include, but is not limited to:

- Documenting brown pelican abundance, distribution, phenology, and reproductive success in and adjacent to the treatment areas.
- Monitoring annual vegetation during all six years of the project within the project area. Monitoring will follow established protocols and will document treatment area, efficacy of treatments, and recovery of native vegetation communities.
- Analyzing treatment efficacy through post treatment monitoring. Post treatment monitoring will include both visual estimates of percent cover of Cape ivy and counts of stem number within permanent quadrats.
- Establishing photo points to document the progression of the treatment areas.

- Eradicating Cape ivy from Summit Canyon. Efforts to control other invasive weeds within the scope of this project will be prioritized upon initial assessments. Additional control efforts on Anacapa Island will be documented and mapped each year.

Evaluation

The Trustees have evaluated this project using the threshold and additional screening criteria developed to select restoration projects and concluded that this project is consistent with and meets the objectives of these selection factors. This type and scale of project will effectively provide appropriate compensation for brown pelicans injured as a result of the spill, and the Trustees have therefore selected this project as a preferred alternative.

Birds and Fishing Conflict Reduction (BIRD-2)

In an analysis of all seabirds brought to International Bird Rescue rehabilitation centers in Los Angeles and San Francisco between 2002 and 2015, fishing hook and line injuries were by far the most common anthropogenic injury, totaling 2,957 birds (Duerr 2016). Brown pelicans and other seabirds, including cormorants and gulls, are often attracted to nearshore areas where schooling bait fish are abundant. If anglers are fishing in these areas (e.g., from coastal piers), seabirds can be inadvertently hooked or entangled in fishing line. In addition, discarded waste fishing line can entangle seabirds. This project would use outreach to raise public awareness and educate anglers about ways to reduce their chances of hooking birds and what to do if one is hooked. Outreach could include printed materials and/or training of docents. This project may also provide support to bird rehabilitation centers to help recover and rehabilitate seabirds with fishing hook and line injuries.

This project is also intended to reduce seabird injury in areas where birds are attracted to fishing waste disposal areas. Brown pelicans and various gull species are often attracted to commercial fishing vessels off-loading small fish (e.g., sardines and anchovies) and squid, and to fish waste receptacles used by recreational anglers. These birds may attempt to dive into open bins of fish and may get injured by off-loading machinery and vehicles. In addition, repeated bodily contact with fish and fish oil can lead to a loss of waterproofing on the birds, resulting in hypothermia and other health issues.

Affected Environment

This project will be located in various locations along the Santa Barbara, Ventura, and Los Angeles County coastlines where recreational and commercial fishing activities are causing injuries to seabirds. Locations with fishing piers, harbors, and other fishing facilities will be targeted. This project may also focus on offshore fishing activities, if needed.

Environmental Consequences (Beneficial and Adverse)

Overall, this project is anticipated to have only minimal adverse environmental consequences and multiple beneficial impacts. In reaching this conclusion, the Trustees evaluated several types of potential impacts, as described below.

1. Biological Impacts – The Trustees do not anticipate any adverse effects to biological resources. Beneficial effects to seabirds are anticipated to be achieved by providing resources and training to recreational and commercial fishermen to reduce entanglements by implementing best practices, and being trained to capture and disentangle birds or transport birds to rehabilitation centers for professional treatment.
2. Physical Impacts – The Trustees do not anticipate any adverse impacts to the physical environment, such as water, air, sediments, etc. Beneficial effects to the physical environment are anticipated from reduced fishing line and fishing waste from entering coastal habitats.
3. Human Impacts – The Trustees do not anticipate adverse impacts from this project on socio-economics, aesthetics, health and safety, historical properties, etc. This project is not intended to reduce any recreational and commercial fishing opportunities, rather it is focused on working with willing recreational and commercial fishermen and fisherwomen to allow them to continue fishing while reducing their impact on seabirds.

Probability of Success

The probability of success of implementing the project is high. The effectiveness of the project in reducing seabird entanglements, however is dependent on the willingness and ability of the target audience to effectively implement what they learn. In order to maximize the probability that the outreach efforts implemented are successful in reducing entanglements, the project will be implemented by people that are knowledgeable about seabird handling/rehabilitation and will seek to create opportunities for anglers to participate in the program in a way that is convenient and approachable for them. For example, trainings may be held at piers, or tackle shops.

Performance Criteria and Monitoring

The performance of this project will be measured by evaluating incidence of birds with fishing hook and line injuries that enter rehabilitation centers after the program is implemented. The goal of the project is to reduce 60 bird deaths per year from fishing hook and line entanglement. It is not possible to measure the performance of the project in terms of the exact number of birds saved; however, evaluating the instances of birds with fishing hook and line injuries being admitted to rehabilitation centers will be a proxy for estimating whether the program is successful.

Evaluation

The Trustees have evaluated this project using the threshold and additional screening criteria developed to select restoration projects and concluded that this project is consistent with and meets the objectives of these selection factors. This type and scale of project will effectively provide appropriate compensation for seabirds injured by the spill, and the Trustees have therefore selected this project as a preferred alternative.

Western Snowy Plover Management at Coal Oil Point Reserve (BIRD-3)

The goal of this project is to protect a breeding colony of threatened western snowy plovers from predation and human disturbance. The focal colony, one of the largest in the region, is located in UC Santa Barbara's Coal Oil Point Reserve and became established largely due to species management efforts. The project aims to compensate for lost fledges due to infertility, as well as for additional unquantified injuries resulting from the oil spill, such as low over-winter survival and decreased breeding effort. Activities may include: predator control, upgraded signage and fences, outreach to reduce disturbances, leashes to lend for pets, and eradication of iceplant in areas of nesting habitat on Ellwood Beach.

Affected Environment

Coal Oil Point Reserve is part of the University of California Natural Reserve system, and protects a variety of coastal and estuarine habitats and fauna, including the threatened western snowy plover. Specifically, this reserve protects coastal dune, estuarine, tidal lagoon, sandy beach, and rocky reef habitats. Coal Oil Point Reserve, which is utilized by western snowy plovers for nesting, was exposed to the greatest oiling and most intense cleanup activities of any plover breeding sites within the spill-affected area.

Environmental Consequences (Beneficial and Adverse)

Overall, this project is anticipated to have only minimal adverse environmental consequences and multiple beneficial impacts. In reaching this conclusion, the Trustees evaluated several types of potential impacts, as described below.

1. **Biological Impacts** – This project benefits the population of western snowy plovers that was directly impacted by the spill. Management actions at Coal Oil Point Reserve aim to protect the plovers from predators and human activities during their nesting season. Benefits include maintaining the current colony of snowy plovers at COPR, along with preventing its displacement and loss. Many of the potential proposed activities will also be beneficial to other bird species and native plants in the area.
2. **Physical Impacts** – The Trustees do not anticipate any major or minor impacts to the physical environment, such as water, air, sediments, etc. Any physical impacts from activities such as installing symbolic fencing are temporary and negligible to the physical environment.
3. **Human Impacts** – The Trustees do not anticipate noteworthy impacts from this project on socio-economics, aesthetics, health and safety, historical properties, etc. COPR has struck a balance between human recreation and access to the coastal environment, while protecting western snowy plovers and other wildlife species and their habitats. This project will seek to continue and expand that dual mission of allowing recreation and protecting natural resources.

Probability of Success

The probability of success is high. Western snowy plover breeding was extirpated at COPR in the 1980s due to high human use of the coastal environment in close proximity to UC Santa Barbara. Due to targeted protective measures, Coal Oil Point Reserve has established a robust nesting population that continues to thrive today. This project has a high probability of success due to the knowledge and expertise of staff at Coal Oil Point Reserve that will be implementing the project.

Performance Criteria and Monitoring

Metrics such as nest success will be compared to initial conditions at the project site. Staff at Coal Oil Point Reserve monitor the western snowy plover population annually to track the number of pairs, nest success, and other parameters. This monitoring will continue throughout the implementation of this project and will be used to determine the success of the project.

Evaluation

The Trustees have evaluated this project using the threshold and additional screening criteria developed to select restoration projects and concluded that this project is consistent with and meets the objectives of these selection factors. This type and scale of project will effectively provide appropriate compensation for western snowy plovers injured as a result of the spill, and the Trustees have therefore selected this project as a preferred alternative.

5.3.7 Second Tier Restoration Projects Considered

The Trustees also considered the following projects (Table 14), and determined that many are valid projects that would provide benefits to seabirds. However, these projects were not selected for various reasons described below. These projects may be reconsidered if a selected project cannot be implemented or if remaining funds allow.

Table 14. Second tier bird restoration projects that may be implemented if funds allow.

ID#	OTHER PROJECTS CONSIDERED	BENEFITS
BIRD-4	Social Attraction for Brown Pelicans at Alcatraz Island	Brown pelicans
BIRD-5	Enhancement of Brown Pelican Nesting Habitat at San Clemente Island	Brown pelicans
BIRD-6	Continue Revegetation Projects on Santa Barbara Island to Promote and Expand Suitable Brown Pelican Nesting Habitat.	Brown pelicans
BIRD-7	Western Snowy Plover Predator Control	Western snowy plovers
BIRD-8	Raven Exclusion Devices for Nesting Ashy-storm Petrels on Channel Islands	Ashy-storm petrels

BIRD-9	Western Snowy Plover Monitoring and Habitat Protection at McGrath, Mandalay, and San Buenaventura State Beaches	Western snowy plovers
BIRD-10	Dune Restoration	Western snowy plovers
BIRD-11	Reduction of Disturbances to Seabirds at the Channel Islands (Seabird Protection Network Channel Islands Chapter)	Various seabirds
BIRD-12	Andre Clark Bird Refuge	Various seabirds
BIRD-13	Protection of Nesting Grebes	Grebe species
BIRD-14	Artificial Nest Habitat Creation at Anacapa, Santa Barbara, and/or San Clemente Island	Scripps's murrelets
BIRD-15	Restore and Increase Artificial Nest Habitat at San Miguel Island	Scripps's murrelets, Cassin's auklets
BIRD-16	Restore Native Habitat at Anacapa Island	Scripps's murrelets, western gulls
BIRD-17	Establishment of Bird and Marine Mammal Rescue and Rehabilitation Facility	Various seabirds, marine mammals

Brown pelican restoration at Alcatraz Island (BIRD-4)

This project involves restoring habitat and using social attraction to try and establish brown pelican breeding on Alcatraz Island. This project could be considered as a second tier project and social attraction could potentially result in recolonization of Alacatraz Island by breeding brown pelicans, but the feasibility of this project is unknown. Alcatraz Island is outside of the current breeding range for brown pelicans, and is substantially distant from the spill-affected area.

Brown pelican restoration on San Clemente Island (BIRD-5)

Brown pelicans have nested on San Clemente Island in the recent past and could benefit from protection actions such as the establishment of exclusion zones from cats, fox, and rats. This action may benefit other seabirds as well. The feasibility of this project is unknown at this time, and would require additional planning. Greater benefits to brown pelicans would be achieved where nesting densities are greater.

Restoration through revegetation on Santa Barbara Island (BIRD-6)

Building on restoration that has begun on Santa Barbara Island, this project would involve promoting suitable brown pelican nesting habitat by revegetating habitat areas. Currently access to Santa Barbara Island is limited due to a damaged boat landing. Upon repair of landing facilities at Santa Barbara Island, this project may become cost effective.

Western snowy plover predator control (BIRD-7)

Provide funding for control of ravens and other predators that kill nesting western snowy plovers in FWS recovery unit 5 (including the spill-affected area) and unit 4 (north of the spill-affected area). Predator control at COPR is listed as a preferred project because that is the location where

western snowy plovers were injured by the Refugio Beach Oil Spill. Predator control efforts could be expanded to other areas, if funds allow.

