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2.0 AFFECTED ENVIRONMENT

The purpose of this section is to provide a general description of the environment which encompasses the geographic area where the spill occurred and where restoration will be implemented. Although many species and geographic areas are mentioned in this section, those species, habitats and services potentially injured by the spill are discussed specifically in the following section. Much of the information contained in this section is from the Final Environmental Impact Statement/Management Plan for the Hawaiian Islands Humpback Whale National Marine Sanctuary (NOAA 1997). Additional information on Oahu's natural resources and habitat can be found in the Final Restoration Plan for the May 14, 1996 Chevron Pipeline Oil Spill in Waiau Stream and Pearl Harbor, Oahu, Hawaii (Pearl Harbor Natural Resource Trustees 1999). Most of the discussion below focuses on Kauai, the island most heavily impacted by the Tesoro spill. Although there is some limited discussion about Oahu, the island where the offshore spill occurred, the only other island that was lightly impacted, and cleaned, was Niihau.

2.1 PHYSICAL AND BIOLOGICAL ENVIRONMENT

The islands of Oahu and Kauai are part of the Hawaiian Archipelago which consists of eight major islands with 124 islets, reefs and shoals extending 1,490 nautical miles on a southeast-northwest axis. Kauai and the City and County of Honolulu are two of the four counties of Hawaii.

Gradual accretion of basaltic lava flows and ejecta formed the Hawaiian Islands over the last few million years. Coral

reefs and numerous bays typically surround the islands. More than half of the islands of Oahu and Kauai are fringed by coral reefs. The reefs are typically wide, shallow platforms in subtidal areas. There are sandy beaches along the shoreline of all of the islands, but these beaches are best developed on Kauai, the oldest of the main islands. The eastern shoreline of Kauai, the area most heavily oiled, consists primarily of exposed rocky shores and naturally occurring vertical seawalls with fine-grained to gravel beaches. At Ahukini, large shallow tide pools dominate the flat part of the basalt bench.

The Hawaiian Islands are located on the northern edge of the tropics. However, cool ocean currents and persistent northeasterly tradewinds result in a subtropical climate. The average wind velocity is between ten and twenty knots. There are occasional kona or southerly winds which can bring storm events. The climate is characterized by abundant rainfall. Ocean temperatures range from 21° to 29°C.



Due to isolation and a northerly geographic setting which results in relatively low water temperatures for a tropical environment, the shallow Hawaiian marine fauna is lower in species diversity than other tropical areas of the Pacific. Nevertheless, there are about 450 species of inshore fish, 40 species of corals, about 1,000 species of mollusks, approximately 243 species of polychaete, and around 200 species of Bryozoa (aquatic colonial animals). Many of these are the types of species potentially affected by the Incident.

Certain species of Cetacea (whales and dolphins) also frequent the waters around the Hawaiian Islands. Common throughout the islands are Pacific bottlenose dolphins (*Tursiops gilli*), spinner dolphins (*Stenella longirostris*), spotted dolphins (*Stenella attenuata*) and humpback whales (*Megaptera novaeangliae*). During a 1993 aerial survey, spotted dolphins and a sperm whale (*Physeter macrocephalus*) were documented off northeast Kauai, and a pilot whale (*Globicephala macrorhynchus*) was observed in the Kauai channel between Kauai and Oahu. The same survey recorded spotted dolphins on the western and southern sides of Oahu.

Of particular concern as a result of this oil spill are Kauai and Oahu's resource-rich nesting and rearing habitats for a variety of endemic, indigenous, migratory and introduced sea and shore birds and mammals. Many of these species are listed as endangered or threatened under both federal and/or state laws, including the Hawaiian monk seal, one of only two native mammals in the Hawaiian Islands. See Section 2.2 below. See also the discussion in Section 2.4 concerning resources of the natural wildlife refuges on Kauai.

Seabird colonies potentially impacted by the Incident include the two largest and most diverse seabird colonies located on islands offshore of the main Hawaiian Islands -- Ka'ula Rock and Moku Manu. These two sites represent the only breeding places in the main Hawaiian Islands for black-footed albatross (*Diomedea immutabilis*), brown boobies (*Sula leucogaster plotus*), masked boobies (*Sula dactylatra personata*), great frigatebirds (*Fregata minor*), blue-grey noddies (*Fregata minor*), Christmas shearwaters (*Puffinus nativitatis*), and gray-backed terns (*Sterna lunata*). These islands also support large populations of the ten other species of seabirds breeding on the offshore islands around the main islands. While oil was not observed on the beaches or during surveys of the seabird colonies conducted 47 and 85 days post-spill on Ka'ula Rock and Moku Manu, the birds in these colonies forage in the areas where oil was observed and were likely impacted. During the Incident, 21 oiled brown boobies were recovered. These birds only breed on Ka'ula Rock and Moku Manu indicating that these colonies were impacted by the Incident. In addition to the offshore islands, the main Hawaiian Islands also support significant seabird colonies. The island of Kauai supports the highest density of seabird species, possibly due to the absence of mongoose (*Herpestes auropunctatus*) on that island.