Raven Exclusion Devices for Nesting Ashy-Storm Petrels on the Channel Islands (BIRD-8)

This project involves providing enhanced protection for nesting Ashy-storm petrels that are preyed upon by common ravens. This project may be funded as a second tier project if funds allow, as the impact of the spill on this species was low compared to other seabirds.

Western Snowy Plover Monitoring and Habitat Protection at McGrath, Mandalay, and San Buenaventura State Beaches (BIRD-9)

Much of the suitable habitat for western snowy plovers and California least terns is within California State Parks ownership. This project would include monitoring and protecting western snowy plovers and California least terns in State Parks through installation of symbolic fencing, signage, docent programs, predator control, and other measures necessary to monitor and protect nesting shorebirds. These sites have been identified as secondary priorities, and could be implemented if preferred locations become infeasible.

Dune restoration (BIRD-10)

By removing invasive non-native plants that degrade dune ecosystems, these projects will restore dune habitats, native species and landscapes, and enhance ecosystem functions. Removal of invasive plants will increase the amount of useable nesting areas for the western snowy plover and, in some locations, the California least tern. It will also reduce cover for predators of eggs, chicks and adult birds. This project is a selected project in the Shoreline Restoration section of this plan. Additional project locations could be funded if birds would benefit, and if funds allow.

Seabird Protection Network – Channel Islands (BIRD-11)

This project would implement tasks identified by the Channel Islands Seabird Protection Network that are aimed at reducing human disturbances to seabirds at the Channel Islands. This is a second tier project, as the anthropogenic threats to seabirds are greater along the mainland coastline where the human population is greater. If funds allow, this project would be implemented.

Andre Clark Bird Refuge Restoration (BIRD-12)

Located near the Santa Barbara Zoo, this project is designed to improve water quality and habitat for both bird and aquatic species, and to allow the bird refuge to function as nursery habitat for ocean going fish. The proposed project includes five primary components: 1) restoration of 1.5 acres of coastal dune habitat; 2) restoration of 5 acres of coastal salt marsh habitat; 3) construction of a new multi-use recreational loop trail around the restored lagoon; 4) dredging of flow channels and deep pools to improve circulation and provide refuge for fish and other aquatic organisms; and 5) removal of flow barriers to improve flushing between the ocean and the lagoon in order to improve water quality, bird, and fish habitat. The benefits of this project to bird species impacted by the spill are unclear. The existing habitat at the Andre Clark Bird

Refuge serves as resting habitat for seabirds, and the improvements from the project to seabirds are unclear.

Protection of nesting grebes (BIRD-13)

Western and Clark's grebes have historically nested at Cachuma Lake in Santa Barbara County and Lake Casitas in Ventura County. This project would improve nesting success of grebes at these lakes. Restoration projects to improve grebe nesting success have been successfully implemented in northern California, focused primarily on outreach to reduce human disturbance at nesting colonies. No specific project has been proposed for lakes in Santa Barbara or Ventura Counties, and it is not known what management actions at these lakes would result in greater nesting success.

Artificial nest habitat creation at Anacapa, Santa Barbara, and/or San Clemente Islands (BIRD-14)

This project would improve nesting success of Scripps's murrelets at Anacapa, Santa Barbara, and/or San Clemente Islands. On Anacapa Island, the project would benefit murrelet populations by placing structures in the habitat adjacent to traditional nesting areas in Landing Cove and newly restored upland habitat. Scripps's murrelets have been utilizing artificial nest burrows placed within the habitat restoration area near Landing Cove at Santa Barbara Island. Additional artificial modules placed in other restored areas on this island would enhance murrelet populations by providing additional nest sites that typically have high nest success. Scripps's murrelet populations are severely limited by nest sites on San Clemente Islands. Several areas occur at San Clemente Island within the Seal Cove area where artificial nest sites could be installed and significantly increase the size of the nesting population at this island. This project is a second tier project as there was no evidence of injury to Scripps's murrelets and other alcids by the spill and the damages were not quantified.

Restore and increase artificial nest habitat at San Miguel Island (BIRD-15)

Increase the number of nesting boxes and improve older auklet boxes to protect the continued existence of this colony well into the future. Both Scripps's murrelet and Cassin's auklets could utilize artificial nests. This project is a second tier project as there was no evidence of injury to Scripps's murrelets and other alcids by the spill and the damages were not quantified.

Restore native habitat at Anacapa Island (BIRD-16)

The project would benefit Scripps's murrelets, western gulls, as well as many other native birds, insects, amphibians, reptiles, and restores ecosystem functions. The project could contribute to ongoing efforts to restore native habitat at Anacapa Island and help restore additional nesting habitat for both Scripps's murrelets and western gulls. This project is a second tier project as there was no evidence of injury to Scripps's murrelets and other alcids by the spill and the damages were not quantified.

Establishment of bird and marine mammal rescue and rehabilitation facility (BIRD-17)

This project would facilitate the establishment of a bird and marine mammal rescue and rehabilitation facility in Ventura County. This project is a second tier project because establishing a new bird and mammal rescue is beyond the Trustees' ability to implement.

5.4 Marine Mammals

Marine mammal species exposed to oil may suffer immediate or long-term health problems, leading to death or reproductive impairment. Small doses of oil may impact an animal's physiology or behavior by causing skin or gastrointestinal irritation, impairing reproduction, and compromising its immune system. Marine mammals can be exposed to oil through ingestion of contaminated food and water, grooming, absorption through wounds or eyes, inhalation of oil-derived volatiles, and aspiration of oil droplets directly to the lungs.

Most marine mammal species of California occur in the waters adjacent to the Gaviota coast, some transitory, some resident. These include pinnipeds, such as California sea lions, harbor seals, Guadalupe fur seals, and northern elephant seals; mustelids, such as southern sea otters; and cetaceans, such as bottlenose dolphins, long beaked common dolphins, gray whales, and humpback whales.

Marine mammals are generally difficult to study because of their wide-ranging pelagic life styles. Accordingly, comprehensive marine mammal surveys and studies can be logistically prohibitive to conduct and may last years. Therefore, the Trustees relied heavily on mammal stranding¹⁴ data in conducting their assessment because visible and easily-tracked strandings can provide an index to what is happening in the marine mammals' environment. Records of strandings from May 19, 2015, through July 7, 2015, formed the basis of the Trustees' assessment and quantification of injuries to marine mammals (Figure 33)¹⁵.

¹⁴ A stranding can be defined as (1) a dead marine mammal on the beach or in the water, (2) a live marine mammal on the beach and unable to return to the water, or (3) a live mammal in the water that is unable to function normally due to sickness or injury.

¹⁵ Plains disagrees with the Trustees' injury quantification, scaling, and restoration projects for marine mammals.

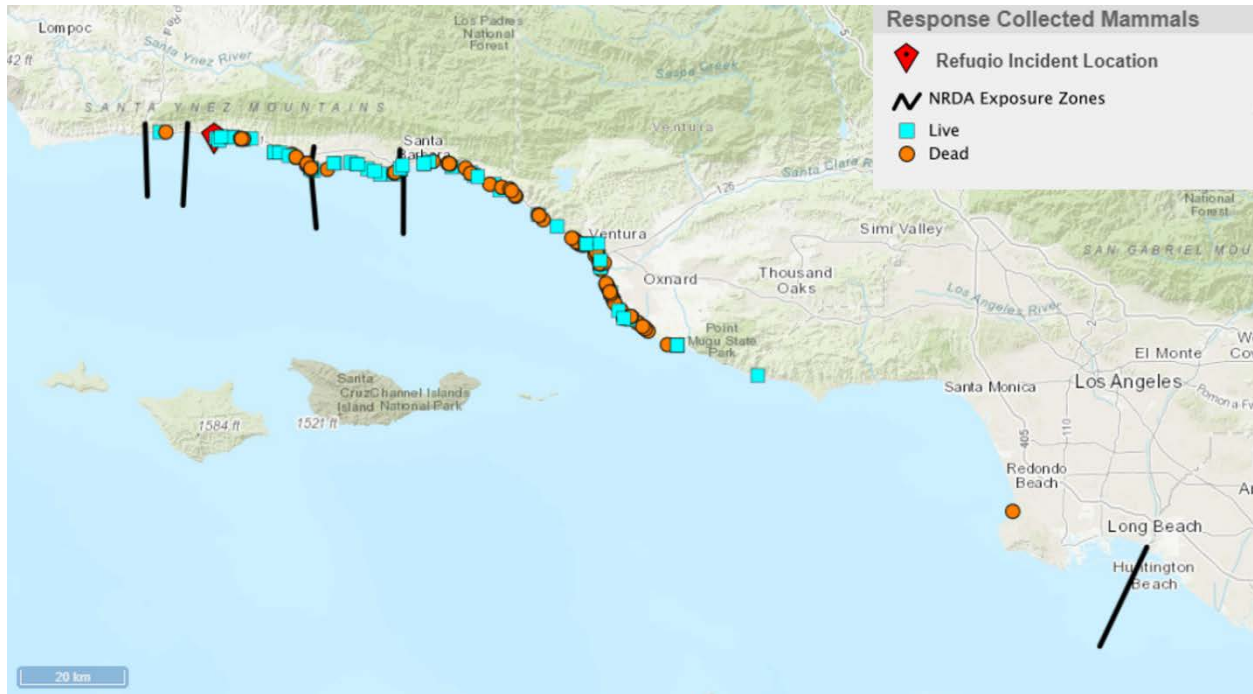


Figure 33. Location of marine mammal strandings, live and dead, collected during the spill cleanup period. The back lines show the NRDA Exposure Zone boundaries for reference; however these boundaries were not used in the quantification of injury to marine mammals.

5.4.1 Overview of Data Collection and Studies

This list below summarizes field surveys, data collection tasks, and analyses for the assessment of marine mammal exposure and injuries.

Live and Dead Marine Mammal Intake Data—Unified Command

Documentation of oiled live and dead animals is performed as a normal part of the spill response through the Unified Command. Intake logs describe the collection of each mammal, including the date, location, species, sex, condition (*e.g.* live or dead), and degree of oiling at the time of collection. These data provided the foundation for estimating mammal injury. Oiled wildlife were collected from May 19 through June 24, 2015.

California Marine Mammal Stranding Network Data

In addition to the intake logs for the marine mammals collected as part of the spill response (including date, location, species, sex, and condition), data on stranded, or beached marine mammals are routinely collected along the Santa Barbara and Ventura County coast lines through NOAA’s Marine Mammal Health and Stranding Response Program. These data collected by the stranding network from 2000-2015 provided key information for estimating total marine mammal mortality for this assessment. A total of 264 marine mammals were recovered between May 19 and July 7, 2015, the period considered for this assessment.



Figure 34. Oiled California sea lion recovered during cleanup operations. Photo Credit: Santa Barbara Channelkeeper.

Wildlife Response Reconnaissance surveys

The Unified Command conducted aerial surveys on May 21, 2015, between Point Conception and Goleta to document wildlife in the area and search for oiled animals. Additional surveys were performed on May 24 and May 26, 2015. Marine mammal sightings included California sea lions (Figure 34), harbor seals and unidentified whales and dolphins. No sea otters were observed during the survey. One additional aerial survey was conducted on May 28, 2015, to document presence or exposure of southern sea otters in the area. During this survey, no southern sea otters were detected in the cleanup area, and were therefore not considered further for the NRDA.

Table 15. Daily summary of marine mammal sightings (and average group size per sighting) during boat-based surveys in 2015.

Species	6/2	6/3	6/4	6/5	6/6	6/7	Total sighting
Dolphin, Coastal Bottlenose	0	2 (5)	3 (3)	2 (6)	2 (7)	4 (4)	13
Dolphin, Long-beaked Common	1 (1050)	3 (42)	0	1 (70)	0	6 (205)	11
Dolphin, Common, unidentified to species	1 (41)	0	0	0	0	0	1
Pinniped, California Sea Lion	6 (7)	3 (7)	4 (1)	3(1)	8 (1)	5(7)	29
Pinniped, Harbor Seal	1 (1)	1 (1)	4 (1)	0	6 (1)	4 (2)	16
Whale, Gray	1 (2)	0	1 (2)	0	0	1 (2)	3
Whale, Humpback	0	1 (2)	0	2(1)	0	1 (14)	4

Pre-Assessment Marine Mammal Surveys

To estimate the number of common bottlenose dolphins in the affected area and to document exposure of marine mammals to oil, photo-identification surveys were conducted from small boats and from shore along the Santa Barbara and Ventura County coastline from May 24 to June 7, 2015. Figure 35 gives an example trackline of one of the survey days. Dolphins, whales

and pinnipeds were sighted on all days of the survey. Table 15 shows sightings from the boat-based surveys, which include group size estimates.

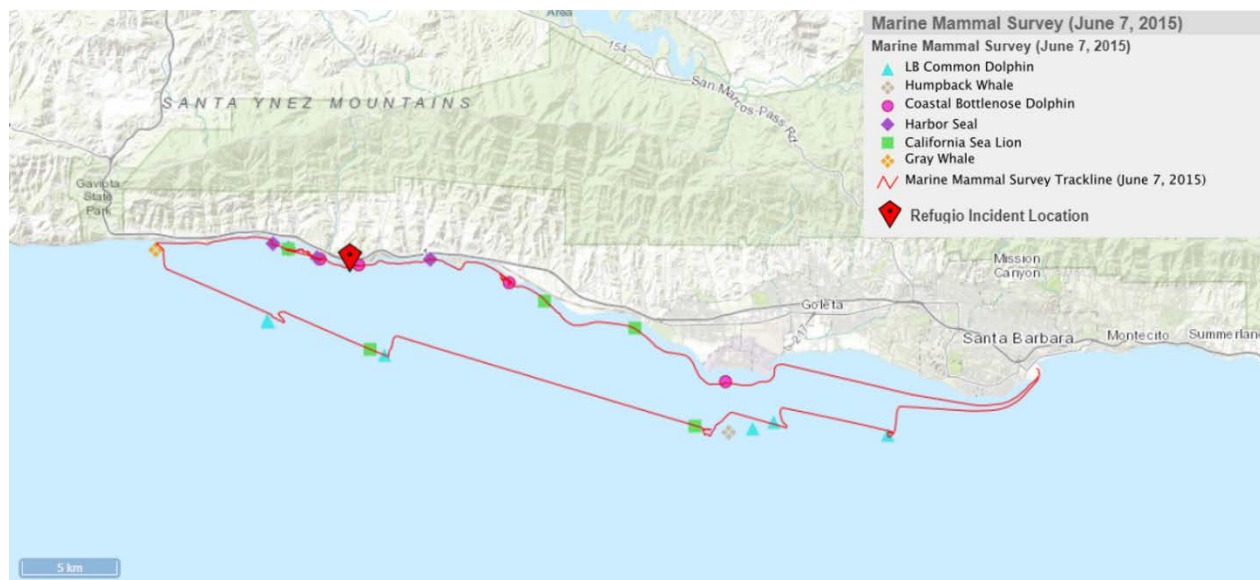


Figure 35. Tracklines of one day of NRDA mammal surveys, including sightings for that day. See Appendix B for data associated with this figure.

5.4.2 Pinniped Injury Analysis

Background

California sea lions are the most frequently stranded marine mammal in California. The stranding numbers vary seasonally by age class and stranding patterns are correlated with the reproductive cycle. Pups strand in the highest numbers during the spring, when they are being weaned. The spill year, 2015, was an anomalous stranding year¹⁶ for California sea lion pups, with unusually high numbers stranding much earlier in the year than usual. By the time of the oil spill, after this surge of unusual strandings, pup stranding rates had lowered. Typically, fewer older animals, i.e., non-pups, strand throughout the year although, reproductive females frequently strand in the spring, just prior to the annual birth pulse.

Northern elephant seals and Pacific harbor seals strand in much lower numbers than California sea lions, which largely reflects their relative population sizes. However, like the California sea lions, strandings vary seasonally and are correlated with the reproductive cycle. Stranding numbers are highest when pups are weaning, which is in late winter/early spring in the cleanup area. The Guadalupe fur seal, an endangered species, was not observed either stranded or at-sea during any NRDA post-spill surveys and so were not considered further for the assessment. Similarly, the northern fur seal, a depleted species, was not observed and therefore not considered for the assessment.

¹⁶ This was the third year of an unusual mortality event for California sea lions, declared January 1, 2013. The unusual mortality event was in part attributed to reduced prey availability (McClatchie et al. 2016).

Injury assessment

The Trustees assessed injuries to California sea lions, northern elephant seals and harbor seals by determining the number of strandings that occurred in the spill-affected area (Santa Barbara and Ventura Counties) from May 19 through July 7, 2015, and comparing that number to the baseline stranding patterns for the region. This provided a framework for the Trustees' injury assessment by providing insight into how many strandings would be expected "but for" the oil spill.

In addition to quantifying stranding baseline numbers for each species, the Trustees reviewed the available data for individual strandings recorded during the assessment period to determine whether the recovered strandings could be attributed to non-spill related causes (e.g. fishery related deaths). The Trustees also reviewed carcass decomposition information to remove strandings that likely occurred before the spill (i.e., dead, highly decomposed animals). Once it was determined how many documented strandings were likely due to the spill, they applied a correction factor for animals that would likely have died from the spill but were not found due to drift, sinking, scavenging or other factors. No correction factor was applied to live stranding numbers to account for animals that might have been exposed to oil and moved out of the area. The number of observed strandings attributed to the spill are given in Table 16.

For harbor seals and northern elephant seals, past stranding numbers during the time of year in which the cleanup occurred were low (i.e., fewer than 5 per year) and often zero. Because of this and the highly unusual fact that the strandings of these species were alive and oiled and died during rehabilitation, no baseline correction was applied to the stranding numbers. That is, the observed number of strandings for both species were considered spill-related injuries after removing any pre-spill and fishery-related strandings.

Table 16. Strandings of pinnipeds recorded in Santa Barbara and Ventura Counties after the spill. Records for each stranding were reviewed to determine whether they likely died before the spill (i.e., "pre-spill") or had injuries consistent with fishery entanglement (i.e., "fishery related"). "Pre-spill" animals were removed prior to adjusting for stranding baseline.

Species	Total Stranded May 19-July 7	Stranded			
		Pre-spill	Fishery- related	Baseline	Spill Period
California sea lion	221 (89 live, 132 dead)	-40	0	-87	94
Northern elephant seal	9 (8 live, 1 dead)	-1	0	0	8
Harbor seal	2	0	0	0	2

5.4.3 Cetaceans

Background

Long-beaked common dolphins (LBCO) are the most frequently stranded cetacean (whales, dolphins and porpoises) in the affected area and throughout southern California. Strandings of common bottlenose dolphins are rare, in part because their population off the California coast is

small (~500 individuals) and mobile, with dolphins ranging from Ensenada, Mexico, to San Francisco, California. From the pre-assessment survey, approximately 20% of the common bottlenose dolphin coastal ecotype population was estimated to be present in the area in the weeks following the spill. Dolphins of both species as well as other cetaceans were observed from shore and at sea in the weeks following the spill (Figure 36; Table 17)

No large whales stranded during the spill period, but several were observed (including a mother/calf pair) in the spill area both by local news agencies in the first days of the spill and during NRDA marine mammal boat surveys between May 27 and June 6, 2015 (see Figure 36).

Injury assessment

Similar to pinnipeds, the Trustees assessed injuries to long-beaked common dolphins and bottlenose dolphins by comparing strandings observed during the assessment period to a baseline of strandings for the area, after removing records of strandings that likely occurred prior to the spill. A correction factor was applied to the strandings deemed to be likely spill related to account for animals that likely died but were not been found due to drift, sinking, scavenging or other factors

The number of observed strandings attributed to the spill is given in Table 17. For both dolphin species considered for the injury assessment, previous years’ strandings are variable, and for the LBCO have been tied to episodic algal blooms. While algal blooms were present during the spill period, principally north of Point Conception, there were no data that tied dolphin deaths to algal blooms in the oil spill-affected area. The Trustees concluded that oil was the more likely causal factor in the dolphin strandings in Santa Barbara and Ventura Counties during the timeframe considered.

Table 17. Dead dolphin strandings collected after the spill. Records were reviewed and dolphins were not considered potential spill-related injuries if they were determined to have stranded before the spill (i.e., “pre-spill”) or had injuries consistent with fishery entanglement (i.e., “fishery related”). Baseline refers to the expected “natural” deposition that would occur under non-spill conditions.

Species	Total Stranded May 19-July 7, 2015	Stranded			
		Pre-spill	Fishery-related	Baseline	Spill period
Dolphin, long-beaked common	22	-2	-2	0	18
Dolphin, bottlenose	1	0	0	0	1

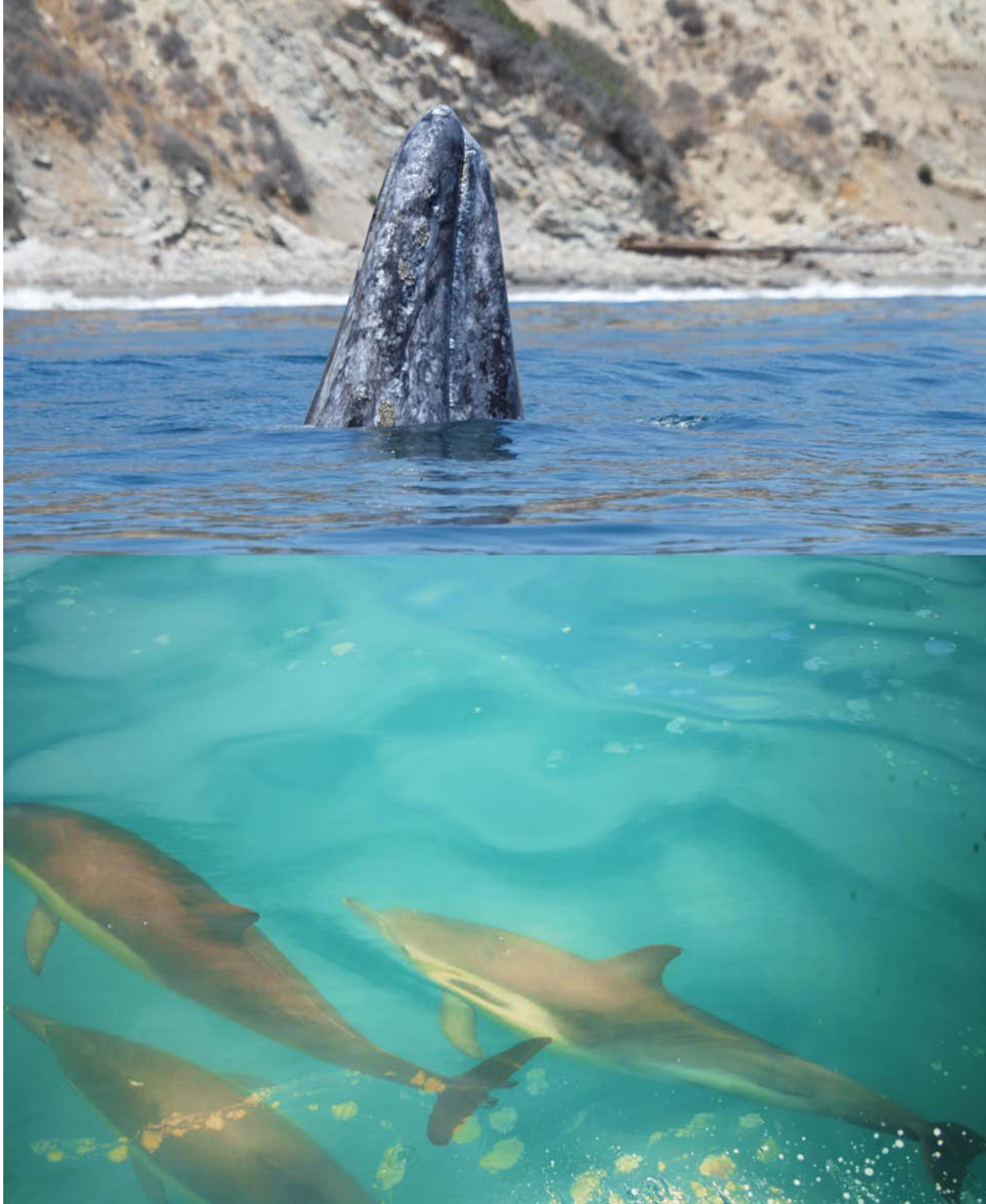


Figure 36. Top - gray whale observed on June 7, 2015, near Gaviota State Beach during boat-based surveys. Bottom - long-beak common dolphins swimming in an oil slick during NRDA boat surveys. Photo Credit: Natural Resource Damage Assessment Trustees.