2.2 ENDANGERED AND THREATENED SPECIES

Several federally- and state-listed seabirds are found in and around Kauai and Oahu. The core of the populations of the endangered Hawaiian dark-rumped petrel (*Pterodroma phaeopygia sandwichensis*) and the threatened Newell's shearwater (*Puffinus auricularis newelli*) are on Kauai where these birds breed at high elevation sites in the interior of the island. Breeding populations of Newell's shearwaters and Hawaiian dark-rumped petrels on Kauai have been estimated at 14,600 pairs and 1,600 pairs, respectively (Ainley *et. al.* 1995, 1997). However, recent studies have shown a mean decline of 60% across all monitoring sites for these species (Day and Cooper 1999). The band-rumped storm petrel (*Oceanodroma castro*) is listed as endangered by the State of Hawaii and is a candidate species for federal listing. The white tern (*Gygis alba rothschildi*) is listed as threatened by the state. All of these species forage in the channel between Kauai and Oahu and congregate in the waters surrounding Kauai.



The federally- and state-listed threatened Pacific green sea turtle (*C. mydas*) historically nested on beaches throughout the Hawaiian Islands. Today the main nesting area is French Frigate Shoals in the Northwest Hawaiian Islands. However, green sea turtles have been known to nest in the sandy bays along the coast of Kilauea Point and other areas around the southeast coast of Kauai. Green sea turtles, which feed on sea grasses and algae, have been commonly observed in Oahu and Kauai (Naughton pers. comm.).

The federally-listed, endangered Hawaiian monk seal (*M. schauinslandi*) is extremely vulnerable to human disturbance on pupping and haul out beaches, by entanglement in fishing gear, and by shark predation. Breeding populations occur almost exclusively in the Northwest Hawaiian Islands, although births were observed on Kauai in 1988 and on Oahu in 1991. During the time period from 1984 through 1993, there were a number of Hawaiian monk seal observations in the main islands, primarily around Oahu and Kauai. There is resident population of Hawaiian monk seals at Kipu Kai, an area consisting of approximately three and a half miles of coastline on the southeastern shore of Kauai. The total size of the population using the Kauai-Niihau Island Area is estimated to be 16 to 30 seals (Don Heacock, DLNR, pers. comm.).





Photo: National Marine Fisheries Service

The humpback whale (*M. novaeangliae*), a federally-listed endangered marine mammal, has been sighted in the Hawaiian Islands since the 1840's. The humpback whale occurs in both coastal and open ocean waters throughout the Hawaiian Islands, one of its wintering areas. While wintering, the humpback whale gives birth and may mate in this area as well. A 1990 survey indicated increased sightings around Kauai, although overall density of pods is much less than in some other areas of Hawaii.

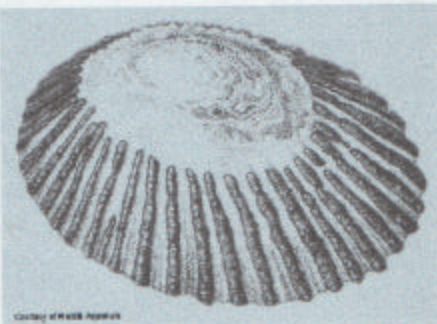
2.3 HISTORIC AND CULTURAL RESOURCES

Hawaiians have used the ocean for fishing, trade, transportation, communication, religious practices and aquaculture. Aquaculture is an important historic use of the marine environment. Historic evidence suggests that fishponds were introduced on Oahu before the 13th century, and by the 14th century, fishponds were being developed throughout the Hawaiian Islands. It is estimated that Hawaiians constructed 178 fishponds on Oahu and 50 on Kauai. By the latter half of the 19th century, Hawaiians abandoned many fishponds as their population declined and food consumption patterns changed. Some of these fishponds can still be found on Oahu and Kauai, including the Menehune Fishpond, a national historic site located near the Huleia NWR on the southeastern side of Kauai.

Hawaiian culture viewed mankind as being in harmony with nature. Many of Hawaii's myths and legends relate to the ocean. In some stories, Hawaiian deities are appeased by sacrifices of fish, eels or other sea creatures. Altars (known as koa) associated with these practices are found on all of the major Hawaiian Islands. Some are still in use today.