5.4.4 Final Injury Determination

The final step in quantifying marine mammal injuries for both pinnipeds and cetaceans was to account for animals that died but were not observed. The Trustees assumed that for mammals, all carcasses that reached the beach were found. However, the Trustees could not account for animals that died at sea and either sank, floated, or were scavenged before being observed and counted. Therefore, the Trustees applied a correction factor (‘lost at sea factor’) to the observed dead, spill-related strandings based on a study by local marine mammal scientists on common bottlenose dolphin carcass recovery off the southern California coastline (Table 17) (Carretta et al. 2016). The final injury numbers are given in Table 18¹⁷.

Table 18. Final injury numbers for marine mammals affected by the Refugio Beach Oil Spill.

Species	Dead	Live	Observed spill related strandings	Lost-at-sea factor (for dead animals)	Estimated number injured
California sea lion	52	42	94	2	146
Northern elephant seal	0	8	8	NA	8
Harbor seal	0	2	2	NA	2
Long-beaked common dolphin	18	0	18	4	72
Bottlenose dolphin	1	0	1	4	4

5.4.5 Selected Restoration Projects

The Trustees are proposing the projects described below to compensate for injuries to marine mammals caused by the oil spill (Table 19). The two selected projects benefit pinnipeds (MAMM-1) and cetaceans (MAMM-2).

Table 19. Selected projects for marine mammals

ID#	SELECTED PROJECTS	BENEFITS
MAMM-1	Pinniped rehabilitation survival improvement	Pinnipeds
MAMM-2	Cetacean entanglement response	Cetaceans

Pinniped Rehabilitation Survival Improvement (MAMM-1)

The goal of this project is to supplement and improve stranding response capabilities in Santa Barbara and Ventura Counties by providing enhanced rehabilitation capacities and veterinary facilities for stranded marine mammals. The program will augment the stranding cleanup and treatment activities of an existing, local facility which is authorized and permitted to respond to and treat stranded marine mammals. The project includes labor and supplies to treat sick and injured pinnipeds, including food, medical evaluations and treatments.

¹⁷ Plains does not agree with the Trustees’ final injury numbers for marine mammals.

Affected Environment

The project area is mainland Santa Barbara and Ventura Counties. Sick or injured pinnipeds are rarely rescued at sea. Stranding response most often takes place on beaches and rehabilitation centers.

Environmental Consequences (Beneficial and Adverse)

Overall, this project is anticipated to have only negligible, if any, adverse environmental consequences and multiple beneficial impacts. In reaching this conclusion, the Trustees evaluated several types of potential impacts, as described below.

1. *Biological Impacts.* Stranding response removes sick and injured live pinnipeds from beaches, potentially reducing the spread of disease amongst other populations. Treatment of diseased and injured marine mammals improves animal health, and thus the biological environment. Because the activities will be carried out by personnel trained and experienced in marine mammal recovery, no adverse biological impacts are anticipated, as most outdoor project activities will occur on beaches, which are already heavily-trafficked by humans. There will be minimal, if any, interaction with particularly sensitive habitats. No adverse biological impacts are anticipated
2. *Physical Impacts.* This project involves trained personnel removing stranded mammals from beaches and treating them. The project is expected to have negligible adverse or beneficial impacts to the physical environment.
3. *Human Impact.* Removal of sick and injured live pinnipeds from beaches and rocky coast will reduce the risk of spread of disease and other adverse interactions with humans. Humans should experience improved beach experience with the removal and treatment of diseased animals. No adverse effects to humans are expected.

Probability of Success

This project will expand the rehabilitation facility's capacity to treat live pinnipeds and increase the number of healthy animals released, approximately 30% of animals treated. Rescue and rehabilitation/ treatment of pinnipeds under veterinary care has a successful track record. Increasing capabilities are expected to further improve the success rate.

Performance Criteria and Monitoring

This project will expand the rehabilitation facility's capacity to treat live pinnipeds and increase the number of healthy animals released, approximately 30% of animals treated. Rescue and rehabilitation/ treatment of pinnipeds under veterinary care has a successful track record. Increasing capabilities are expected to further improve the success rate. The proposed time period of the project is three to seven years, depending on the need of the program with a goal of a total of 150 additional marine mammals successfully responded to and/or treated through the program.

Specifically, the Trustees may use the following measures to determine the effectiveness of the restoration. Based on responses and outcomes from before implementation of the project, we will monitor:

- The number of animals (and species) taken in per year for treatment/rehabilitation;
- The number of live and dead animals responded to per year; and
- Outcomes from live strandings, including from treatment at the facility or in the field.

Evaluation

The Trustees have evaluated this project using the threshold and additional screening criteria developed to select restoration projects and concluded that this project is consistent with and meets the objectives of these selection factors. This type and scale of project will effectively provide appropriate compensation for pinnipeds injured as a result of the spill, and the Trustees have therefore selected this project.

Cetacean Entanglement Response (MAMM-2)

Entanglement in fishing gear is a source of mortality to whales and dolphins off the California coast and nearly all entangled animals die. The program will augment an existing permitted and authorized program by providing additional gear and personnel to disentangle cetaceans in areas not currently covered off the southern California coast.

Affected Environment

This project will operate within the southern California to respond to entangled cetaceans reported off Santa Barbara, Ventura, Los Angeles and Orange County coastlines.

Environmental Consequences (Beneficial and Adverse)

Overall, this project is anticipated to have only negligible, if any, adverse environmental consequences and multiple beneficial impacts. In reaching this conclusion, the Trustees evaluated several types of potential impacts, as described below.

1. *Biological Impacts.* Increased preparedness for entanglement response will provide a beneficial biological impact by reducing fishing gear-related mortality to whales and dolphins. Personnel implementing this this project would be trained and experienced in entanglement response and would operate using best practices to avoid adverse impacts to the environment. Therefore, no adverse biological effects are anticipated.
2. *Physical Impacts.* This activity will minimally increase boat use because of increased response capabilities. Personnel implementing this this project would be trained and experienced in entanglement response and would operate using best practices to avoid adverse impacts to the environment. Therefore, no adverse physical effects are anticipated.

3. *Human Impacts.* Human enjoyment of wildlife viewing will be enhanced by (1) encountering fewer dead cetaceans floating in the water or beached and (2) seeing fewer animals in distress due to gear entanglements. For larger whales, a dead whale can be a hazard to navigation, so reducing mortality will reduce the number of potential hazards. While this project will minimally increase boat use, the Trustees anticipate that this will have negligible adverse impacts to boaters.

Probability of Success

This Project is anticipated to double the response capacity of the current cetacean disentanglement program operating off California's coast, which has a proven record of success. For this reason, the probability of success for the project is very high.

Performance Criteria and Monitoring

The number of whales with gear successfully removed compared to the number of entangled whales reported will be the criteria used to measure success. These data will be available to the Trustees because entangled whales are reported to the NMFS, which authorizes and coordinates entanglement response activities. Disentanglement response meet the guidelines and protocols of the MMPA and Animal Welfare statutes.

Specifically, the Trustees may use the following measures to determine the effectiveness of the restoration:

- Increased capacity to respond to entanglement events, measured by numbers of responses during the funding period compared to past performance; and
- Outcomes from entanglement response, by species.

Evaluation

The Trustees have evaluated this project using the threshold and additional screening criteria developed to select restoration projects and concluded that this project is consistent with and meets the objectives of these selection factors. This type and scale of project will effectively provide appropriate compensation for cetaceans injured as a result of the spill, and the Trustees have therefore selected this project.

5.4.6 Second Tier Restoration Projects Considered

The Trustees also considered the following projects (Table 20), and determined they are valid projects that would provide benefits to marine mammals. However, these projects were not selected for various reasons described below. They may be reconsidered if a selected project cannot be implemented or if remaining funds allow.

Table 20. Second tier marine mammal restoration projects that may be implemented if funds allow

ID#	SECOND TIER PROJECTS CONSIDERED	BENEFITS
MAMM-3	Reduce California Sea Lion Entanglement Mortality on San Miguel Island	Pinnipeds
MAMM-4	Mitigate Entanglement Risk for Pinnipeds	Pinnipeds
MAMM-5	Protect Marine Mammal Haulouts and Rookeries	Pinnipeds
MAMM-6	Mitigate Cetacean Ship Strikes	Cetaceans
MAMM-7	Remove Derelict Fishing Gear	Cetaceans/pinnipeds
MAMM-8	Establish a Bottlenose Dolphin Protection Area	Cetaceans

Reduce California sea lion entanglement mortality on San Miguel Island (MAMM-3)

The goal of this project is to remove fishing gear from live pinnipeds on San Miguel Island and identify the source fishery from the recovered gear. Individual pinnipeds would be branded and tagged to monitor their survival after gear removal. The project benefits pinnipeds by directly removing entangled gear, a known source of mortality. A secondary, unquantified benefit to all marine mammals is identifying the source fishery causing the entanglements and likely bycatch. The Trustees are satisfied with the feasibility of this project and consider it a potential alternative to the selected pinniped project, if necessary.

Mitigate Entanglement Risk for Pinnipeds (MAMM-4)

The goal of this project is to remove fishing gear from live pinnipeds that come ashore on mainland beaches in Orange, Los Angeles, Ventura and Santa Barbara Counties. The project was not selected because it did not specify how success would be measured, and it would be implementing new, unproven technology. This project could be reconsidered if the selected pinniped project is not feasible.

Protect Mammal Haulouts and Rookeries (MAMM-5)

The goal of this project is to further protect the Pacific harbor seal rookery and haulout areas at various areas throughout Santa Barbara and Ventura Counties. Other than Carpinteria, no specific locations or actions were identified.

A specific project at Carpinteria proposed to enhance protection by purchasing conservation easements at Carpinteria Beach to provide further buffers for the rookery. It would also consider other areas that that could provide additional protected rookery habitat. This proposal includes an outreach component to reduce human disturbance to marine mammals at rookeries. The rookery is already protected under the MMPA, and the proposed additional conservation easements would increase existing buffers to reduce risk of harassment. Routine monitoring of the rookery would provide data to estimate pupping success, but it would be difficult to specifically quantify the beneficial effects of the project separate from those protections already provided by the MMPA. This project was not selected to be carried forward for implementation at this time because the project does not contain sufficient information for the Trustees to understand the benefits to marine mammals injured by this spill.

Mitigate Cetacean Ships Strikes (MAMM-6)

The goal of this project is to quantify ship strike risk to large whales attributable to a voluntary vessel speed reduction program in the Santa Barbara Channel shipping lane. This project would monitor ship speed and ship strike rate of large cetaceans to compare to historic data. This project may provide data to evaluate how much the vessel reduction program would reduce large ship-strike cetacean mortality. However, the program's methods to estimate and monitor ship strike risk are unclear, the voluntary nature of the program makes implementation uncertain, and metrics for measuring success in terms of whales saved are currently unavailable. The Trustees determined that this could be reconsidered as a pilot project if other preferred projects became infeasible.

Remove Derelict Fishing Gear (MAMM-7)

The goal of this project is to reduce entanglement risk of lost fishing gear for marine mammals by removing large nets and traps. Based on recent past gear removal projects conducted in southern California, there appear to be a low number of marine mammals entangled in lost nets. The Trustees concluded that this program could be beneficial to both cetaceans and pinnipeds, but the benefits would be difficult to quantify. Other projects proposed and evaluated in this Plan provide more direct benefits to marine mammals. The Trustees could reconsider this project if the selected projects became infeasible.

Establish a Bottlenose Dolphin Protection Area (MAMM-8)

The goal of this project is to improve habitat for the coastal population of bottlenose dolphin by establishing a bottlenose dolphin protection area along the Santa Barbara county coastline. The protection area would regulate chemical contamination and anthropogenic noise. The proposal did not identify a specific area, provide criteria to identify one, or indicate how success would be measured. This project would also be challenging, as it involves complex legal and regulatory issues that are not within the direct control of the Trustee agencies. The Trustees would consider this project if other projects to benefit cetaceans are not possible.

5.5 Human Uses

In the wake of an oil spill, some people may decide not to visit the shoreline. Others choose to visit alternative sites. Some visit affected shorelines but experience reduced enjoyment due to the spill. These all represent spill impacts.

The Trustees quantified impacts to selected human uses resulting from the Refugio Beach Oil Spill. Effects were identified from as far north as Gaviota State Beach to as far south as Long Beach. This stretch of coastline includes a range of public access points with rich natural resources and scenic vistas that provide exceptional recreational opportunities. People in the region engage in a variety of recreational activities. Examples include camping, sunbathing, beach combing, exercising, swimming, wildlife viewing, and dog-walking, as well as more

specialized activities such as fishing, diving, boating, and surfing. Trustees did not quantify impacts from third-party claims (e.g., from non-government parties, such as commercial fisheries and affected businesses), pursuant to NRDA regulations.

The Refugio Beach Oil Spill entered the ocean in Santa Barbara County just west of Refugio State Beach. Spill impacts on human recreation were highest in this area. Refugio and El Capitan State Beaches, popular state campgrounds and day use areas, were closed for 59 and 37 days, respectively. Access to adjacent small pocket beaches was restricted through August 28, 2015. There was significant oiling along the Gaviota Coast down to the University of California Coal Oil Point Reserve, where cleanup operations and closures disrupted normal reserve operations. Recreational fishing in this region was closed for 41 days (see Figure 37).

Spill impacts on recreation were less severe south of Coal Oil Point Reserve. Although spill-related oiling, advisories, and significant media coverage of the incident occurred, no closures were identified along the remaining sections of the Santa Barbara and Ventura County coastlines. This stretch includes several incorporated cities (Santa Barbara, Carpinteria, Ventura, Oxnard), county properties, and additional State Park holdings. While the impacts were not as prominent as those found along the Gaviota Coast to the north, many of the affected beaches have significant visitation, particularly during and after Memorial Day weekend. Thus, even a small percentage decrease in use can translate into a sizeable reduction in the number of trips taken.

In Los Angeles County, there were two separate beach closures after an unusual amount of tar balls washed up on beaches. The first occurred in southern Santa Monica Bay from May 27 to 29, 2015. The second occurred in Long Beach (June 3 to 5, 2015). Both events triggered cleanup operations and resulted in closures of the beach seaward of the lifeguard towers.

This assessment and restoration plan focuses primarily on impacts to public recreational use and does not include private claims for losses to commercial fishing or recreation-based concessionaires. Impacts to commercial activities and other private party claims may be addressed through third party claims procedures under OPA or in private civil litigation.

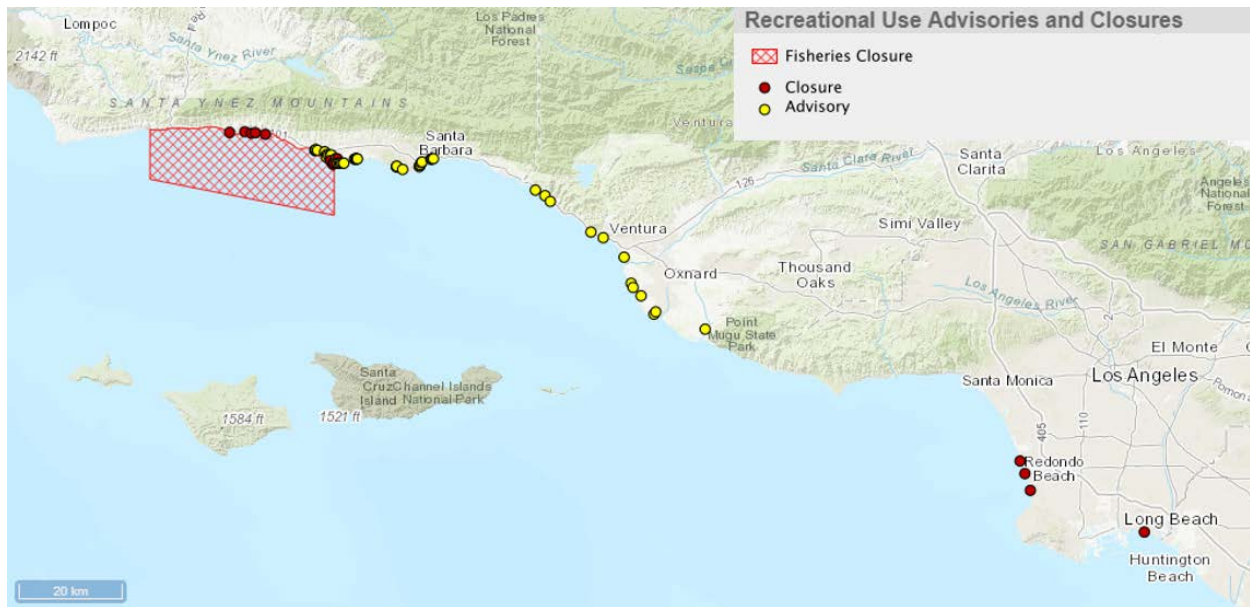


Figure 37. Overview of posted Closures and Advisories after the Refugio Beach Oil Spill.

5.5.1 Scaling Approach

The natural resource damages for human uses are based on the monetary value of spill-related human use impacts. Monetary value is measured using the economic concept of “consumer surplus”. For recreation, consumer surplus is the value that an individual places on their recreational activities above and beyond the cost they incur to engage in those activities. It is not a calculation of the cost of participating in various recreational activities, nor is it the resulting economic impact in the community. Lost income to recreational businesses, lost tax revenue to municipalities, and lost user fees to public parks, while related to lost public use, are third-party claims that are not compensable under NOAA’s NRDA regulations under OPA. However, these losses are indicative of loss of public recreation.

For calculating lost value, human uses were broken up into four general categories. These categories were delineated based upon the qualitative character of the use and the inherent separability of the relevant data available to identify losses:

Coastal Camping

Coastal camping includes overnight stays at campgrounds that are within relatively short walking distance to the beach or shoreline. In addition to camping, these users typically engage in a range of related day use activities (e.g., general beach use, bike riding, swimming, fishing, picnicking). Coastal camping impacts were measured in camping nights at identified camping areas.

Non-Camping Shoreline Recreation

Non-camping shoreline recreation captures a broad range of day use activities pursued by non-campers. It includes traditional beach use activities, such as sunbathing, walking, exercising, picnicking, beach combing, wildlife viewing, swimming, and surfing. However, it also includes diving, kayaking, standup paddle boarding and similar activities that originate from the adjacent

shoreline, rather than from a marina or specified boat launch. Different quantification methods were used for (1) Santa Barbara and Ventura Counties (Section 5.5.4) and (2) Los Angeles County (Section 5.5.5). Impacts to non-camping shoreline use were measured in user days for the northern two counties and in direct lost value for Los Angeles County.

Boating and Offshore Recreation

Boating and offshore recreation includes motor boating, sail boating, and use of the Channel Islands National Park, as well as non-motorized boating originating from harbor marinas or identified boat launches that are not associated with specific recreational day use shoreline areas. Non-motorized boating includes activities such as kayaking, standup paddle boarding, and canoeing, as long as they originate from a marina or specified boat launch. Launches associated with data connected to “Non-Camping Shoreline Recreation” are addressed under that category of use (Sections 5.5.4 and 5.5.5). Motorized boating includes charter fishing trips, charter dives, and charter boat-based wildlife viewing. Lost use for these activities was measured in user days.

Research, Education, and Outreach

Research, Education, and Outreach refers to trips to the University of California Coal Oil Point Reserve for the purpose of conducting research, participating in university-level classes, and reserve related outreach activities. Lost use for these activities was measured in user days.

Our quantification of lost value incorporates measures of affected human use activity (e.g., lost, diminished, and substituted trips). Total lost value is further adjusted by a three-percent annual percentage rate (compounded monthly) to reflect the change in value associated with delaying compensation.

5.5.2 Overview of Data Collection and Studies

The list below summarizes various field studies, data collection tasks, and analyses used for the assessment of human use impacts.

Documentation of Closures, Advisories, and Spill-related Notifications

The Trustees tracked site closures and posted advisories by location and date. The Trustees also evaluated conventional media coverage of the spill along with social media posts and public announcements from selected organizations (e.g., public agencies).

Data Collection around the Time of the Spill

The Trustees conducted systematic counts of people on the beach in selected locations in Santa Barbara and Ventura Counties. The Trustees also tracked foot and bike entries to El Capitan State Beach and conducted daily monitoring of automatic car counters at Goleta Beach and Arroyo Burro County Parks. Finally, the Trustees contacted water- and shore-oriented recreation businesses regarding impacts to their customers.

Compilation and Evaluation of Existing Data Related to Spill-Effects or Baseline Use

The Trustees compiled historical data related to the public use of various sites, and then assessed these data for their relevance and efficacy for estimating spill-effects and baseline use. The data sources compiled and evaluated included:

- Paid vehicles at State Park properties from Gaviota to Point Mugu;
- Overnight stays at State Park properties from Gaviota to Point Mugu;
- Parking fee data from select coastal lots between Santa Barbara and Malibu;
- Historic records of automated car counters at Santa Barbara County Parks;
- Marine Protected Area (MPA) Watch shoreline user counts;
- South Coast MPA Baseline Program survey data, collected by researchers at Point 97/Ecotrust and Natural Equity;
- Jalama County Park Camping Occupancy;
- Commercial Passenger Fishing Vessel (CPFV) log summaries;
- California Recreational Fisheries Survey (CRFS) angler estimates;
- Fuel Sales at Santa Barbara Harbor fuel dock;
- Channel Islands National Park visitation;
- University of California, Santa Barbara (UCSB) Coal Oil Point spot counts;
- USCB Coal Oil Point Reserve annual estimates of research, education, and outreach use;
- Long Beach lifeguard beach user estimates; and
- Los Angeles County lifeguard beach user estimates.

Data Collection on the First Anniversary of the Spill

The Trustees evaluated gaps in the assessment data listed above. These gaps guided the prioritization and research design of data collection around the first anniversary of the spill. The Trustees conducted interviews and user counts to estimate baseline use and augment existing data to estimate spill-related changes in use at selected sites.

Analysis of Camping Losses

The Trustees evaluated data and other information on coastal camping in Santa Barbara and Ventura Counties. Data from the spillthe spill period were compared to historical information. Camping impacts were identified at Refugio State Beach, El Capitan State Beach, and Gaviota State Park. Site-specific economic models were developed from existing data on camping reservations to estimate the value of a camping night. See Appendix K.