The Island of Kauai is rich in native Hawaiian cultural history and is dotted with traces of the remains of the temples of the royal families. The historic Kilauea Lighthouse is also located on the northeastern shore of Kauai, at the Kilauea Point NWR.

One of the resources used for subsistence and cultural purposes on Kauai is the opihi (*Cellena sp.*). Opihi is the Hawaiian name for a species of limpets which are gastropod molluscs with flattened, cone-shaped shells about one inch in diameter. On Kauai, opihi is found on coralline algae and/or where there is a constant wave splash (Kay 1979). Because opihi are found on rocky areas which may be steep and/or slippery and dangerous to those gathering the limpet, Hawaiians call opihi the fish of death (*hei'a make*). Midden material



Courtesy of Mark Pomara

from archaeological sites reveals that 30%, on average, of the windward middens is opihi shells while only 5% of the material in leeward middens is opihi shells. Besides harvesting opihi, subsistence fishermen also gather Limu (seaweed).

2.4 PROTECTED AREAS

Kauai is home to forest reserves, sanctuaries, refuges, and parks, including the Mokuaaeae State Seabird Sanctuary to the north; the Moloaa and Kealia Forest Reserves on the northeastern portion of the island; the Nounou and Kalepa Forest Reserves on the eastern portion; the Huleia, Hanalei and Kilauea Point NWRs; and the Menehune Fishpond. Three other forest reserves are found in the interior of Kauai -- Lihue-Koloa, Halelea, and Na Pali-Kona. These reserves and refuges offer protected habitat for a number of natural resources. These areas serve as feeding, foraging, resting and nesting habitat for species of federal- and state-endangered endemic waterbirds and seabirds and 25 other species of federally-protected migratory birds including shorebirds and waterbirds.

USFWS refuges have three management goals:



1. to support the recovery and perpetuation of federally-listed endangered and threatened species especially endangered Hawaiian waterbirds;
2. to provide adequate water quality to maximize habitat size and value for migrant, endangered and resident waterbirds; and
3. to provide opportunities for quality wildlife-dependent recreation, education and research to enhance public appreciation, understanding and enjoyment of Refuge wildlife and habitats. (USFWS, undated).

The three USFWS refuges on Kauai are described briefly below.

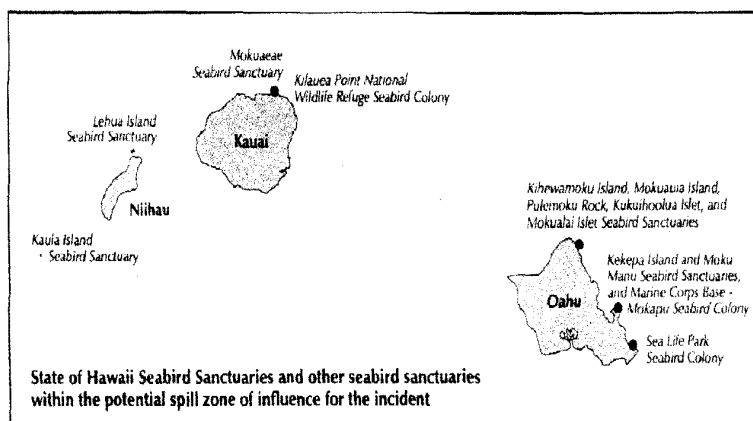
Hanalei NWR: This refuge consists of 917 acres of river bottomland, taro farms, and wooded slopes in the Hanalei River Valley on the northern coast of Kauai. It was established to protect the endangered Hawaiian duck, the Hawaiian gallinule, the Hawaiian coot and the Hawaiian stilt. The refuge also provides habitat for waterfowl and migratory shorebirds. Although closed to public use, visitors can observe the wildlife from along Ohiki Road which begins at the west end of Hanalei River Bridge; from an overlook one and a half miles east of Hanalei or six and a half miles west of Kilauea on Highway 56.

Huleia NWR: Located on the southeastern side of Kauai, this refuge is 238 acres of seasonally flooded river bottom land, the Huleia River estuary and the wooded slopes of Huleia River Valley. Like the Hanalei NWR, this refuge protects the

endangered Hawaiian duck, the Hawaiian gallinule, the Hawaiian coot and the Hawaiian stilt. The refuge is closed to the public, but it can be seen from the Menehune Fishpond Overlook.