Analysis of Non-Camping Shoreline Recreation Losses in Santa Barbara and Ventura Counties

The Trustees examined data on recreational use along the Santa Barbara and Ventura County coast. In general, data from outside the spill period were used to create statistical predictions of recreational use had the spill not occurred. These predictions accounted for weather, day-of-the-week, and other site-specific factors. Where reductions in recreation were identified, the trustees translated these reductions into estimates of lost user days. Lost value was calculated by

multiplying the number of lost user days by an estimated dollar value per user day derived from economic research on shoreline recreation in California (English 2010). See Appendix L.

Analysis of Shoreline Recreation Losses in Los Angeles County

The Trustees' estimate of lost value in Los Angeles County focuses on the relatively short periods where shoreline areas were closed in southern Santa Monica Bay and in Long Beach. The estimate of lost value was determined utilizing the southern California Beach Recreation Valuation Model (Hanemann et al. 2004), a state of the art recreation demand model designed specifically for the Los Angeles County beaches affected by the spill. See Appendix L.

Analysis of Boating and Offshore Recreation Losses

The Trustees considered a range of data sources for evaluating losses to boating and offshore recreation. The estimate of offshore recreation losses was based upon a series of phone contacts to recreational businesses that collected information on the reduction in passenger trips that these businesses experienced following the spill. The estimate of lost value per trip was based on a study of the consumer surplus value of boating trips to the Channel Islands (Gornik et al. 2013). See Appendix M.

5.5.3 Coastal Camping

The trustees identified spill impacts at Refugio State Beach, El Capitan State Beach, and Gaviota State Park campgrounds. The Refugio State Beach campground was closed for the longest time period (59 days). El Capitan State Beach experienced a shorter closure period (37 days), but it has more campsites and therefore more users were affected per day of closure. Both of these campgrounds are popular and reach capacity in summer months. Once the closures were lifted, the campsite occupancy recovered to near baseline conditions rather quickly at both locations (i.e., within a few weeks). Thereafter, small trailing reductions in use occurred over the entire summer. Gaviota State Park did not experience a closure. However, reductions in camping use were identified during the first two weeks after the spill. A total of 49,188 camping nights were lost across all three sites.

Data on the origin of visitors (by zip code) was combined with census data to create an economic model to estimate the value per camping night. This analysis resulted in an estimate of \$29.57 (July 2018 dollars) per camping night lost. The total undiscounted damages are therefore \$1,454,663, and the resulting total lost value is \$1,593,571 (July 2018 dollars and present value). The model, along with the analysis of lost camping nights, is described in more detail in Appendix K.

5.5.4 Non-Camping Shoreline Recreation Use: Santa Barbara and Ventura Counties

The Trustees identified impacts to recreational shoreline users at multiple locations along the Santa Barbara and Ventura County coastlines (Table 21). Reductions in recreational use were assessed through quantitative analyses of a range of data indicators related to shoreline recreation (see Appendix L).

The observed impacts were greatest upcoast of Coal Oil Point Reserve, where sections of shoreline were subject to relatively long access and recreational fishing restrictions. Refugio and El Capitan State Beaches, and associated day use recreation opportunities, were officially closed for extended periods (59 and 37 days, respectively). Access to pocket beaches at Tajiguas, Venadito, and Las Flores were limited through August 28, 2015 by spill-related restrictions to roadside parking at historic highway pull offs. After the closures, recreational use at most of the sites returned to expected levels relatively quickly, within two to four weeks. The only exception was Refugio State Beach, where recreational use did not return to baseline until 8 weeks after the park reopened.

Shoreline recreation impacts on the Santa Barbara and Ventura Coastlines downcoast of Coal Oil Point were less severe. These locations were subject to a range of posted advisories, oilings, and media coverage about the “Santa Barbara spill”. However, relative reductions in recreational use were generally modest, returning to baseline within two to four weeks after the initial spill. The only exception to this was at Leadbetter Beach on the Santa Barbara Waterfront, where lower levels of recreational use were observed in the data for 12 weeks.

A total of 89,380 shoreline recreation user days in Santa Barbara and Ventura Counties were estimated as lost due to the spill. Each user day was assigned a value of \$21.45 (July 2018 dollars) based on an evaluation of economic research of shoreline recreation in California. Associated undiscounted damages are \$1,917,317, and total lost value is \$2,101,467 (July 2018 dollars and present value) This analysis is described in detail in Appendix L.

Table 21. Non-Camping Shoreline Losses in Santa Barbara and Ventura Counties

Section of Coastline	Estimate of Lost Value (July 2018 dollars)
Gaviota State Park through El Capitan State Beach	\$ 723,987
El Capitan to Coal Oil Point	\$ 295,335
Coal Oil Point to Santa Barbara Waterfront	\$185,783
Santa Barbara Waterfront	\$297,957
Santa Barbara Waterfront to Ventura County Line	\$43,006
Ventura County Line through Emma Wood State Beach	\$21,635
Surfers’ Point/San Buenaventura to Pt. Mugu	\$349,614
Total Undiscounted Damages	\$1,917,317
Total Value Lost	\$2,101,467

5.5.5 Non-Camping Shoreline Recreation Use: Los Angeles County

The Trustees quantified spill-related losses in Los Angeles County based on the number of days with oil-related beach closures following the spill (Table 22). Closures in south Santa Monica Bay began on May 27 and ended on May 29. Closures at Long Beach City Beach were initiated

on June 3 and ended on June 5. The affected beaches were closed seaward of the lifeguard towers.

Damages for the Los Angeles County closures were based upon the southern California Beach Recreation Valuation Model (Hanemann et al. 2004), an economic model that was constructed to evaluate the impact of closures and water quality changes to recreational use on southern California beaches. Specific sites affected by the closures are included in the model (Manhattan Beach, Hermosa Beach, Redondo Beach, Long Beach, and Belmont Shore). See Appendix L.

Table 22. Non-camping shoreline recreation losses in Los Angeles County

Section of Coastline	Estimate of Lost Value (July 2018 dollars)
South Santa Monica Bay (Manhattan Beach to Redondo Beach), May 27-29	\$445,125
Long Beach (1 st Place to 72 nd Place), June 3-5	\$92,444
Total Undiscounted Damages	\$537,568
Total Lost Value	\$590,067

5.5.6 Boating and Offshore Recreation

The spill closed an area of fishing off the Gaviota Coast for 41 days. Cleanup vessels conducted cleanup operations in the cove at Refugio State Beach and elsewhere in the days following the spill. Information about the spill was reported in the media throughout the summer. Businesses that provide boat transport and other services to recreational users reported a total loss of 2,379 client trips (See Appendix M). These trips originated from marinas along the Santa Barbara, Ventura, and Los Angeles County coastline. These trips do not include launches of non-motorized boats (e.g., canoes, kayaks, standup paddle boards) that occurred from shoreline areas covered in the estimated loss of “Non-Camping Shoreline Recreational Use”. These trips were assigned a value of \$59.01 (July 2018 dollars) based upon Gornik et al. (2013). Total undiscounted damages are \$140,384. Total lost value for this category of human use is \$153,867 (July 2018 dollars and present value).

5.5.7 Research, Education, and Outreach

The Coal Oil Point Reserve at the University of California, Santa Barbara was closed for 26 days. In addition to providing opportunities for traditional beach recreation (e.g., sunbathing, beach combing, exercising, and swimming, which are covered above), the University of California operates the reserve to benefit its mission to provide high quality educational opportunities and conduct research. The Coal Oil Point Reserve provides a real world laboratory in which these activities can occur.

The University of California Natural Reserve System reports 7,521 research, education, and outreach user days for the 339 days that the Coal Oil Point Reserve was open between July 1, 2014 to June 30, 2015. Staff at the reserve system believe that the amount of research, education,

and outreach activities on the days that the reserve was open provides a reasonable basis for estimating use over the 26 days that the reserve was closed. Applying the resulting overall rate of 22.2 users per day to the 26 days of closure yields a user day loss estimate of 577 user days.

A value of \$47.00 (July 2018 dollars) was attached to each of these user days. The Trustees were not able to identify a direct measure of consumer surplus for research, education, and outreach. This estimate is based upon the approximate tuition and fee cost of a course-day of instruction at the University of California, Santa Barbara, accounting for the proportion of undergraduate versus graduate and in-state versus out-of-state students. This results in a \$27,116 estimate of undiscounted damage, and a total lost value estimate of \$29,735 for this category (July 2018 dollars and present value).

5.5.8 Summary of Injury

The lost recreation use value estimated by the Trustees (July 2018 dollars and present value) is summarized in Table 23 by general geography and type of use.

Table 23. Total lost value by section of shoreline and quantified human uses.

Section of Shoreline	Camping	Non-Camping Shoreline	Boating, Offshore	Research, Education, Outreach	All Activities Combined
Gaviota SP to El Capitan SB	\$1,593,571	\$792,815			\$2,386,385
El Capitan to Ellwood		\$285,425			\$285,425
Sands Beach / Coal Oil Point Reserve		\$38,392		\$29,735	\$68,126
Santa Barbara Waterfront		\$326,364	\$127,592		\$453,956
Santa Barbara County (Other)*		\$250,795			\$250,795
Ventura County		\$407,677	\$1,580		\$409,258
Los Angeles County		\$590,067	\$24,695		\$614,762
Total Lost Value	\$1,593,571	\$2,691,534	\$153,867	\$29,735	\$4,468,707

*This includes sections of coastline both upcoast and downcoast of Santa Barbara Waterfront.

As explained above, the lost use value represents the lost consumer surplus value to the public. It does not represent the cost of participating in these activities, nor the sum of their travel expenditures and resulting economic impact in the community. Table 23 represents the Trustees' best estimate of lost value, i.e., \$4.47 million¹⁸.

5.5.9 Proposed Restoration

The Trustees (including the University of California) intend to select a suite of restoration projects to compensate the public for lost use of the recreational resources caused by the spill. The Trustees will work cooperatively with local government agencies and non-governmental organizations to identify a suite of potential restoration projects according to the relative magnitude of spill impacts. These projects may include improvements or enhancements to public piers, parks, bike paths, boat ramps, fishing areas, or other infrastructure in order to increase the value of recreational experiences involving beach use, boating, and/or fishing. Specific examples include, but are not limited to: beach and waterfront access; boardwalk construction and improvements; fishing pier and dock improvements; beach sand management and replacement; beach fire rings; beach shower and restroom improvements; picnic facilities; Coastal Trail improvements; public access components of large ecological restoration projects; interpretive, educational, and wildlife viewing facilities.

¹⁸ This is less than the amount to be recovered for lost recreation through the pending settlement process, i.e., \$3.90 million. However, the Trustees believe the amount to be recovered through the settlement is adequate based on the following considerations: the amount is within the range of values the Trustees deem plausible given the uncertainties in some of the data; the Trustees' desire to reach a settlement and commence restoration more quickly; and the inherent risks involved in litigation if a settlement is not reached.

It is a goal of the Trustees to select projects spanning the geographic area of the spill and to address the various types of activities (e.g. camping, fishing, day use, other uses) that were impacted by the spill. To that end, and to the extent feasible, funds will be allocated among the regions affected by the spill according to the relative magnitude of the spill impacts, as described in Table 24.

Table 24. Geographic distribution of lost value across all quantified human uses.

Section of Shoreline	Share of Total Lost Value
Gaviota SP to El Capitan SB	53.40%
El Capitan to Coal Oil Point (excluding Research, Education, Outreach)	7.25%
Coal Oil Point Reserve (Research, Education, Outreach only)	0.67%
Santa Barbara Waterfront	10.16%
Santa Barbara County (Other)*	5.61%
Ventura County	9.16%
Los Angeles County	13.76%

*This includes sections of coastline both upcoast and downcoast of Santa Barbara Waterfront.

These percentages reflect the approximate estimated distribution of losses across the spill area. In the event funds allocated to one or more geographic area(s) remain, and such funds are insufficient to implement additional recreation project(s) and/or insufficient feasible recreation projects are identified for one or more geographic areas, the Trustees shall have discretion to spend the money in another geographic area identified in Table 23. Compliance with environmental and other applicable laws will be the responsibility of the implementing agency for each selected project.

The distribution of the \$3.9 million in damages recovered for lost recreational value will be administered as follows:

State Parks

State Parks will administer 53.4% (\$2.08 Million) of the restoration funds for projects to be selected by State Parks with the approval of the Trustee Council. State Parks will work cooperatively with Santa Barbara County and other local government and non-government organizations to identify appropriate projects located within State Parks’ property. These projects are to benefit recreational activities associated with units of CDPR from Gaviota to El Capitan. Funds are intended to compensate for all shore-based recreation losses, with approximately two-thirds being directed to camping and approximately one-third being directed other shoreline uses (including non-camping day use, shore-based fishing, diving, etc.).

South Coast Shoreline Parks and Outdoor Recreation Grants Program – Other Coastal Areas

The State Trustees (including University of California) will administer 45.93% (\$1.79 Million) of the restoration funds for projects to be selected by the Trustees to primarily benefit recreational activities to compensate for recreational losses downcoast of El Capitan State Beach. The Trustees will work cooperatively with Santa Barbara, Ventura, and Los Angeles Counties, local cities, and other public and private organizations to identify a suite of potential projects according to the relative magnitude of the spill impacts, considering the availability of viable projects and types of affected uses. Projects will then be selected for funding using a competitive grant process, until all funds are spent.

University of California

The University of California Natural Reserve System will administer 0.67% (\$26,000) to fund projects selected by University of California in coordination with the Trustee Council and with input from the public. These will address the research, education, and outreach missions of the University of California at Coal Oil Point Reserve.

6.0 NEPA Alternatives Analysis

6.1 Preferred Alternatives

The preferred alternative involves the implementation of the projects listed in Table 25. Anticipated impacts to the environment from implementation of each of these projects is described in Section 5. In the event any of these projects cannot be implemented, the Trustees will look at second tier projects also described in Section 5. Recreation projects to compensate for oil impacts to human uses will be administered by State Parks or handled under a grants program, administered by the State Trustees, and may undergo additional environmental analyses in subsequent NEPA reviews as needed. Project ideas submitted by the public will be considered by State Parks or through this grants program. Appendix N lists all projects submitted by the public and considered by the Trustees.

Table 25. Restoration projects that would be implemented under the preferred alternative.

Shoreline Habitat Restoration		
Shore-1	Ellwood Seawall Removal	Restore sandy beach and mixed shoreline ecosystems and dynamics by removing a wooden seawall at Ellwood Beach that is currently constraining natural functioning condition of the sandy beach ecosystem as well as lateral access along the shoreline at high tide.
Shore-2	Ventura County Dunes Restoration	Remove invasive dune species, protect sensitive bird populations, and enhance public access routes.
Shore-3	Santa Monica Beach Restoration Pilot Project	Restoration of a highly impacted beach system in Santa Monica by stopping beach grooming and

		restoring a diverse, endemic-rich, coastal plant and wildlife community.
Shore-4	Black Abalone Restoration and Relocation	Transplant black abalone into specific locations within rocky intertidal habitat to enhance the overall health of the rocky intertidal ecosystem by returning this important grazer to the community.
Subtidal and Fish Habitat Restoration		
SubT-1	Abalone Restoration	Transplant abalone from donor sites and cultivated populations to a target population within MPAs, in order to bolster the abalone population within MPAs that serve an important ecological role as benthic grazers.
SubT-2	Eelgrass Restoration	Eelgrass restoration in Refugio Cove.
SubT-3	Sand-Dwelling Kelp Restoration Offshore of Goleta Beach	Funding for this project would extend monitoring of the existing pilot project to assess long-term benefits of the project, and viability of the restoration design.
SubT-4	Ellwood Seawall Removal	Removing the Ellwood seawall primarily benefits sandy beach ecosystems, but subtidal habitats adjacent to the seawall are also projected to improve.
Bird Restoration		
Bird-1	BRPE Colony Enhancement on Anacapa Island	Enhance brown pelican breeding habitat on Anacapa Island by removing invasive plants or taking other actions to improve breeding attempts and success.
Bird-2	Prevention of Injury to Seabirds Related to Recreational Fishing	This project would use outreach to raise public awareness and educate anglers about ways to reduce their chances of hooking birds and what to do if one is hooked, and to make improvements to fishing areas to prevent fishing waste from entering the environment.
Bird-3	Coal Oil Point Western Snowy Plover Protection	This may include: predator control; upgraded signage and fences; outreach to reduce disturbances at COPR; leashes to lend; and eradicate iceplant over nesting habitat on Ellwood Beach.
Marine Mammal Restoration		
Mamm-1	Improve Pinniped Rehabilitation Survival	Increase survival rates for live stranded pinnipeds recovered in Santa Barbara and Ventura Counties.
Mamm-2	Cetacean Entanglement Response	Expand response capacity for cetacean entanglement response program to increase survival rates of cetaceans entangled in fishing gear by staging gear in additional locations for quick response to reports of entangled whales in the Santa Barbara Channel.

6.2 Non-Preferred Alternatives

This alternative includes consideration of second tier projects. These projects are discussed in Section 5, and listed in Appendix N. The Trustees may consider these projects for implementation in the event that the preferred projects are no longer available or are infeasible due to unforeseen circumstances. A full environmental review in this DARP/EA was premature for second tier projects considered non-preferred, as they are not yet ready for NEPA analyses for various reasons (e.g., project details and feasibility unknown at this time). Should the Trustees consider these projects for implementation in the future, additional review may be required as project-specific details become available, in which case any subsequent NEPA analyses needed would tier from this DARP/EA.

6.3 No Action Alternative

NEPA requires the Trustees to consider a “no action” alternative, and the OPA regulations require consideration of a roughly equivalent “natural recovery” alternative. Under this alternative, the Trustees would take no direct action to restore injured natural resources or to compensate for lost services. Instead, the Trustees would rely on natural processes for recovery of the injured natural resources.

The principal advantages of the natural recovery approach are the ease of implementation and the absence of monetary costs. However, while natural recovery may occur over time for many of the injured resources, the public would not be compensated for interim losses under the “no action” alternative. In some cases, changing environmental conditions may prevent the environment from recovering to baseline. For example, native kelp species that were killed by the spill may be replaced by invasive kelp that do not support the same ecosystem functions as native species. OPA clearly establishes Trustee responsibility to seek compensation for interim losses pending recovery of natural resources. Losses were, and continue to be, suffered during the period of recovery from the spill, including the loss of an estimated 558 birds, 232 marine mammals, degradation of nearly 1,500 acres of shoreline habitat, degradation of over 2,200 acres of benthic subtidal habitat, and the loss of human uses estimated at 49,000 camping nights and over 80,000 other user days (i.e., general beach use, surfing, boating, fishing, research, etc.). Technically feasible project alternatives exist to compensate for these losses. Thus, the Trustees reject the “no action” alternative and instead have selected the appropriately scaled restoration projects described above as the preferred alternatives.

By definition, the no action alternative lacks physical interaction with the environment. Accordingly, the no action alternative would cause no direct biological, physical, or human impacts to the environment. However, if the Trustees undertook no action, the environment would not benefit from the ecological uplift created by active restoration. Active restoration would restore injured areas and resources, and potentially prevent further injury. The no action

alternative may have minor to moderate short or long-term adverse indirect effects on the environment.

6.4 Cumulative Impacts

The Trustees examined a variety of alternatives to restore resources and/or services lost because of the Refugio Beach Oil Spill. Anticipated environmental consequences arising from each of the selected projects are provided in Section 5. As required by NEPA, this section addresses the potential overall cumulative impacts of implementing the projects selected in this restoration plan.

Cumulative impacts are impacts that result from an action along with other past, present, and reasonably foreseeable near-term future actions taken together. Significant cumulative impacts can result from a combination of actions that do not have significant impacts individually. Taken collectively, the effects of several actions may be additive, countervailing, or synergistic. Impacts are considered regardless of the agencies or parties involved. Thus, in considering cumulative impacts, this analysis is not limited to the impacts of restoration projects detailed herein, but also considers other significant activities and anthropogenic impacts throughout the region.

Overall, the Trustees' selected restoration projects for the Refugio NRDA will result in long-term net improvement in fish and wildlife habitat, restored ecological balance in areas where disturbances have led to adverse impacts on sensitive native species, and improved natural resource services provided to and by fish and wildlife in the region. The Trustees evaluated the restoration projects selected in this DARP/EA in conjunction with other known past, proposed, or foreseeable closely related projects, activities, and anthropogenic impacts that could potentially add to or interact with these projects within the spill-affected area to determine whether significant cumulative impacts may occur. Each resource category is quite different regarding the geographic scope of restoration projects, so cumulative impacts for each category are first treated separately followed by a summary statement regarding aggregate cumulative impacts.

Cumulatively, it is anticipated that there would be a long-term adverse effect to the biological, physical, and cultural environment were the no action/natural recovery alternative selected because no active restoration would occur. However, relative to the magnitude of adverse ecological impacts that currently exist in the project area, the adverse cumulative effect of the no action alternative is not expected to be significant as defined under NEPA.

6.4.1 Shoreline

All shoreline restoration projects are proposed to occur within the habitats formed at the interface of the land and Pacific Ocean, including sandy beaches, rocky intertidal habitats, and rocky-sandy mixed habitats. Within Santa Barbara, Ventura, and Los Angeles Counties, the condition

of these habitats is influenced by a variety of anthropogenic activities including coastal armoring, sediment diversion/stabilization, beach nourishment, and beach grooming, as described further below.

Cumulative Impacts Issues

Some projects may have minor, short-term adverse effects, such as heavy equipment use on the beaches adjacent to the Ellwood seawall removal area; however, the cumulative effects of any short-term effects are anticipated to be negligible to the overall shoreline environment.

Geographic Scope of Restoration Projects

The geographic scope of the shoreline restoration projects includes sandy beach and rocky intertidal habitats in Santa Barbara, Ventura, and Los Angeles County.

Timeframe for Project Implementation

After the DARP/EA is finalized, projects are anticipated to begin within one year, and will be implemented for a period between five and ten years.

Other actions affecting the resources, ecosystems, and human communities of concern

Major anthropogenic stressors that affect the shoreline environment can be grouped into five categories:

1. *Sediment deficit.* Southern California beaches are now receiving less than 50% of their historical sand budgets. This loss of sediment has a significant negative affect on the extent of shoreline habitat, the ecosystem services provided by shoreline habitats, and the amount and intensity of coastal erosion.
2. *Coastal armoring.* Approximately 27% of the southern California coast is armored and shoreline armoring associated with sea level rise is increasing every year. This removes habitat directly from a finite and shrinking resource, and further diminishes ecological and public uses.
3. *Beach nourishment.* Nourishment is an expensive, and as practiced in southern California, only a short-term approach to address sand deficits. Unless nourishment is implemented with great skill and consideration, it can have negative impacts on beach and other coastal environments.
4. *Beach grooming.* Beach cleaning or grooming includes removing trash and kelp wrack with heavy equipment and causes substantial disturbance, loss of productivity, and reduction in species diversity to the shoreline ecosystem.
5. *Invasive species.* Invasive, non-native, plant species such as iceplant and European beach grass have been planted or introduced into the shoreline environment and have spread and out-competed native plant species. In some instances, the spread of these invasive plant species have degraded the diversity and quality of sand dune ecosystems, and precluded species such as the western snowy plover from using these habitats for breeding.