Kilauea Point NWR: Located one mile north of Kilauea, this refuge contains 31 acres of cliffs and headlands jutting up to 200 feet above the surf. The refuge provides habitat for the endangered Hawaiian goose and is home to the historic Kilauea Lighthouse. The grounds have been landscaped using native coastal plants. There is a variety of wildlife in and around the refuge. This refuge was established to preserve and enhance seabird nesting colonies on into the future. Red-footed boobies nest in trees. Shearwaters nest in burrows in the soil of Kilauea Point overlooking the ocean. Great frigatebirds, brown boobies, red-tailed and white-tailed tropic birds, and Laysan albatrosses can be seen from the Point as well as green sea turtles, humpback whales and dolphins. The refuge is open to the public. (USFWS, undated).

The majority of seabird nesting colonies are located on the islands, islets, and rocks offshore of the main Hawaiian Islands. Many of these offshore islands are part of the Hawaii State Seabird Sanctuaries. These sanctuaries protect seabirds, migrating shorebirds, and native coastal vegetation. Seabird colonies also exist on the main Hawaiian Islands and several of these areas have been protected, such as the seabird colony at the Kilauea Point NWR.



Information about the Pearl Harbor NWR on Oahu can be found in the Final Restoration Plan for the May 14, 1996 Chevron Pipeline Oil Spill in Waiau Stream and Pearl Harbor, Oahu, Hawaii (Pearl Harbor Natural Resource Trustees 1999).

In 1992, Congress designated the Hawaiian Islands Humpback Whale National Marine Sanctuary, Title II, subtitle C of the Oceans Act of 1992, P.L. 102-587. The purpose of the sanctuary is to protect humpback whales and their habitat and to educate and interpret for the public the relationship of humpback whales to the marine environment of the Hawaiian Islands. This designation complements other federal authorities which protect the humpback whale. The boundaries of the sanctuary are quite extensive and include the

shoreline out to the 100-fathom isobath depth contour around Kilauea Point on Kauai and portions of north and south Oahu. The State of Hawaii has designated the humpback whale as the state marine mammal.

2.5 HUMAN USE SERVICES

The estimated resident population of Hawaii in 1992 was approximately 1,160,000 people with 75% living on Oahu. Kauai's population is approximately 55,000 people, congregating in large part in the areas around Lihue and Kapaa. The major ethnic groups on Oahu and Kauai are Caucasian, Japanese, mixed/part Hawaiian, mixed/non-Hawaiian and Filipino.

Tourism dominates the Hawaiian economy. Oahu is the primary tourist destination followed by Maui County, Hawaii (Big Island) and Kauai. Tourism and agriculture are the principal industries on Kauai. Tourism activities include swimming, beach walking, wave watching, snorkeling, windsurfing, fishing, and other water-related recreational pastimes. Bird watching and hiking are also favorite tourism activities.

In-season and with a valid license, hunting is permitted on public lands in Kauai for game mammals and game birds. Game animals include feral pigs, feral goats and the black-tail deer. Game birds include ring-neck pheasant, Erckel's francolin partridge, Chukar francolin partridge, Indian black francolin partridge, grey francolin, Japanese quail, lace-necked dove and barred dove (DNLR undated). Residents as well participate in these same activities.

Fishing is an important economic and recreational activity. Surveys indicate that 19-35% of residents fish and that 74% of personal boats are used primarily for fishing. In 1991-1992 there were over 4,000 small craft mooring facilities on Oahu and slightly over 100 on Kauai.

Important harbor areas include Honolulu, Barbers Point and Kewalo on Oahu and Port Allen and Nawiliwili on the east and south shore of Kauai. Two offshore oil moorings, located off Barbers Point, Oahu, serve the oil refineries in Campbell Industrial Park.

Diving and swimming are popular pastimes. Hawaii has approximately 310 miles of sandy beach. Two other water-related sports have roots in Hawaiian culture. Surfing was important in ancient Hawaiian culture and is a popular activity today. Like other water-related sports in Hawaii, surfing is a year-round activity. Hawaiian outrigger canoe racing was also an important cultural tradition. In 1990, there were six outrigger canoe racing associations consisting of 62 clubs. Although not rooted in the culture or history of Hawaii, kayaking is becoming an increasingly popular sport. The largest share of kayak tour revenue comes from Kauai.

Hawaii is important for national defense purposes due to its strategic location. The U.S. Army, Navy, Air Force and Marines all have extensive personnel and equipment based in Hawaii. One such base is the Pacific Missile Range Facility located at Barking Sands off the west coast of Kauai. This facility is used year-round for air, surface and subsurface training. Another facility, on Oahu, is the Pearl Harbor Naval Base, the Navy's largest and most strategic island base in the Pacific. It extends over more than 12,600 acres of land and water and serves as the headquarters for more than 70 commands including the U.S. Pacific Fleet Commander.