6. *Changing environmental conditions (e.g., sea level rise, ocean acidification, etc.)* Future climate scenarios predict rising sea levels, which results in increased overall coastal erosion. Ocean acidification is projected to cause impacts to animals with calcium-carbonate shells (oysters, abalone, sand crabs, etc.), which are a major component of shoreline habitats. Larger storms may also impact coastal areas in the future, causing shoreline habitat degradation and loss.

Individually and in aggregate, all of these stressors have reduced the environmental quality of the shoreline ecosystem. The shoreline restoration projects selected by the Trustees, aim to reverse a portion of the negative effects that these stressors have had. For example, the Ellwood seawall project will remove a section of unnecessary coastal armoring in the City of Goleta, the Santa Monica dune and beach restoration project will discontinue beach grooming in an area of high potential for ecological recovery, and the Ventura County dune restoration project will remove invasive non-native plants from dunes that can be used by rare birds. All selected shoreline restoration projects are anticipated to have long-term beneficial effects.

6.4.2 Subtidal and Fish Habitats

The Trustees believe that the projects selected in this restoration plan that address injuries to subtidal habitats, in conjunction with other existing and anticipated coastal restoration projects, including those funded from damage recoveries from other OPA and CERCLA cases, will have a local and regional, long term, moderate beneficial impact on the extent and productivity of subtidal habitats within the geographic scope of the project implementation footprint. The majority of projects are geared toward restoring or enhancing subtidal rocky reef, kelp forest and eelgrass habitats. All three of these habitats provide ecosystem benefits to a diverse community of fish and invertebrates. As an example, kelp forests provide food to subtidal, intertidal and beach communities (e.g., a large component of beach wrack is produced by giant kelp). Southern California kelp forests have experienced profound losses in area coverage and in some cases losses in diversity and abundance of the key species that serve to regulate the complex community of algae and invertebrates that are foundational to the habitat.

Cumulative Impacts Issues

Some projects may have minor, short-term adverse effects, such as minor air quality impacts via the use of boats to transport divers and equipment to restoration sites and heavy equipment use on the beaches adjacent to the Ellwood seawall removal area; however, the cumulative effects of any short-term effects are anticipated to be negligible to the overall subtidal environment.

Geographic Scope of Restoration Projects

The geographic scope of the subtidal restoration projects is subtidal habitats within three miles of the Santa Barbara County coast.

Timeframe for project Implementation

After the DARP/EA is finalized, projects are anticipated to begin within one year, and will be implemented for a period between five and ten years.

Other actions affecting the resources, ecosystems, and human communities of concern

Major processes or anthropogenic stressors that affect the nearshore subtidal environment can be grouped into six categories:

1. *Loss of kelp forest substrate.* The Santa Barbara coast has experienced a loss of approximately 215 acres of productive kelp forest habitat due to the loss of appropriate structure for kelp holdfasts to attach.
2. *Loss of coastal marine eelgrass habitat.* Eelgrass habitat provides unique and critical ecosystem services to the shallow subtidal component of the California coastal shelf. Eelgrass beds are an important source of primary productivity and create 3-dimensional biogenic habitat that is used by a diverse assemblage of fish and invertebrates as nursery and foraging habitat. Eelgrass habitat is also identified by NOAA as a Habitat of Particular Concern under the Magnuson-Stevens Fishery Conservation and Management Act.
3. *Invasive species.* Invasive, non-native, species such as *Sargassum horneri* and *Undaria pinnatifida* have been introduced into the southern California bight and have spread and out-competed native species. The spread of these invasive plant species have degraded the diversity and quality of giant kelp and other subtidal vegetated habitat, making restoration of native habitat critically important.
4. *Coastal erosion and associated turbidity and scour.* A variety of coastal activities (seawall armoring, excessive irrigation practices, beach nourishment, etc) have been shown to reduce productivity of subtidal habitats due to the impacts of sedimentation (leading to burial of structured habitats), chronic turbidity (leading to reductions in primary production and growth of algae and plants that create three dimensional habitat), and scour (sediment washing over hard substrate and removing algae, attached invertebrates and other living habitat elements).
5. *On-going activities associated with oil extraction.* Numerous activities associated with oil extraction can have significant cumulative impacts on subtidal habitats. Clearly pipeline ruptures and spills from other sources have catastrophic impacts, but ongoing impacts associated with establishing and maintenance of the infrastructure needed to support oil extraction (e.g., pipeline construction and maintenance) can result in impacts to marine habitats.
6. *Changing environmental conditions (e.g., warming temperatures, ocean acidification, altered circulation).* Future climate scenarios predict rising sea levels, which results in increased overall coastal erosion. Ocean acidification is projected to cause impacts to animals with calcium-carbonate shells (oysters, abalone, sand crabs, etc.), which are a major component of shoreline habitats. Larger storms may also impact coastal areas in the future, causing shoreline habitat degradation and loss.

Individually and in aggregate, these processes or anthropogenic stressors have reduced the environmental quality of the subtidal ecosystem. The subtidal restoration projects selected by the Trustees, aim to reverse a portion of these negative effects. Projects were selected with the primary goal of creating positive benefits in the face of the numerous anthropogenic stressors described above. All selected and second tier subtidal restoration projects are anticipated to have beneficial effects. Any adverse effects would be temporary and minor, and are not anticipated to cumulatively have any substantial adverse effects on subtidal resources within the project area.

6.4.3 Bird and Marine Mammal Projects

Unlike shoreline and subtidal habitats, birds and marine mammals travel widely within and outside of the spill-affected area, and the restoration projects selected to benefit these species are likewise located both within and outside of the spill-affected area, in places where the projects can have the greatest benefits. The selected projects will create positive benefits to birds and mammals in the face of anthropogenic effects, such as the ones described above. In many cases, restoration projects were selected to counter-act negative effects that existing human activities are having on bird and mammal resources.

Cumulative Impacts Issues

All selected bird and mammal restoration projects are anticipated to have beneficial effects. Any adverse effects would be temporary and minor, and are not anticipated to cumulatively have any substantial adverse effects on bird and mammal resources within the project area.

Geographic Scope of Restoration Projects

Projects are proposed to occur along the California mainland coast of Santa Barbara, Ventura, and Los Angeles Counties, and on the Channel Islands.

Timeframe for project Implementation

After the Final DARP/EA is released, projects are anticipated to begin within one year, and will be implemented for a period between five and ten years.

Other actions affecting the resources, ecosystems, and human communities of concern:

Environmental quality in the project areas has been affected by a number of anthropogenic stressors grouped into four categories as follows:

1. *Modification of the coastline.* Extensive modification and human use of the shoreline has drastically changed the use of the coastline by birds and marine mammals. Bird and mammal breeding activities are not well-tolerated by human disturbance, and so many birds and mammals have adjusted the location of breeding to move away for areas that humans have modified and inhabited.

2. *Fishing gear entanglement.* As described elsewhere in this document, fishing hook and line injuries are by far the leading source of anthropogenic injury to seabirds brought to rehabilitation centers in Los Angeles and San Francisco.
3. *Harmful algal blooms.* Harmful algal blooms, such as the acute proliferation of plankton that produce the neurotoxin domoic acid, are becoming somewhat more frequent in southern California. These acute harmful algal blooms affect birds and mammals, often lethally.
4. *Changing environmental conditions.* Warmer ocean waters in the southern California area in the past decade have effects on upwelling and primary productivity, which has cascading effects up the food chain. Low prey availability for birds and mammals has caused increased mortality due to starvation.

The selected projects aim to create positive benefits to birds and mammals in the face of anthropogenic effects, such as the ones described above. In many cases, restoration projects were selected to counter-act negative effects that existing human activities are having on bird and mammal resources.

6.4.4 Human Uses

Human uses along the shoreline are comprised of a variety of activities including boating, camping, surfing, general beach use, and other forms of recreation. The Trustees believe that, overall, the alternatives selected in this restoration plan, when considered along with past and reasonably foreseeable future projects, will have long term local and regional beneficial impacts to natural resources and recreation. Any negative impacts are anticipated to be short term, and minor.

Cumulative Impacts Issues

The proposed projects to improve human uses have not yet been selected and will be the subject of a future decision process. However, we anticipate that the benefits of these projects will significantly enhance recreational opportunities along the shoreline. Some projects may create a temporary closure or re-routing of coastal access. For example, one possible project is improved beach access from Ellwood Mesa to Ellwood Beach. Currently, there is a steep dirt trail, which could be improved by the installation of a ramp or staircase to provide safe public access. While the construction of this project may create a month or longer temporary closure of the trail, the completed project will ultimately improve coastal access and provide recreational benefits for many years to come.

Geographic Scope of Restoration Projects

Projects are proposed to occur along the California coast of Santa Barbara, Ventura, and Los Angeles Counties.

Timeframe for project Implementation: CDPR will select projects that will enhance camping and/or other shoreline recreational activities associated with units of CDPR from Gaviota to El

Capitan at State Beaches. A grants program will be initiated to solicit and select proposals for remaining projects to compensate for lost recreation. The Trustees anticipate that projects would be implemented for a period between one and eight years after the grant program has begun.

Other actions affecting the resources, ecosystems, and human communities of concern

In many areas of the coastline within Santa Barbara, Ventura, and Los Angeles Counties, access to the coastline for recreation is precluded or curtailed due to private ownership of coastal property and potential access points. As part of the restoration project selection criteria [in Section 4.2], recreational use projects will be selected and prioritized based on the degree to which they provide positive benefits to recreation in the face of numerous conflicting private and public interests. For example, projects will be selected to ameliorate limitations that exist for public access due to private ownership or limited beach access points. All proposed projects are anticipated to have beneficial effects for human uses within the affected area. Any adverse effects would be temporary and minor, and would not be anticipated to have any substantial adverse cumulative effects. The types of human use projects that are anticipated to be implemented through this plan are generally described by the categories below. When specific projects are selected for implementation, project-specific environmental reviews will be completed and assess the impacts of each project to the environment. Types of projects being considered to be selected by the Trustees may be grouped into the following four categories:

1. Shoreline Access and Amenity Improvements. Create, improve, and maintain access or otherwise improve recreational enjoyment of a day use recreation sites and public amenities that are both adjacent to land along the coast or and on the water. This includes, but is not limited to:
 - Trail improvement;
 - Pier repair, construction and accessibility improvements;
 - Boardwalk repair, construction, and accessibility improvements;
 - Boat launch repair, construction, and accessibility improvements;
 - Beach sand management;
 - Parking improvements at day use recreation sites
 - General infrastructure upgrades that can facilitate access;
 - Signage designed to enhance recreational experience; and
 - Infrastructure upgrades that improve recreational enjoyment of shoreline recreation sites, including locations where on-water recreation is initiated (e.g., dive sites, boat launches, harbors, marinas).

2. Camping. Add, improve, and maintain camping amenities and associated day use amenities at campgrounds. This includes, but is not limited to:
 - Benches and/or picnic facilities;
 - Fire rings;
 - Restrooms/showers;
 - Parking lot improvements;

- Fish/bait cleaning stations, fishing rod holders;
 - Interpretive programs and/or signage;
 - Shoreline access improvements at campground sites; and
 - General infrastructure improvements that increase the efficiency, utilization, or enjoyment of campground amenities.
3. Recreational Programs. Programs including but not limited to:
- Guided trips;
 - Education aimed at increasing public utilization of shoreline and on-water recreation resources; and
 - Equipment that supports recreation programs (e.g., kayaks, fishing gear).
4. Research, Education, and Outreach at University of California, Santa Barbara property.

The Trustees believe that, overall, the alternatives selected in this restoration plan, when considered along with past and reasonably foreseeable future projects, will have long term local and regional beneficial impacts to natural resources, as well as short term, minor negative impacts to human uses.

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